Brilliant Things for Akhenaten

The Production of Glass, Vitreous Materials and Pottery at Amarna Site O45.1

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The Production of Glass, Vitreous Materials and Pottery at Amarna Site O45.1

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Front Cover: Site O45.1 looking east. Kilns 2 and 3 are clearly visible in the centre of the photograph. ''Kiln 4'' is to the south of ''Kiln 2'' and ''Kiln 6'' is visible at the extreme south where the boundary wall runs up to it. Part of the potter's workshop can be seen at the extreme bottom left.

Rear Cover: Clay mould (find no. 30547) for making a faience cartouche of the early name of the Aten.

Set in Adobe InDesign CS2 4.0.4.
by
Ian Dennis (Cardiff University)

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"Among the many thousands of things I have never been able to understand, one in particular stands out. That is the question of who was the first person who stood by a pile of sand and said 'you know, I bet if we took some of this and mixed it with a little potash and heated it, we could make a material that would be solid and yet transparent. We could call it glass.' Call me obtuse, but you could stand me on a beach until the end of time and never would it occur to me to try to make it into windows."

Bill Bryson (1995:111) Notes from a Small Island

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Section II: Finds Figures

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Acknowledgements

In undertaking research for this project I have been struck by just how often one wants to know the details of how an excavation took place, or to have some idea of why the excavator took a particular course of action. Invariably this information is not published, presumably because it was thought to be of no interest, once the work at the site was completed. Petrie (1894) even fails to say exactly where the glass and glazing works he found were located.

With these failings in mind, I have tried to be as explicit as possible about how the *Amarna Glass Project* was conceived, what was done during the excavation seasons and how the interpretations have been arrived at. The project was begun during my time as De Velling Willis Research Fellow at the University of Sheffield, and I am grateful to that body for its sponsorship of my work, and in particular to Professor Keith Branigan for his help and support. From September 1994 I was employed by Cardiff University's School of History and Archaeology (HISAR), where I have enjoyed the support of many colleagues and friends. Professor W.H. Manning has provided useful advice on the project, and Professor Jonathan Osmond has made it possible for me to take time to work in Egypt during my time as Head of Archaeology. During my absences the late Professor John Evans and Mr. David Watkinson have generously stood in for me and attended to my administrative duties. During this time some of my work on Egyptian glass was funded by a Leverhulme award which paid for the employment of Dr. Caroline Jackson and, later, Mr. Walter Gneisinger. I am grateflul to the late Professor John Percival for his encouragement with the project at this time. Mr. Peter Fisher at Earth Sciences kindly advised on the analytical work with the Scanning Electron Microscope.

I have also received considerable support from the administrative and technical staff at HISAR, Ms. Liz Walker has given her help with financial matters, Mrs. Susan Virgo and Mr. Bob Jones have dealt with the purchase of supplies and Mr. John Morgan has advised on photographic matters. Ms. Janice Coyle at the School of Architecture has also provided valuable help and advice with digital photography. Mr. Mark Hale and Mr. Paul McGeoghan at Information Services have provided a great deal of computing support, and I am greatly indebted to them as well as to Mr. Aled Cooke in HISAR. I have also received support for publication from the School of History and Archaeology at Cardiff (HISAR) and I am inebted to Professor Peter Coss, Professor Douglass Bailey and Professor Alasdair Whittle for their help in this respect.

Many of those who have worked at Amarna have been graduates in Archaeology and Conservation from Cardiff, and it has been a pleasure to work with them, and with all those who took part. All are listed below.

The Work at Amarna itself was undertaken under the auspices of the Egypt Exploration Society, to whom I am indebted, and would not have been possible without the generous co-operation of Professor Barry Kemp who provided help and encouragement throughout, and who first invited me to work at Amarna as part of his expedition there. He has also been kind enough to read and comment on some of the draft of this manuscript. I have also enjoyed the support and friendship of many Amarna veterans, including Mrs. Ann Cornwell, Mrs. Jane Faiers, Sal and Barbie Garfi, Dr. Pamela Rose, and Dr. Ian Shaw.

The project would not have been possible without the generous support of the British Academy, Wainwright Fund, Seven Pillars of Wisdom Trust, and Thames Valley Ancient Egypt Society all of whom provided funding for the excavation. Much of the ordering of the data was undertaken as part of a Leverhulme Trust funded project to examine the work of Petrie at Amarna and at Kom Helul, Memphis and to put it into context. I am indebted to them for their generous support of the project. The organisation of the data, supported by Leverhulme, essential for this publication was undertaken by Ms. Rowena Hart and I am indebted to her for her work on this and in the field. She was also responsible for writing the database and preparing plans drawn by herself and other site supervisors for publication. Mr. Alf Baxendale made considerable efforts to bring the project to the notice of potential sponsors, and I am indebted to him for his efforts. As well as providing the bone report, Phillipa Payne kindly drew my attention to the Bill Bryson quotation. I know how he feels.

Many colleagues have provided helpful information with aspects of the work, and I am particularly indebted to Dr. Mary Anne Murray for the checking of some of the botanical information from the furnace experiment.

The writing-up of the results of the work was made possible by a grant from Cardiff University to buy me out of teaching for one semester, and by a grant from the A.H.R.B. (No.111883) which allowed me a further year of research leave to complete the task. To both of these I am deeply indebted. The layout of the volume and the scanning of illustrations was carried out by Mr. Ian Dennis of HISAR, who also made some of the original drawings.

No project is the work of the Field Director alone, and this is certainly the case with the present project. Below are listed those staff who took part in the project, along with the dates of work and the funding body concerned. I am grateful to all who took part, not least our friends from the villages of Hagg Qandil and El-Till. In particular I am grateful to Hosny Osman Mehenni Osman, Saleh Osman Mehenni Osman, Abdel Halim, and Abd el-Aziz Abu Aleaqa for their cheerful hardwork at site O45.1 over many seasons. It is always a pleasure to work with them.

1993 Excavation.
August 30th–September 30th, 1993.
Inspector: Mr. Atta Makramallah Mikhail
Ms. Susan Cole (Site Supervisor)
Dr. Paul T. Nicholson (Director)
Professor Michael S. Tite (Visiting faience expert)
Funding: Wainwright Fund

1994 Excavation.
August 28th–September 26th, 1994.
Inspector: Mr. Kamal Ammar
Ms. Susan Cole (Site Supervisor)
Dr. Caroline Jackson (Finds and Glass Technology)
Dr. Paul T. Nicholson (Director)
Ms. Kathryn Trott (Registrar)
Professor Michael S. Tite (Faience Technology)
Funding: Wainwright Fund

1995 No E.E.S. Work In Egypt.
Work this season was not permitted by the E.E.S. whilst the security situation in Middle Egypt was re-assessed.

1996 Experimental Archaeology.
August 26th–September 13th, 1996.
Inspector: Mr. Atta Makramallah Mikhail
Dr. Caroline Jackson
Dr. Paul T. Nicholson
Funding: Wainwright Fund

1997 Production of Drawings.
March 10th–April 10th, 1997.
Inspector: Mr. Atta Makramallah Mikhail
Mr. Ian Dennis (Illustrator)
Mr. Barry Kemp (Director — this work was carried out during his field season)
Funding: Wainwright Fund

1998 Excavation Season.
August 29th–September 17th, 1998.
Inspector: Mr. Usama Galal Redwan
Ms. Elina H. Brook (Finds and pottery)
Ms. Susan Cole (Site supervisor)
Ms. Zadia A. Green (Finds and pottery)
Mr. Philip Macdonald (Site supervisor)
Dr. Paul T. Nicholson (Director)
Mr. Andrew Shortland (Visiting PhD Student — Technology)
Funding: Wainwright Fund

1999 Study Season.
August 29th–September 23rd, 1999.
Inspector: Mr. Usama Galal Redwan
Ms. Elina H. Brook (Registrar/Illustrator)
Ms. Jennifer Hesford (Pottery)
Ms. Zadia A. Green (Registrar/Illustrator)
Dr. Paul T. Nicholson (Director)
Mr. Gwil Owen (Photographer)
Dr. Pamela Rose (Pottery)
Funding: Wainwright Fund

2003 Excavation.
August 12th–September 19th, 2003.
Inspector: Mr. Ali Mustapha Bakry
Ms. Rowena Hart (Site Supervisor)

Acknowledgements

Ms. Cara Jones (Site Supervisor)
Dr. Paul T. Nicholson (Director)
Drs. Hendrikje Nouwens (Registrar)
Ms. Anna Stagg (Photographer)
Ms. Nicole Stahl (Conservator)
Funding: British Academy (LRG-35405)

2004 Study Season.
August 11th–September 15th, 2004.
Inspector: Mr. Mohammed Hassan Mahmoud
Ms. Rowena Hart (Finds Database)
Ms. Tabitha Jones (Pottery)
Mr. Mark Lewis (Conservator)
Ms. Claire Morgan (Pottery)
Mr. James Newboult (Illustrator)
Dr. Paul T. Nicholson (Director)
Ms. Phillipa Payne (Faunal Remains)
Mr. Boris Trivan (Pottery)
Funding: British Academy (SG-37920)

Beyond the excavation itself, I am grateful to a number of individuals and institutions for their help. Barabara Adams, Rosalind Janssen and Stephen Quirke and Sally MacDonald have all provided access to the collection at the Petrie Museum, University College London. Professor Rosalie David arranged similar access and sample collection at the Manchester Museum. I was fortunate enough to attend a lecture by Dr. Ian Shaw on his work at the Harrow School Museum, which drew my attention to the vessel which has subsequently been suggested to be from the reign of Tuthmosis III. He was kind enough to put me in touch with Dr. Carolyn Leder, curator of the museum, who allowed me access to it.

For several years I was able to work at the Metropolitan Museum of Art in New York, and so examine at first hand many of the key pieces of early glass and faience. This work was facilitated by Dr. Dorothea Arnold and I am indebted to her and her colleagues, particularly Dr. Susan Allen, Dr. Marsha Hill and Dr. Christine Lilyquist, for the help and hospitality I received there. Dr. Florence Friedman of the Rhode Island School of Design generously invited me to work on her *Gifts of the Nile* project which was of great help in my study of faience. I also had the opportunity to examine material at the Corning Museum of Glass and am indebted to Dr. David Whitehouse and Dr. Robert Brill for their assistance there.

Dr. Jaromir Malek and his colleagues Alison Hobby and Elizabeth Fleming at the Griffith Institute were kind enough to arrange access to the Petrie journals there, which has been of great value.

I am grateful to all those specialists who have provided reports and summaries for this volume. Professor M.S. Tite, Dr. Andrew Shortland and Dr. Gareth Hatton kindly provided a valuable summary of their extensive and important work on Amarna material. Dr. Rainer Gerisch provided the appendix on the charcoal samples, and Phillipa Payne provided the section on animal bones. Dr. Jerome C. Rose made the identification of the human remains and Dr. Anthony Leahy and Dr. Kasia Szpakowska kindly read the ostraca and jar sealings on my behalf. In particular I am indebted to Dr. Caroline Jackson of Sheffield University who has been involved with the project in both field and laboratory since 1994 and who has commented on this manuscript as well as co-authoring chapters for it. Mr. Boris Trivan kindly entered the unfired pottery into a form suitable for analysis, and has assisted throughout the latter stages of the project. Professor Barry Kemp, Ms. Panagiota Manti, Dr. Philip Macdonald and Ms. Cerian Whitehurst all commented on aspects of the manuscript and made valuable corrections to it. Cerian Whitehurst also helped with revisions to the database and its transfer into a suitable format for word processing and publication.

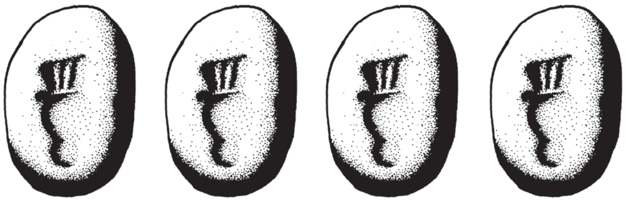
The finds illusrations in this volume are the result of work by several illustrators and most drawings have been worked on by at least two individuals. The illustrators were Elina Brook, Ian Dennis, Zadia Green, James Newboult and Hendrikje Nouwens. Howard Mason and Frances Taylor undertook some of the inking work. on the moulds and jar sealings respectively. The object photographs are by Gwil Owen, Anna Stagg or the author (if unacknowledged). Site photographs are by the author or by Dr. Caroline Jackson.

The manuscript was prepared for publication by Mr. Ian Dennis of HISAR, who also digitised the plans and digitally inked some of the drawings. I am indebted to him for his patient and professional work on this publication.

The academic editing of the volume was kindly undertaken by Dr. Ian Shaw and the copy–editing carried out by Ms. Hilary Meeks. To both of these I am indebted.

Last, but not least, I must thank my parents for their support of my work in Egypt over many years. My father died as this book was nearing completion and it is dedicated to him and to my mother.

Introduction



Introduction

The last decade or so has been an interesting and exciting one in the study of ancient Egyptian glass and vitreous materials, and there have been many challenges to hitherto conventional explanations made by many individuals and teams.

The *Amarna Glass Project* was, from the very beginning, conceived as an attempt to take a holistic approach to glass and vitreous materials at Tell el-Amarna. As such the publication of its work is not a conventional archaeological "site report" but rather an attempt to put the site and the findings from it into the broader context of ancient Egyptian glass.

In fact, Amarna site O45.1 — as excavated — is a relatively small area, and this would be a much shorter volume were it to be confined to simply describing the excavation and its finds. Such a treatment would, however, fall far short of the aim of the project, which was to try to put the glass and vitreous materials represented at Amarna into context.

Because of the fundamental importance of Amarna in histories of glass production it is necessary to review how that history has come about and separate the fact of what was actually found from the "mythology" of the early work there carried out by Petrie (Petrie 1894). Petrie worked and published quickly, and often it appears that he worked from memory rather than checking original field notes. As a result his interpretation of some of his finds changes over time, sometimes in the light of new discoveries, sometimes because he uses information without checking it against his original notes.[1]

To this picture of Petrie's changing views we must add the changes which have taken place in the interpretation of Egyptian glass. Although it was not Petrie's view that glass was an Egyptian invention (Petrie 1925:72) it was one which was commonly held during his lifetime (e.g. Kisa 1908). Subsequent work in the Near East suggested that the origins of the material might lie beyond Egypt, and consequently views on Egyptian glass changed radically, even to the point that all glass must have been imported into Egypt and that the "Ancient Egyptians were not able to make their own glass, even though their glass-melting skill was highly developed" (Newton and Davison 1989:62).

In assessing the role of Amarna therefore, one must set it into the context of the earliest regular, deliberate, production of glass in Egypt. To this end I have included a chapter reviewing the evidence for the coming of glass in Egypt, since without it the status of the material within society would be less obvious.

The excavation at site O45.1 was designed to try to give some archaeological context to the finds made by Petrie, and to add to them. Although work at the site has shown no trace of Petrie's excavations, it has yielded finds comparable to his, as well as new pieces of evidence. It was also hoped that the project might throw some new light on the production of glass and vitreous materials generally during the 18th dynasty.

When the work was begun in 1993 the picture of

Egyptian glass production was very different to that which has now emerged, and a very great deal of work has been produced by numerous scholars in the decade or so since that time. As a result views have changed, either radically or subtly, as research has continued, such that some areas of work are now criticised for perceived shortcomings which were never part of their original brief. For example, the discovery of what are believed to be glass furnaces at site O45.1 led to debate about whether such structures could actually be for glass production at all. Despite the fact that no comparable glass furnaces of such early date existed, it was stated in questions arising from a paper given at the 13th Congress of the International Association for the History of Glass in 1995 (Nicholson 1996), that such furnaces were simply "too big" for their suggested purpose, and could not have reached temperatures necessary to melt glass. This was said against a background of received wisdom which suggested that temperatures in excess of 1200 or even 1300ºC would be necessary to achieve such a feat.

Experimental work using a reconstructed furnace undertaken in 1996 (Nicholson and Jackson 1998, Jackson *et al.* 1998) showed that glass of a relevant composition could be melted at temperatures around 1100ºC in the reconstructed furnace. This view has now been widely accepted.[2] However, the experiment has subsequently been criticised for various aspects, such as the type of alkai (discussed below — Chapter 4), which were never part of its original design. I include mention of it here to illustrate how quickly views of early glass production have changed over the last decade, partly in response to the work of the *Amarna Glass Project* itself.

Similarly, there have been major advances in the chemical analysis of ancient glasses and related vitreous materials, not least those carried out by Shortland and Tite (e.g. Shortland *et al* 2000, Shortland 2002, Tite *et al.* 2002, Tite and Shortland 2003) and by Rehren and Pusch (1999, 2005). These have added greatly to our picture of the sources and processing of materials for the making of ancient Egyptian glass and have lent considerable support, and sometimes clarification, to the archaeological data.

In summary, it is the intention of this volume to synthesise what is currently known of the production of glass and vitreous materials at Amarna and to set it in the wider context of glass and faience production during the New Kingdom.[3] As a result, the conventional "site report" takes up only a part of this volume but as the only excavated site where glass may have been made from its raw materials (rather than simply being *worked* from prepared materials), and which preserves evidence *in situ,* it has an important role in the picture of glass production in 18th Dynasty Egypt and beyond. The analyses of glass and interpretations of them have, in turn, been used to throw light on the archaeological evidence in the hope that this holistic approach will give a more coherent view of the industry than has hitherto been possible.

Endnotes

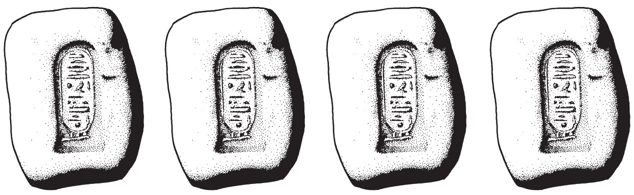
1. For example the pans in which glass was melted are described in 1909 as being "four or five inches across" (Petrie 1909a:124) but were originally said to be "two or three inches in depth and diameter" (Petrie 1894:26).
2. It is featured as "fact" at the Corning Museum of Glass, New York, where the first display in the early glass gallery comprises a full-size reconstruction of the Amarna furnace as built for the experiment.
3. There is, of course, evidence for glassmaking at the later site of Qantir; however, at that important site no actual furnaces or work areas have yet been identified. As a result Amarna remains the only site excavated to date which has glassmaking installations in *situ*.

Section I

The Amarna Glass Project

Chapter 1

The Coming Of Glass To Egypt



Introduction

This chapter[1] examines the origins of the glass industry in ancient Egypt and attempts to assess, independently of the recent work at Amarna, whether or not it is likely that there could have been an industry actually *making glass* rather than simply *working* it as early as the time of Thutmose III (1479–1425 B.C.). The locations of places mentioned in the text are shown on Map 1.1.

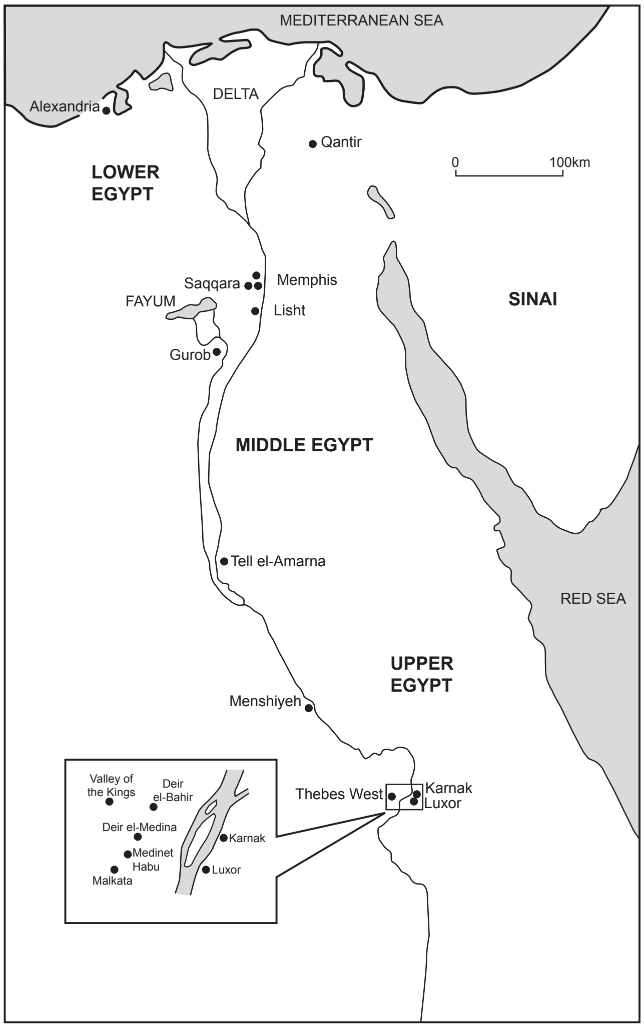
Early Glasses

There have been many reports of glass in Egypt before about 1500 B.C. (Lucas 1926, Beck 1934, Shortland 2001). However, many of the pieces cited — such as the famous ''Bull Mosaic'' of Princess Khnumet[2] and the lion head amulet inscribed for Nubkheperre[3]— are now known to be of materials other than glass. Moreover, such genuinely early pieces as are known do not seem to represent a deliberate and regular production of glass, but rather may be the result of accidents during the production of faience or frit.

Two glass fragments from the tomb of Thutmose I (1504-1492 B.C.; tomb KV38) may represent early imports or belong to the time of his reinterment by Thutmose III (Roehrig 2005:67).[4] However, Roehrig (2005:67) suggests that they might equally be the result of booty from the campaigns of Thutmose I in the Near East, or trade with the region since other beads dating from the time of Ahmose through to Thutmose II (1492-1479 B.C.) are known from the excavations of the Metropolitan Museum of Art. Other early pieces of glass, including the well known flask[5] from the tomb of Maiherperi (KV36) which is believed to be an import, and probably a royal gift, have recently been discussed by Lilyquist (2005) who also provides a timely summary of contact with the Near East around the reign of Hatshepsut (1473-1458 B.C.).

There are, however, several pieces which may be especially relevant to the present discussion but whose status must for the moment remain unclear. These are two name beads[6] bearing inscriptions mentioning Hatshepsut and her steward Senenmut (Reeves 1986) which are now in the British Museum and a further example in the Metropolitan Museum of Art, along with two coloured examples.[7] The colourless beads were originally thought to be of rock-crystal, but are in fact of clear colourless glass and, although without a properly documented context, may originally have come from the foundation deposits of the Hathor shrine of Hatshepsut at Deir el-Bahri, believed to date from Year 7 of her reign (Reeves 1986:388). Since raw glass is naturally coloured with a greenish or brownish tinge due to impurities such as iron it must be decolourised in order to obtain such clear objects as these beads. Decolourisation is a sophisticated process, and virtually all the glass known from ancient Egypt has a strong body colour, usually light or dark blue. That colourless glass could have been produced so early, either in Egypt or elsewhere, suggests a remarkable sophistication in this early glass industry. It is, of course, possible that the lack of colour results from very pure batch materials alone (below).

The composition of the beads has been analysed and has been found to be "compositionally similar to analyses of glasses from Tell el Amarna" (Bimson and Freestone 1988:11).[8] This does not necessarily mean that the glass was made in Egypt, the beads may simply



Map 1.1. Map of glassmaking sites in Egypt.

have been inscribed there, and indeed colourless glass from an inscription on a queen's canopic jar of the Amarna period[9] has a different composition (Bimson and Freestone 1988:12), though it is similar to other glasses from Amarna.[10] The colourless glass of the canopic jar has twice the amount of lime present in the name beads. It may be that we are seeing an early stage of glass imported into Egypt and a later stage of local production, the change occurring during the Amarna period. Alternatively we may be seeing an Egyptian industry already established by the time of Hatshepsut and later changing its recipes to better utilise local raw materials. This may be indicated by the work done by Rehren (2000a), which suggests that the Hatshepsut/Thutmose III glasses were made by carefully selecting raw materials and then melting the total batch, whereas those of Amenhotep II and after use a different approach which Rehren (2000a:17) describes as ''partial batch melting.''

Whatever the position regarding the production of these glasses it is of interest that both the beads and the canopic jar, which were intended for a royal wife, have royal connections. The same is true of a light blue glass bead of unknown provenance[11] which bears on one side the name of Ahmose (1550–1525 B.C.) and on the other that of Amenhotep I (1525–1504 B.C.) (Brovarski *et al.* 1982: 169). The piece is regarded by Brovarski *et al.* as possible evidence for a co-regency between these, the first two rulers of the New Kingdom, and the authors claim that "x-ray spectrometry yielded findings consistent with the analysis of known 18th Dynasty parallels" (Brovarski *et al.* 1982:69). That the piece is seen as evidence for a co-regency might well suggest that it is of early date, and it is implied that it is contemporary with the rulers whose names it bears. This would suggest that from the very beginning of the Egyptian New Kingdom glass and royalty were inter-linked (though this does not of course preclude the ownership of glass objects by private individuals of status). If the piece were made in Egypt the industry would be put earlier than has thus far been realised, however, the authors do not cite the x-ray analyses to which they refer and in any case the fact that it matches with other 18th Dynasty glasses does not necessarily mean it was made in

Egypt. Indeed its colour and possible early date may argue otherwise (below).

The question of the establishment of either glassmaking or regular glassworking is a vexed one, and there has been a general consensus that glass comes to Egypt as a developed craft, perhaps a century old (Tatton-Brown and Andrews 1991:26), and that "with dramatic suddenness, glass makes its appearance also in Egypt" (Oppenheim 1973:262). The idea that the craft was imported from beyond Egypt seems to have been first published by Petrie (1925) who states that "as soon as Egypt overran Syria, artificers were brought in, about 1,500 B.C., and glassmaking became a flourishing and varied industry" (Petrie 1925:72). However, it is clear from Newberry (1920:158) that the *idea* that glass was not an Egyptian invention pre-dated Petrie's publication. Newberry himself (1920) was firmly of the view that there was no evidence for this foreign inspiration, but he was already in the minority. Harden (1968:48) took the view that glass was an imported craft and he specifically mentioned the borders of Mesopotamia, in other words the region which is usually referred to as the Kingdom of Mitanni.

The idea of glass being imported from this region was strengthened on linguistic grounds by Oppenheim (1973). In his article he stresses that two Akkadian words previously identified as ''precious stone'' (*mekku* and *ehlipakku*) might refer to glass. *Ehlipakku* is sent from Mitanni to Egypt and features as such in the Amarna Letters. The Egyptian king is always the one requiring *mekku* or *ehlipakku* and it is clear from one of the letters[12] that the two words refer to the same thing. Indeed Petrie states that there "was little difficulty in attributing to the Syrians the glasswares which were imported into Egypt prior to 1500 B.C." (Petrie 1926: 230).[13]

Such glass wares are illustrated at a number of sites, the most famous of which is the representation in the *Annals of Thutmose III* at Karnak. These texts describe the campaigns of Thutmose III, and the 8th and 9th campaigns, which saw Egyptians reaching Mitanni, are of particular interest as a likely source of glass and glass workers. In the *Annals*[14] the king lists glass after gold and silver, suggesting its importance (Nolte 1968:12–13). Some of the glass is shown as circular pieces of fairly consistent size, perhaps ingots, whilst other pieces are shown as irregular lumps. The apparent raw glass is described as ''Menkheperre lapis lazuli''[15] to distinguish it from genuine lapis lazuli. Bianchi *et al* (2002:20) speculate that the King may have been so impressed by this new material that he chose to add his throne name to it. Not only is there deep blue glass in imitation of lapis lazuli, but also green glass shown as round cakes. These two are given the king's throne name, this time as ''Menkheperre turquoise/malachite''.[16]

Bianchi *et al.* (2002:20) convincingly argue that the green glass is meant in opposition to the blue which must have been considerably darker (though its colour is now lost on the Karnak relief), which one would expect given that it is meant to represent lapis lazuli. The authors estimate that 60kg of the dark blue glass as ingots are represented plus a further 55kg as lumps. Some 83.72kg is estimated for the lighter blue/green glass (Bianchi *et al* 2002:21). The authors note that this distinction is interesting, since most of the vessels from the time of Thutmose III are in light blue, rather than dark and that the finds may therefore be unrepresentative.

Also shown are finished vessels in ''Menkheperre turquoise/malachite''. Bianchi *et al.* (2002:22) argue that vessels of such size are never found in genuine turquoise or malachite, but only in vitreous materials. However, it is worth pointing out that although the vessels appear large, they are not drawn to scale, as can be seen by comparing them to the size of the supposed ingots. Furthermore, the shapes do not closely resemble any known glass vessels from the Egypt of Thutmose III, though there are vague similarities to the famous marbleised goblet from the tomb of the foreign wives of Thutmose III at the Wadi Qabbanet el-Qirud[17] (see Lilyquist 2003, Lilyquist *et al*. 1993). The Petrie Museum also houses fragments of a faience vessel from Sinai[18] which is not a typically Egyptian shape and which seems to be derived from a metal proto-type. The scene may therefore represent vessels in vitreous materials other than simply glass.

Philip (2000:129) notes that fragments of glass vessel are known from Alalakh on the border between Syria and Turkey at around 1600 B.C., suggesting that the knowledge of core-formed vessels was already established there (contrary to the statements made by Kozloff 1992:374).

The tomb of Rekhmire (TT100), Vizier under Thutmose III and Amenhotep II (1427–1400 B.C.) at Thebes also contains relevant scenes. On the west wall of the hall in the second register from the top (Davies 1944:Plate XXI) are shown two vessels "apparently of glass" (Davies 1944:28) which are amongst tribute brought by Syrians (*Retenu*). It is worth pointing out that, although glass may be a likely candidate for these vessels, they are, in detail, unlike any other glass vessels known to the author, and are arguably more similar to wooden dummy vessels representing stone.[19]

The other tomb worthy of note in this context is that of Amenmose (TT89). This tomb supposedly dates from the reign of Amenhotep III (1390–1352 B.C.) but includes a scene of Thutmose III (Brock 2000:130). The presence of this ruler in a supposedly later tomb is seen by Brock (2000:137) as perhaps connected with scenes showing glass in tombs of his time, notably that of Rekhmire. The tomb of Amenmose shows what are believed to be dark blue glass ingots, although they are stated to be lapis lazuli, and are not given the Menkheperre prefix. They appear similar to the supposed ingots from the *Annals of Thutmose III* at Karnak.[20] The appearance of Thutmose III in this later tomb is strange, and one must wonder whether a scene has simply been copied, or even an unfinished tomb of that date been reused. Little weight should be attached to this scene for the moment.

It is clear, however, that Mitanni was a source of glass, and one which Egypt was exploiting into the Amarna period, as is evidenced by the Amarna letters. However, this does not mean that *all* glass was imported to New Kingdom Egypt or that the Egyptians could not make their own glass as some have suggested (Newton and Davison 1989:62). Such a conclusion overlooks Petrie's (1925:72) view that "artificers were brought in".

One should look now at those actual examples of glass vessels known to be of the reign of Thutmose III and examine how they relate to the local versus imported debate.

Shortland (2001:214–15) follows Nolte (1968:46–50) in attributing 12 vessels or vessel fragments of glass to the reign of Thutmose III. Of these, two belong to the same vessel,[21] whilst another, though relevant to the discussion, is believed to be glassy faience rather than glass.[22] In other words, there are actually only 10 examples of glass vessels from this reign. Shortland (2001:215–16) notes that the commonest body colour is light blue. He goes on to note that this is not surprising because so much light blue glass was being imported. However, his evidence for this comes from the *Annals of Thutmose III*, a figure which he gives as 10913.8 dbn or 993kg (2001:213). This is indeed a significant figure and implies glass production, albeit outside Egypt, on a hitherto unexpected scale. However, Shortland's reading of this figure from the *Annals* is probably incorrect, the actual figure being probably 913 dbn or 83.72kg, as quoted by Bianchi *et al.* (2002:20).[23]

The scene shows 24 lumps of "Menkheperre lapis lazuli", which may be dark blue glass or Egyptian blue, no weight is given but Bianchi estimates each lump at 2.5kg yielding some 60kg of dark blue glass (Bianchi 2002:20–21). To this must be added the similar material from a third tray shown in the scene, whose text is only partly preserved, to give a figure of at least 115kg of dark blue glass.

It would seem then (*contra* Shortland) that more dark blue glass was imported than light blue, and yet most of the vessels we have (which account for nowhere near the 83.72kg let alone the 993kg figure) are light blue. Shortland (2001:217) rightly notes that dark blue may also be achieved using high levels of copper, and it would be interesting to know whether the single known dark blue piece[24] is coloured with copper or cobalt.

This raises the question of where all the dark blue glass has gone. Why do we have only one piece from the reign of Thutmose III when it seems that it was commoner than the light blue? Could it be that the dark blue glass was made into beads or other small items which have largely been ignored? Such dark blue glass as occurs in inlays from the tomb of the foreign wives of Thutmose III seems to be coloured by cobalt (Lilyquist 2003:124–25) though this is, of course, a tiny sample of all those beads known. Could most of the material have been worked and sent out of Egypt to vassal states whilst the genuine lapis remained in the country? As Kemp (pers. comm.) has pointed out, much of what is shown in the Karnak reliefs is now lost, and it is certainly true that this must be the case for much of the glass. As a recyclable material it is also possible that some of it was melted down and used again.

The Thutmose III Vessels

Attention should also be paid to the vessels dated to the reign of Thutmose III (1479–1425 B.C.), since the security of the dating of some may be open to question. These are shown in Table 1.1 (below).[25]

Most secure are those vessels from the tomb of the foreign wives of Thutmose III in the Wadi Qirud. These vessels comprise the marbleised vessel of glassy faience,[26] which though relevant is not of glass, the lotus chalice bearing the incised cartouche of Thutmose III[27] and according to Nolte (1968:48) the kohl vessel.[28] However, this latter was actually purchased by the Metropolitan Museum of Art in 1926, having originally been acquired by Hood around 1860. Lilyquist (2003) does not list this last vessel as part of the contents of the tomb, which would be reasonable if it were not located until August 1916 as she states (2003:27). Her view (Lilyquist pers. comm.)[29] is that the vessel is a miniature ointment jar "certainly not

Number	Shape/Type	Body colour	Technology
Munich ÄS630	Chalice	Light Blue	Core-formed
Ashmolean E2451	Chalice	Light Blue	Core-formed
MMA23.9*	Lotus Chalice	Light Blue	Cast and cold worked
BM 24391	Kohl pot with lid	Light Blue	Drilled and cold worked
UC 19657	Kohl pot (no lid)	Light Blue	Drilled and cold worked
MMA26.7.1179	Kohl pot (no lid)	Light Blue	Drilled and cold worked
Cairo 24959	Kohl pot (lid only)	Dark Blue	Cold worked
Cairo 24961	Handled vessel	Light Blue	Core-formed
Cairo 24960 AND Brooklyn 53.176.4	Rounded vessel	Light Blue	Core-formed
BM 47620	Jug	Light Blue	Core-formed with powdered glass decoration
MMA26.7.1175*	Krateriskos	Marbleised	"Glassy faience" — probably core formed

* Indicates Wadi Qirud provenance

Table 1.1. Glass of Thutmose III.

from the Wady Qurud" (*sic*). All that can be said of the piece therefore is that it was bought in Qurneh around 1860, and is of a style which is not dissimilar to other vessels of the time of Thutmose III. Thus we have only one glass vessel from the Wadi Qirud tomb.

The royal tomb itself (KV34) was discovered by Victor Loret on February 12th, 1898 (Reeves 1990a:19) but there is evidence that the tomb had at some time been heavily plundered (1990a:23). Four pieces of glass are associated with the tomb. There is a dark blue glass lid[30] and a light blue core-formed vessel with handle support.[31] These definitely come from the tomb, as does a light blue fragment of core-formed vessel with yellow and dark-blue decorative band[32] now in Cairo. This piece is usually reckoned to be from the same vessel as that now in the Brooklyn Museum[33] which is the same in colour and decoration, though it does not join with the Cairo fragment. It is therefore reasonable to assume that it came from the original burial.

There is, however, a further piece of glass which has also been associated with the tomb. This is the exceptionally well preserved juglet now in the British Museum.[34] This piece is in light blue and decorated with dark blue, yellow and white. The yellow has been used to enamel a floral motif on the vessel as well as to add an inscription for Thutmose III himself. According to Cooney (1976:71), no contemporary record of the acquisition of the piece by the museum exists, although Budge (1925:391) states that it probably came from the burial of the king. Cooney accepts this view and suggests that it came to the museum between 1870 and 1872, during which time the royal cache (DB320) was being looted (Cooney 1976:71). The unusual decoration, which is arguably more "Near Eastern" than Egyptian (but see now Roehrig 2005:69), and the light blue body colour, as well as the inscription, all argue for a Thutmose III date. Thus, although the provenance cannot be accepted without question, it does seem likely that it belonged to the pharaoh concerned.

One more vessel also bears the prenomen of the king, and is now in the Munich collection.[35] This is a light blue core-formed chalice decorated in dark blue and yellow and with the cartouche of the king in dark blue. The cartouche itself is at something of an angle and the hieroglyphs are grouped toward the top edge of the name-ring. The rim is uneven. The piece once belonged to the Dodwell collection and was bought in 1832, probably at Thebes (Newberry 1920; Nolte 1968:48). It is not possible to give a more definite provenance to the piece, though I would agree with Nolte (1968:49) that it is contemporary with Thutmose III and not a later piece belonging to the Theban ruler Menkheperre of the 21st Dynasty. The quality of the glass seems altogether better than comparable later glasses. Nonetheless, one should bear in mind that the piece lacks a definite provenance.

Of a similar form is a plain light blue chalice from the Ashmolean collection.[36] The piece comes from Tomb 58 at Gurob (Loat 1904:7). It has been dated to the reign of Thutmose III, largely by comparison with the Munich piece. Thus, although it has a provenance, its dating largely relies on the unprovenanced Munich piece. So, although the comparison seems a fair one, one must proceed with caution.

Last in the Thutmose III group are two kohl pots. One of these[37] comes from Riqqeh cemetery B and, although illustrated in the publication (Engelbach 1915:16 and pl. 12 no. 14), the rest of the contents of the tomb are not published. Thus the dating is based on the fact that stone kohl pots of this type were popular during the reign of Thutmose III. The vessel has provenance but the dating cannot be relied upon. That same dating is then used to provide the date for an unprovenanced piece in the British Museum,[38] a light blue vessel with its rim, foot and lid decorated with gold leaf. The vessel was acquired by the museum in 1892 (Nolte 1968:47). These two vessels must be regarded as having the least satisfactory dating of all.

In summary then, the two kohl pots rely only on style for their dating. The Ashmolean chalice relies on the Munich chalice, itself unprovenanced—though probably of Thutmose III. The British Museum juglet has no provenance, and though the dating seems very probable, it cannot be certain. The ointment vessel in the Metropolitan Museum[39] is no longer regarded as from the Wadi Qirud burials and so cannot be dated with certainty. The Metropolitan Museum's lotus chalice is the only certain glass vessel from the tomb of the foreign wives. This leaves four fragments, three of which are certainly from the tomb of the king himself[40] and one which is almost certainly from the tomb, as it seems to be the same vessel as one of these certain pieces.[41]

During the course of this study it has been possible to examine one additional vessel which may also belong to the reign of Thutmose III. This piece was collected by Sir John Gardner Wilkinson (1797–1875) and subsequently donated to Harrow School.[42] The piece is in light blue glass with yellow and dark blue trail decoration, and its form is very similar to the piece in the Ashmolean collection. If the dating of the Ashmolean and Munich pieces is correct then it is likely that this piece also dates to the reign of Thutmose III (for a more detailed discussion of the vessel and its origin see Nicholson 2006a).

Clearly, the status of some of the Thutmose III glass is uncertain and in the absence of analytical studies of all of the pieces caution must be exercised. However, it may be possible to make some observations on technological grounds, and group the pieces accordingly.

The two kohl pots, whose attribution to Thutmose III is arguably least secure, both seem to be cast and then drilled; that is, the technology is closely akin to the working of stone whose form they imitate. The same holds true of the kohl or ointment vessel originally thought to be from Wadi Qirud, but whose provenance and date have been shown to be uncertain. The lid from a kohl pot found in the tomb of Thutmose III[43] is also cold-worked, suggesting that it belongs with this little group. The elegant lotus chalice from the Wadi Qirud burial is also cast and cold-worked.

The British Museum juglet has no exact parallel (see however Roehrig 2005:69) though its shape is similar to the—apparently much larger— vessel shown in the Tomb of Rekhmire (TT100) and discussed above. Its very accomplished decoration, of a type not otherwise known from Egypt, suggests a foreign source. It is core-formed, however, and so treated in a manner distinct from stone.

Also core-formed are the two chalices now in Munich and the Ashmolean Museum. Although one of these has a cartouche, the workmanship is much less confident than we see on the juglet. The other fragments all come from core formed-vessels, the standard of workmanship is good, but not as high as in the British Museum juglet.

It might tentatively be suggested that what we see here amongst the Thutmose III glasses are an early stage in which glass is treated as stone and is worked cold, perhaps from imported ingots. This cold technology is gradually replaced by hot-working inspired by vessels such as the juglet. This vessel may have been imported into Egypt or made in Egypt by foreign craftsmen brought in to establish such an industry. In the two core-formed chalices and the core-formed vessel fragments from KV34 we may see the earliest steps in a native Egyptian core-formed glass industry (c.f. Shortland 2001:220).[44]

It is, of course, possible that some of these steps went on almost simultaneously, but the fact that cold-working of vessels, particularly drilling them, dies out after this time may be significant. Unfortunately, only a few of the important vessels attributed to this reign have been subject to analysis. Those which have been examined lend some support to the view; thus the Brooklyn fragment[45] contains cobalt, likely to come from the Egyptian oases (Shortland 2001:218, Lilyquist *et al*. 1993:36–37). Shortland (2001) regards the piece as Egyptian.

Whilst I would agree with Shortland (2001) that (leaving aside the problems of date and provenance for some pieces) we are seeing the earliest experiments in glass production in Egypt, it still appears to me that this experiment may be inspired by foreign glass workers. Shortland's interesting observation (2001:220) that the core-formed vessels from Egypt are appearing at roughly the same time as they occur in Mesopotamia, and therefore might be an Egyptian invention, is an interesting, but as yet, unproven one. The key to this might be the analysis of the British Museum juglet, which, if foreign, might suggest a greater standard of competence than that demonstrated by the chalices and vessel fragments from KV34.

Against this background we should again consider the Hatshepsut and Senenmut name beads. It would be tempting to suggest that there was indeed a flourishing and sophisticated glass industry already established in Egypt when Thutmose III came to the throne, and that this develops into the core-formed vessel industry which we then see. However, it seems that the colourless beads are perhaps the result of a particularly well refined glass batch and that they, too, were then worked as stones, just as were the kohl vessels.

The Glass of Amenhotep II and Thumose IV

As early as the reign of Amenhotep II (1427–1400 B.C.), the refinement of the quality of glass production had already begun (Nolte-Refior 1967:151, Rehren

2000a:17). From the tomb of Amenhotep II (KV35) itself come 76 vessels which are exceptional for their size, the largest[46] being some 40cm in height (Nolte 1968:54 and Taf. II:2). The body colour of these vessels tends to be from dark to translucent copper blue, though there are some light blue examples along with white and "Tyrian Purple" (Nolte-Refior 1967:151) and brown. Decoration is usually in yellow, white and light blue or green. Marbled patterns are common but there are also garlands and arcades as well as early attempts at feathering. "Mosaic patterns" (Nolte-Refior 1967:151) are also present, as on the rosettes seen on the two unusual ribbed or lobed vessels from the tomb.[47]

The reign of Amenhotep II can be seen as a time of transition from—apparently— small-scale production, albeit becoming increasingly refined, to larger groupings of glass workers, which Nolte (1968) has attempted to identify as workshops on the basis of stylistic similarities between products. It need not be supposed that the production of glass was suddenly on a very much larger scale, however. It may be that what we are seeing is the completion of the establishment of an Egyptian glass industry, one which was now working glass primarily as a material in its own right, rather than treating much of it as a substitute for stone and to be worked in the same manner. This change may also be reflected in the technology, and Rehren (2000a, 2000b) argues that materials were no longer carefully selected, but that a "partial batch melting" system was employed.

This new era begins with the reign of Thutmose IV (1400–1390 B.C.) from whose tomb (KV43) come 35 vessels. None of these are on the same scale as those from the burial of Amenhotep II but two thirds of them (Nolte-Refior 1967:151) are of dark blue glass which uses cobalt as a colorant. This is surely significant, since there is a source of cobalt in Egypt itself, and though it may have been exploited earlier, the reign of Thutmose IV may mark its first major exploitation. These sources are in the Dakhla and Kharga oases (Kaczmarczyk 1986; 1991:195) of the Western Desert and would perhaps have required military expeditions to exploit them, something already well established for quarrying operations.

This new era also sees the firmer establishment of the vessel shape corpus, with *krateriskoi* and *amphoriskoi* dominant, and the end of lotus chalices and drilled kohl vessels. Thread decoration is confined to yellow, white and blue, and the garland and feather patterns become established as the decorative norm. Within these norms Nolte (Nolte-Reifor 1967, Nolte 1968) has sought to identify particular *Werkkreise*. These make use of the characteristics of the decoration, since particular craftsmen are likely to have particular ways of thread-trailing, and particular patterns would only remain in fashion for a certain time. Shapes and colours are also attributed to particular time periods.

The burial of Thutmose IV also marks the last great find of glass in a funerary context; most of that known from subsequent reigns has been found on settlement sites. Because of the uneven nature of settlement excavation in Egypt it is not possible to put too much weight on this apparent change, but it is tempting to assume that a local industry is now producing glass on a somewhat greater scale than previously, so that it is more widely available, albeit only within elite circles.

It can be suggested that access to raw materials, such as cobalt, was probably a royal prerogative, and that access to glass is a mark of status, although Kemp (pers. comm.) has rightly pointed out that sumptuary laws would be needed if access to cobalt and glass were to be deliberately controlled. However, given that cobalt may have had to be acquired by expeditions, access to it may have been restricted simply by access to the supply. Since glass was also a relatively new material, and one which often used cobalt, it too would have been in limited supply and most likely to find its way into the hands of the wealthiest individuals. Here it differs from blue-painted pottery, which was also coloured with cobalt. The pottery technology was relatively simple, and the end product correspondingly less expensive, despite its exotic colourant. Glass, in contrast, was less common because it was a new, and perhaps controlled, technology and used the expensive colourant material.

Thus we find, from the time of the very earliest sculpture in glass, a royal portrait head of Amenhotep II[48] (Goldstein 1979). It seems possible that, by assembling the makers of glass and the materials for its production, the Palace had some control over the dissemination of glass to its most worthy courtiers. This apparently began in this same reign when Amenhotep II presented a glass shabti to his First Steward Kenamun[49] (Cooney 1960:11). A similar presentation is known from the subsequent reign of Thutmose IV, who presented a similar piece to the royal tutor Hekareshu[50] (Cooney 1960:11). Although there may have been no formal prohibition on the use, or even making, of glass outside Palace circles, the limitation of its supply and the limitation of access to certain materials may have had the effect of making glass a material for the upper echelons of society, at least in its earliest stages.

Glass in the reign of Amenhotep III

The reign of Amenhotep III (1390–1352 B.C.) marks a departure from the pattern of evidence which has been discussed so far. His reign "was one of the most prosperous and stable in Egyptian history. His great-grandfather, Tuthmosis III [*sic*], had laid the foundations of the Egyptian empire by his campaigns into Syria, Nubia and Libya. Hardly any military activity was called for under Amenhotep" (Clayton 1994:115).

Amenhotep III comes to the throne at the height of an established and consolidated empire and quickly establishes himself as the archetypal oriental potentate (see Kozloff *et al.* 1992). If we are right in believing that glass came to Egypt largely as a result of the conquests of Thutmose III, then the subsequent two reigns may be seen as establishing and developing this industry such that under Amenhotep III it is ripe for expansion.

Expansion does not, however, imply cheapening. Glass is still a product of royal interest, as is witnessed by the blue glass head, believed to be of Amenhotep III, now in the Miho Museum in Japan[51] (Goldstein www1), continuing the fashion for high status sculpture in glass. Indeed, it may be that such moulded and then cold-worked, objects represent a hitherto undervalued aspect of Egyptian glass production—the moulding of softened glass. This would allow the making of objects at lower temperatures than might normally be expected.

Links with Mitanni (known to the Egyptians as Naharin) continued by a diplomatic marriage of Amenhotep III to Gilukhepa, a daughter of Tushratta King of Mitanni, in his tenth regnal year. She arrived in Egypt with a retinue of some 317 persons, and is but one example of the ongoing, and increasing, foreign presence at the court of Amenhotep. Such outside influences, combined with the growing wealth of Egypt through the exploitation of Nubian gold and through foreign trade, led to a period of artistic and craft development.

It is perhaps not surprising then, to find that glassmaking appears to have been one of the crafts taking place in Amenhotep III's palace complex at Malkata (Chapter 5). Malkata is certainly no ordinary settlement, and the royal interest in glass is obvious. It is also apparent that excavation of non-funerary sites has much to tell us about the early stages of glass production, and one should not overlook the likelihood that similar installations may have existed earlier. Instead of dealing with only a few fragments of vessel glass there are now many hundreds known from Malkata and elsewhere (Nolte 1968:65), reflecting the opulence of the reign.

There is much similarity in the glass from Malkata and that from Amarna, suggesting that at least some of the craftsmen may have moved to the new city during the reign of Amenhotep IV/Akhenaten (1352–1336 B.C.).

Despite general similarities, A.P. Kozloff in preparing for the exhibition *Egypt's Dazzling Sun*, examined over 1000 fragments and complete vessels and found "a definite evolution in the design, color [*sic*], and technical execution of core-formed glass vessels from Malqata to el-Amarna" (Kozloff 1992:375). Vessels from Malkata were (1) predominantly cobalt blue, (2) more opaque than those from Amarna, (3) often fitted with feet which were separately made and attached, (4) provided with pommel handles on jars, (5) often bearing unmarvered decoration, (6) frequently with spiral formed two-tone rods used on rims, lips, shoulders or handles and (7) were normally of elegant shape (Kozloff 1992:376). The shapes were small jars and small amphorae, as well as palm-column kohl tubes.

The finished Amarna pieces show far fewer examples of cobalt blue glass with two-tone rims etc., and Kozloff considers examples of these to be imports from Malkata "or they may have been made early on by the Amarna glassmakers, if these individuals were themselves transplants from Malqata [sic]" (Kozloff 1992:376). There are also types of glass from Amarna which are unknown at Malkata, and the following were distinguished (1) mid-blues and blue-greens coloured with copper are in quantity equal to the cobalt blues, (2) greater translucency in blue glasses except where made milky by lead, (3) thin, angular or S-shaped handles on *Krateriskoi*, (4) greater variety of colours, notably opaque yellow, white and red, especially yellow or white with inset blue and white "eye" shapes and crisscrossed rods of blue and white, (5) well marvered surface decoration, (6) heavier more squat proportions and (7) so-called pilgrim flasks and hemispherical bowls are more common and palm-columns less popular (Kozloff 1992:376).

The *Werkkreise*

In the 1960s Birgit Nolte attempted to define a series of *Werkkreise* (Nolte-Reifor 1967, Nolte 1968). It should be borne in mind, however, that most of this material comes from funerary contexts, and that—with the exception of Amarna—there is insufficient evidence from actual workshops on which to base such a classification and as Kemp (pers. comm.) has pointed out, the absence of good evidence from Memphis presents major difficulties for a classification of this kind. Kozloff's (1992) observations go beyond those of Nolte in terms of dating, but the Nolte classification is still widely referred to and it is worthwhile summarising it here for the period up to and including the reign of Amenhotep IV.

Werkkreis I covers the period from Thutmose IV to Amenhotep IV. It began production at an unknown site under Thutmose IV, moved to Malkata, and thence to Amarna. The *Krateriskos* is the preferred shape, and less commonly the *Amphoriskos* or lentoid flask, which first appears under Amenhotep III. The dominant base colours are sky blue and dark blue with contrasting decorative threads in white, yellow and blue tones. The decorative patterns are highly consistent with finely drawn out feathering on the necks and garlands on the bodies (Nolte-Refior 1967:151).

Werkkreis II begins early in the reign of Amenhotep III and continues into that of Amenhotep IV. The workers are believed to be based first at Malkata and then at Amarna. As might be expected from the proximity of this workshop to *Werkkreis I* at Malkata, there was influence between the two workshops. The characteristic feature here is the garlands which form elegant swirls on the necks and bodies of *Krateriskoi, Amphoriskoi* and lentoid flasks. Yellow, white and sky blue appear on dark blue to translucent copper blue body glasses. Very rarely white or sky blue base glass is also used (Nolte-Refior 1967:151-52). Note that dark blue is now a predominant body colour, perhaps confirming that exploitation of the Western Oases for cobalt was now well established.

Werkkreis III is also dated to Amenhotep III and IV. The body colour is most commonly dark blue, more rarely sky blue, and the forms are *Amphoriskoi, Krateriskoi* and occasionally bottles with handles as well as jugs. The decoration is in yellow, white, sky and dark blue. The vessel necks and bodies are decorated with very fine feather patterns, sometimes accompanied by arcades or garlands. The decorative scheme is sometimes divided into two by horizontal threads (Nolte-Refior 1967:152).

As well as the core-formed vessels there are also mosaic glass bowls, and—exclusively from Amarna—small gold-yellow or faint-blue pieces with layered eyes, dripped on circular layers of glass of varying dimensions and colour.

Conclusions

It appears that the development of glass in Egypt is bound up with influences from outside the Nile Valley, and that the material—perhaps because of its exotic nature—is quickly a focus of royal patronage, and possibly monopoly.

Most of the evidence for glass in this earliest phase comes from funerary contexts. This may reflect the limited utilisation of glass in Egypt at this time, but may equally be a factor of the limited investigation of settlement sites. The matter of funerary contexts, and indeed the social status of glass, may be settled by the investigation of a cemetery belonging to the ordinary people of Amarna begun in 2006. Whilst this post-dates the earliest glass in Egypt, it may give an indication of just how widely glass was used beyond elite contexts.

When settlements are examined it would not be surprising to find the establishment of at least limited workshops as early as the time of Thutmose III. However, it is to the reign of Amenhotep III (1390–1352 B.C.) that one must look for our earliest evidence of production sites. Manufacturing evidence forms the subject of the next chapter.

Endnotes

1. Parts of this chapter are derived from a paper published in Journal of Glass Studies (Nicholson 2006a). I am indebted to Dr. Christine Lilyquist of the Metropolitan Museum of Art, New York, for her comments on that paper, which have led to amendments to the present chapter.
2. Cairo CG 52975, JdE 31126.
3. BM EA 59619.
4. CG24981
5. CG24059. An eye bead (CG24068) belonging to Maiherperi is also likely to be an import (Lilyquist 2005:63).
6. BM EA 26289 (fragment) and EA 26290 (intact).
7. The colourless example is MMA26.7.746, the coloured example is Merseyside Museums 11568 and a bottle green example is now lost (see Lilyquist *et al.* 1993:24 note 17). Lilyquist *et al.* (1993:36) have analysed the colourless example in the Metropolitan Museum's collection.
8. When compared to analyses done by Cowell and Werner (1973).
9. BM EA 9558.
10. Again when compared to analyses by Cowell and Werner (1973).
11. Boston MFA 1978.691.
12. BM EA 148. For translation see Moran (1992:235).
13. Although attributed to Petrie the text of this reference is a summary prepared by a member of the audience at a Society of Glass Technology meeting held in London on June 1st,1926 and contains numerous errors.
14. The *Annals* were probably carved in regnal year 42 or later. The 8th campaign took place in regnal year 33. See O'Connor (2006:29ff). For details of the campaigns see Redford (1992:156ff; 2006).
15. ḫsbd-Mn- ḫpr-Rʿ.
16. Mfk3.t-Mn- ḫpr- Rʿ. Recent work by Hatton (2005:13) suggests that the artificial lapis lazuli may in fact be a type of Egyptian Blue rather than glass.
17. MMA26.7.1175—note that Lilyquist *et al*. (1993:10) and Lilyquist (2003:151) consider this to be ''glassy faience'' rather than true glass.
18. UC35334.
19. Shortland (2000:6) believes that the vessels "are quite similar to two real vessels found in the Wadi Qirud tomb…" but in the view of the present author they do not stand such close comparison.
20. Brock (2000:134) states that Nicholson agrees that these are ingots. However, as she rightly notes this identification is based only on a photograph, and I do not believe that they must therefore indicate the import of cobalt blue glass during the reign of Amenhotep III. Nor do I believe that the Keftiu figure holding ''precious stone'' from the tomb of Rekhmire is carrying glass ingots as Brock suggests.
21. Cairo 24960 and Brooklyn 53.176.4.
22. MMA26.7.1175.
23. See Bianchi *et al.* 2002:20 note 52—Gardiner (1957) sign T14, the throw-stick which can be used to denote ''foreign'', has mistakenly been read as the finger (D50) meaning ''10,000''. I am grateful to Dr. Ian Shaw and Dr. Kasia Szpakowska for confirming that the Shortland reading is likely to be mistaken.
24. Cairo 24959. Dark blue decoration on Brooklyn 53.176.4 has been found to be cobalt coloured (below).
25. Adapted from Shortland (note 1) p.215.
26. MMA26.7.1175.
27. MMA23.9.
28. MMA26.7.1179. This was purchased from the Carnarvon collection, having originally been bought from the Hood collection and was found at Gurna around 1860. I am indebted to Dr. Christine Lilyquist for drawing this to my attention.
29. I am grateful to Dr. Lilyquist for confirming this view in an e-mail of 1-3-2005.
30. Cairo 24959. See Lilyquist *et al.* (1993:50, Fig. 30).
31. Cairo 24961.
32. Cairo 24960.
33. Brooklyn 53.176.4. See analyis by Lilyquist *et al.* (1993:33, 36).
34. BM 47620. For a recent line-drawing of this piece see Lilyquist *et al.* (1993:52-53, Fig. 43).
35. Munich ÄS630. I have not seen this piece, and have not received any reply to requests to examine it. As a result my conclusions on this piece are based only on published sources and must remain provisional.
36. Ashmolean E2451. I am grateful to Dr. Helen Whitehouse for allowing me to examine this piece.
37. UC19657.
38. BM 24391.

39. MMA26.7.1179.
40. Cairo 24959, 24960, 24961.
41. Brooklyn 53.176.4.
42. HE 121. I first saw this piece in an illustrated lecture on the Harrow Collection given by Dr. Ian Shaw, who kindly put me in touch with Carolyn Leder, Curator of the Museum. I am indebted to her for allowing me to examine the piece and making the notebook available to me, and to the Keepers and Governors of Harrow School for allowing me to mention it here. The piece has not yet been analysed, though it is hoped that this will be undertaken shortly. Until such analyses are completed conclusions concerning the vessel must remain speculative.
43. Cairo 24959.
44. Kemp (pers. comm.) points out that this could also be a reflection of a change in the technology of Kohl pot production, rather than a stage in glass production.
45. Brooklyn 53.176.4.
46. Cairo CG24804.
47. Cairo CG24761 and Brussels E6201.
48. Corning Museum of Glass, CMG 79.1.4.
49. Cairo 5319.
50. Cairo 34405.
51. No museum number given in catalogue.

Chapter 2

Archaeological And Technological Evidence

Introduction

This chapter examines the evidence for glassmaking in Egypt, as known from Petrie's (1894) work at Amarna and that of Rehren and Pusch (1999) at Qantir along with other evidence from less well documented sites. The evidence from the excavations at Amarna site O45.1 will be considered in later chapters.

Although chronologically later than Malkata, Petrie's Amarna evidence is here treated first since it gives the most detailed account of finds associated with glass and faience production and serves to put other finds into context.

Tell el-Amarna

Flinders Petrie worked at Amarna from November 17th, 1891 to the end of March 1892 (Petrie 1894:1). He was the first to attempt systematic excavations at the site, although the celebrated "Amarna Letters" had already brought the site to notice having allegedly been dug up by *sebbakin*[1] in 1887 (see Moran 1992: xiii and note 1), and their significance had already been realised by the time Petrie began his work.

Those interested in early glass technology often seem to overlook the fact that Petrie did not go to Amarna to investigate early technologies of any kind. He went there with the purpose of unearthing well-dated objects which might throw light on the period (Petrie 1894:1), and no doubt in the hope of finding more of the Letters, an aim in which he was successful (Moran 1992:xiv). The discoveries relating to vitreous materials were largely incidental; in so far as he wanted to investigate these he had his sights set on Kom Helul, Memphis, as he later made clear (Petrie 1911:34). Whilst this does not entirely excuse his lack of detail in some aspects of the work at Amarna, one must appreciate that the standard of work was higher than that of most of his contemporaries, and that he was trying to give an overview of the archaeology and history of the entire site, not an account of glass and faience making. That his account of these materials still occupies us today is a measure of his interest in the finds and the standard of his work.

The following is a summary of Petrie's findings as given in his 1894 publication, attempting to make clear what was actually discovered and what was interpolated. This is important since some, such as Vandiver *et al.* (1991), have been misled by the account, or secondary interpretations of it.

Glass

The first area of relevance to this study is Petrie's investigation of the Palace Dumps, which he found located "on the nearest open ground to the palace". It seemed "evident that these are the palace waste heaps I sought; though probably mixed with waste from other large houses in the neighbourhood…The whole of this area was turned over, and the lads and boys employed were encouraged to preserve everything beyond the rough pottery" (1894:15–16). Petrie clearly made a distinction between the contents of these dumps and those of "lower status" dwellings, based on the type and quality of the finds made. He was surprised to find "several scattered human bones...among the pottery" (1894:16). We have no way of knowing if the bones were really contemporary with the dumps, but if they were it is tempting to suggest that they may have been

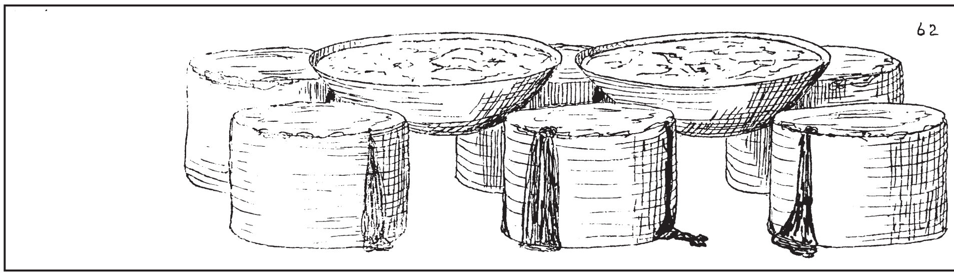


Figure 2.1. Petrie's reconstruction of the glassmaking process. (Petrie 1894:Pl. xiii: 60). (Copyright Petrie Museum of Egyptian archaeology UCL).

derived from the early (pre-Amarna?) burial site at O45.1 where the industrial buildings were eventually established (below).

More surprising to Petrie was the discovery of Aegean pottery "and so-called Phoenician glass…the glass vases were of many patterns, as yet quite unknown; but from the factories of glass-working found here [i.e. at Amarna], it is almost certain that they were made on the spot" (Petrie 1894:16). Some 750 fragments of glass were recovered, and estimated to represent about 150 vessels (1894:15–16). This is "a large number considering the general value and rarity of such, and quite enough to come as broken waste from a palace in fifteen years"[2] (Petrie 1894:16). Note that the rarity and value of glass is already understood at this time, and although Petrie noted that the dumps may include waste from large houses as well as the Palace, he clearly believed it to be a very high status product, and by implication "royal".

He then turned to excavations of actual industrial sites at the beginning of his section on "The Manufactures" (Petrie 1894:25) and informed his readers that "Fortunately the sites of three or four glass factories, and two large glazing works, were discovered: and though the actual work-rooms had almost vanished, the waste heaps were full of fragments which shewed the methods employed" (1894:25). Unfortunately Petrie failed to state where any of these glass factories or glazing works were located. They do not feature on his plan of the city, and no clue is given as to their location relative to other features. It is noteworthy that he states that the work-rooms had almost vanished, and one wonders if this should be read as "actual work-rooms could not be distinguished", in which case it would link very well with the evidence from the more recent excavations (below). Shaw (2004:16) makes the important point that many craft activities probably took place in open courtyards, and as a result have been missed because of the tendency amongst archaeologists to look for workshop *buildings*. Much the same view was taken by Woolley (1922:64) in speaking of the industrial quarter of the Central City where he found evidence of faience and glass manufacture: "there were no factories; the workmen carried on their trade with the simplest of appliances in their own small houses and courtyards, after the normal fashion of the East, so that there was little to distinguish these ruins from others of their size…". It should not be surprising then, that the features of Petrie's workshop areas were not always clear.

Petrie goes on to discuss the making of frits, some of which he had previously had analysed by Dr. Russell, and notes the greenish tinge imparted "if iron be present" (1894:25). He felt that it would be a priority to find elements free from iron, but could not see how this could be achieved until he "picked up a piece of a pan of frit, which had been broken in the furnace…this shewed clearly throughout the mass the chips of white silica; and from their forms they were clearly the result of crushing quartz pebbles which are to be found on the surface of the desert…"[3] (1894:25). This half-formed frit was of violet colour, which Petrie took to mean that it was iron free. Though this may be so, the colouring of such frit is not wholly dependent upon the presence or absence of iron, it is but one of many factors affecting colour. He believed that the product would then have been made into "pats, and toasted in the furnace until the desired tint was reached by the requisite time and heat" (1894:25).

The half-pan of frit is described in some detail as "about 10 inches across and 3 inches deep" (1894:26) and is contrasted with the cylindrical vessels of "7 inches across and 5 inches high". These latter had runs of glaze on them and were believed by Petrie to have stood mouth down, as the runs were evidently coming from the base. Recent opinion suggests that this interpretation of the runs is incorrect.[4]

In his diagram (1894:Pl. xiii: 60 here Fig. 2.1) Petrie shows the cylindrical vessels serving as stands to support the fritting pans. It is notable that these vessels are not shown standing on a floor of quartz pebbles (below), presumably because Petrie could not determine how such an arrangement would have functioned. Shortland (2000:34) convincingly argues that the use of the vessels as stands in the kiln is unlikely as they would be prone to failure. The white lining on the interior of the cylindrical vessels is not remarked upon, and it is left to Turner[5] (1954:440T) to comment on this important feature.

In his manuscript (Petrie Unpublished:6) he makes the observation that these cylindrical vessels might also have been used as saggars "containing the objects to be glazed". Here he is influenced by his experience at Kom Helul, Memphis where similar vessels were undoubtedly used in this way, as he makes clear.

He then turns his attention to furnaces and their waste, stating that "among the furnace-waste were many pebbles of white quartz. These had been laid as a cobble floor in the furnace and served as a clean space on which to toast the pats of colour, for scraps of the paste or frit were found sticking to one side of the pebbles. This floor also served to lay objects on for glazing, as the superfluous glaze had run down and spread over the pebbles as a thin wash of green" (Petrie 1894:26). It would seem then that the pebbles were part of a furnace which served to make pigment/frit, some of it for colouring faience or glass, as well as for the glazing operation itself. However, it is not clear how many of these pebbles were found. Petrie's account suggests that there were many, and yet the Petrie Museum has no great number of them,[6] and nor do other collections. Either he did not consider them sufficiently important to collect, or they were in fact much rarer than he implies. The recent excavations suggest that these pebbles are actually quite rare. Shortland (2000:34) suggests that the fritting pans (rather than cylindrical vessels) stood on quartz pebbles in the kiln. There is no doubt that quartz was sometimes present and may have been used as a support, but there is no evidence for actual flooring. It may be that the pebbles are to be linked to the production of frits rather than the direct production of glass. Petrie makes the important point that continued heating and cooling in the furnace would make the pebbles easier to crush and so use as a high quality raw material in the fritting process.

Petrie (1894:26) is then explicit in stating that "of the furnaces used for glass-making we have no example". At first sight it is not clear whether this is being contrasted to furnaces or kilns for frit and faience making, but since he goes on to describe a furnace "apparently used for charcoal-burning" (1894:26) we must assume that he would have described any furnace or kiln used in the other processes. It is certainly the case that these are described in his later work at Memphis (Petrie 1909b, 1911; see also Nicholson 2003). This charcoal-burning furnace (Fig. 2.2) evidently contained a great deal of charcoal, but whether that was actually its purpose is debatable. On the rare occasions when charcoal burning can be observed

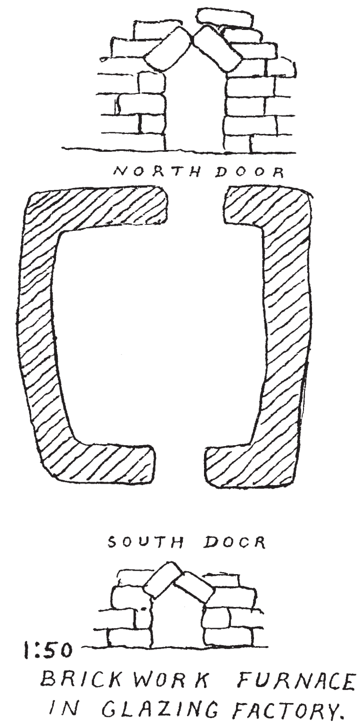
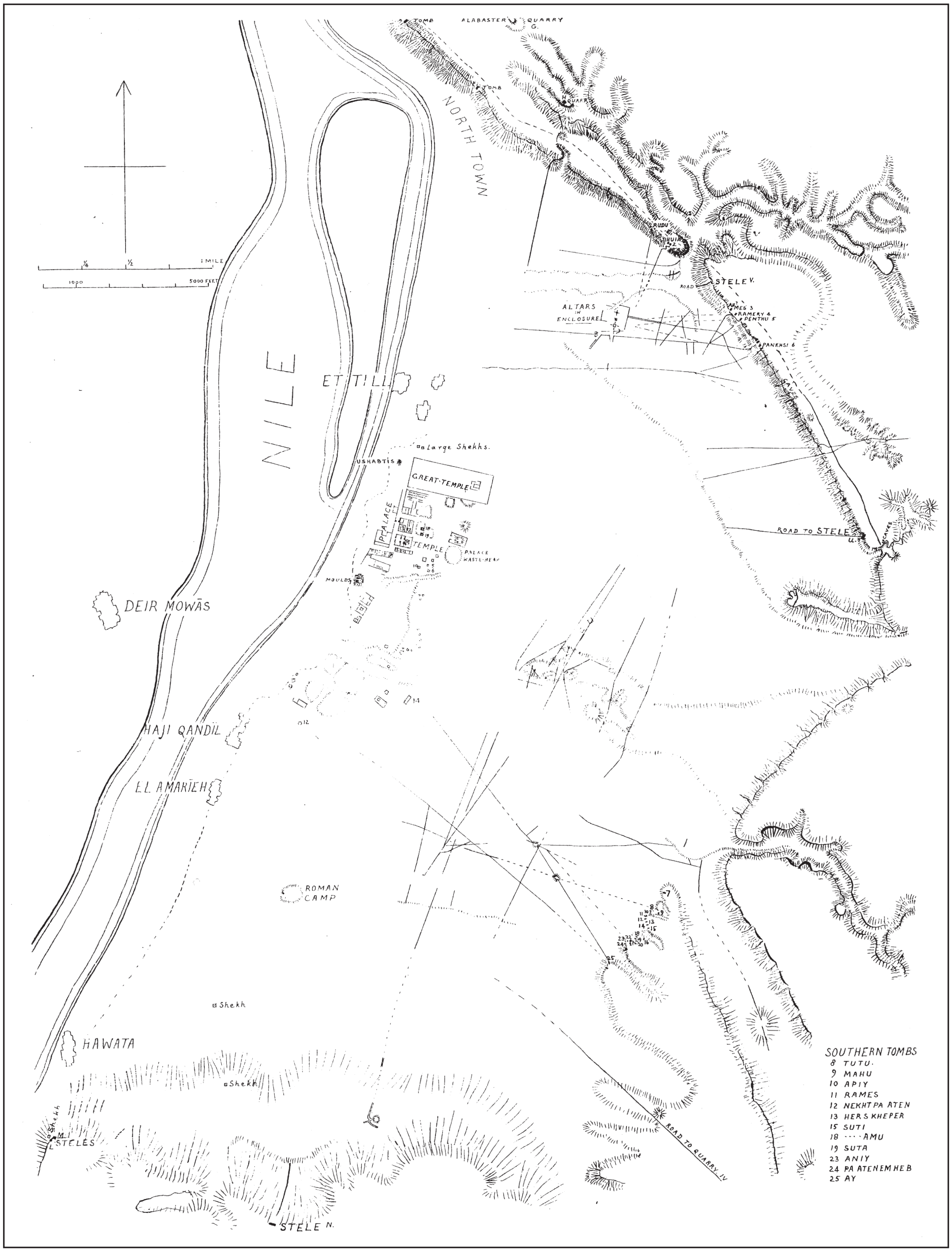


Figure 2.2. The "charcoal furnace" discovered by Petrie. (Petrie 1894:Pl. xlii). (Copyright Petrie Museum of Egyptian Archaeology UCL).

in Egypt today, it is undertaken without any actual superstructure[7] (Plate 2.1). This identification of this feature is probably heavily influenced by knowledge of European furnace fuels, although structures such as those that Petrie describes from Amarna do not seem to be associated with charcoal burning. The closest parallel is a much longer wooden structure in use in 18th-century Australia (Kelley 1996:8).

In short, if this structure was a furnace it was probably not for charcoal burning. It was found "near the great mould and glaze factory" (Petrie 1894:26) but how near is not made clear. Indeed we can only guess that this location is the one shown as "moulds" on Petrie's Plate xxxv (1894:Pl. xxxv here Map 2.1). It has not been relocated. He goes on to suggest that the glazing furnaces may have been of the same type and even that "the same furnace would be used for varying purposes" (1894:26) though he is not explicit that his charcoal furnace was also for glazing. I suspect that he cannot be explicit because no flooring of quartz pebbles was found, and he had already theorised that such pebbles made up the floor of the glazing furnaces. One must, for the moment, assume that the "charcoal furnace" was unconnected with glass or faience production as too little evidence for its function remains.

When looking specifically at glass, Petrie interpreted his finds as stages in a continuous sequence. The



Map 2.1. Map of Amarna showing area of 'Moulds". (Petrie 1894:Pl. xxxv). (Copyright Petrie Museum of Egyptian Archaeology UCL).

Plate 2.1. Charcoal burning, as carried out by the Ababda Bedouin, Wadi Gemal, Eastern Desert, Egypt, 2001.

crucibles used for melting the glass were deeper than the fritting pans being between "two or three inches in depth and diameter" (Petrie 1894:26). This conflicts with his earlier statement that the fritting pans could themselves be 3 inches deep. It also conflicts with his statement of 1909 that the glass melting vessels were "four or five inches across" (Petrie 1909a:124). This seems to reflect some uncertainty as to which vessels were used for which process, as well as a tendency to rely on memory rather than notes when writing up. He illustrates a block of glass (1894:Pl. xiii: 40) which is said to come from such a vessel, but it has not been possible to identify this with certainty in the Petrie Museum.[8] He makes the interesting observation that the surface of the glass is often "frothy and worthless [which] proves that the materials were fused in these vessels, as the froth of carbonic acid expelled by combination was yet in the vessel. If the glass had been made elsewhere then merely remelted here it would have been clear" (1894:26 see also Chapter 5 here). This is an important point, since most workers, including myself, have assumed that the frit was actually being used in glass production, and that Petrie thought so too. In fact, though this point is not made in his *Tell el-Amarna* (1894), Petrie does state in his *The Arts and Crafts of Ancient Egypt* (1909a:124) that the frit was used as a colouring for the glass.

The use of frit in glass is made still more explicit in the manuscript on glass production held at the Petrie Museum (Petrie Unpublished). In this he talks specifically of the preparing of frit (Unpublished:5–6) in various colours. He also states that production was in a sealed vessel for 16–20 hours at 830–890°C. Note that there is no discussion of such closed vessels in his published text.

He is also explicit that the glass cooled in its containers and was not poured out, as if it were, the frothy surface and scum at the bottom would not have been found. Rather it was cooled before working. Once cool the scum would be broken away, along with the crucible and a "lump of good glass obtained for working up" (1894:26).

These are important observations. The features which Petrie describes on the glass do indeed suggest that it is being made in the vessels. It may be that it is being made in a single stage operation, without fritting (see Chapter 4) or being partly fused and then finished in the pans. In either instance it would be made at Amarna, not simply melted from ingots before being worked.

Petrie also found samples of glass bearing the marks of pincers (1894:26) and these he thought were the result of testing glass whilst it was being made. This may be the case, but it is also possible that these are the result of tests made during re-melting glass for working into objects.

He goes on to describe how finished lumps of clear glass are processed. It is not obvious what is meant by "clear". His discussion on the problems caused by iron in glass would suggest that he means colourless and transparent, but since his 1909 account makes it obvious that it could be coloured he must mean that it is free from impurities. He believed that the lumps of glass were then heated and worked on a flat surface using a bar to shape them into a "roll". He notes that if a large section were rolled at once the bar would tend to become hollow in the middle, so that only short sections were rolled. The rolling was done diagonally, as can be seen from marks on the bars. This is problematic, since it seems to serve no obvious purpose, given that glass would normally be worked in molten form, and the thin glass rods used in decoration are normally drawn from such a mass. It is however, true that thicker rods of glass are found bearing marks from a marver[9] (see Nicholson 1993:52). It may be that these were intended to be sent to secondary workshops where they would be melted for vessel production, although why larger ingots were not sent is unclear.

Petrie believed that the thin rods or "cane" would then be drawn from these thicker ones or that they would be flattened into strips as inlay. This latter explanation, as inlay, is perhaps the most likely. He also comments on the discovery of glass tubes, probably intended for bead making.

His discussion of the tubes leads on to a description of glass bead making (Petrie 1894:27). Beads are said to be made by winding glass thread around a wire, and he gives examples where the wire is still in the bead (1894:Pl. xiii: 59–61).

Petrie then turns to the manufacture of glass vessels. He states that a "tapering rod of metal was taken, as thick as the intended interior of the neck; on the end of this was formed a core of fine sand, as large as the intended interior of the vase" (1894:27). Note that he is assuming that the metal rod has a diameter which would take up the whole of the neck of the vessel. The rod would have been of copper or bronze and experimenters have had difficulty in seeing how this might work without melting or softening. The core would then be "dipped in melted glass" (1894:27) and hand worked. The decorative pattern was made by winding "thin threads of coloured glass around the mass, and rolling it so as to bed them into the body of the glass; the wavy design was made by dragging the surface upward or downward at intervals…" (1894:27). He does not say that these thin threads were the softened cane made earlier, which suggests that he thought the cane was intended for making beads or for inlaying into glass ribbon, or flattening to make ribbon (see Petrie 1894:26). He realised that after the process was ended the rod would contract and could be worked loose from the core which itself would be broken up and removed.

Petrie's Work: Archive Sources

Whilst the main source of information on Petrie's work is his publication on Tell el-Amarna (Petrie 1894) there are also important archive sources from his "Journal".[10] It is clear from these that he took great interest in the glass finds, but it also throws some light on the context of some of the discoveries.

The "Journal" letters tend each to cover a period of several days. In that for November 22nd–29th, 1891 Petrie states: "I picked up a bit of a fritting dish, with some dark blue frit, with sand grains undissolved in it: this dish seems to have been a flat tray, to judge by this bit. We also found a pot bottom with some very bright pale blue frit in it; probably it had been ground in the pot, from the rough lump." This may be the well known lump of frit now in the Petrie Museum,[11] since "flat" seems to be used by Petrie to mean "shallow", though the description of it as "tray-like" is odd. The wording of this entry strongly suggests that it was a surface find, and not an excavated piece, since there is no mention of a factory.

A second letter deals with the period from November 29th to December 5th, 1891 and probably covers the same find: "I picked up part of a spoilt dish of frit. It is very interesting as shewing the material. The silica is in grains not at all like sand, quite white, mainly opaque, larger and sharply angular and splintery. It is evidently pounded material and apparently not flint but white quartz rock, probably heated and quenched to break it up. The mass is full of large bubbles, due to the carbonic acid liberated in the pasty mass from the carbonate of lime. This shews that the lime was not calcined first. I think the batch has failed from the silica being in excess, and too coarse. But it shews excellently the procedure for making the coloured frits. I shall add it into Dr. Russell's paper about it." He goes on to note that at Amarna glass rod is commonly found whilst it is rare at Gurob.

A third letter, also dated November 29th mentions that "a very curious piece (is) from a glass bowl made of fragments fused together and then ground and polished. This process is essentially Roman in general, and I am surprised to find it here and certainly fixed to this age, as the individual colours are those of XVIII dyn." This is an example of the kind of conglomerate glass known from Malkata, as he illustrates in a coloured sketch. Whilst the glass may simply be an import from Malkata, it may also hint at the bringing of craftsmen from that site to Amarna.

Later in the season Petrie wrote to his mother about the arrival of Howard Carter at the site (January 3rd –9th, 1892) and implies that Carter may be working on one of the actual factory sites: "The main matter this week has been turning over some remains of amulet factories; over a thousand pottery moulds have been found, and much remains to be turned out yet. I have sorted out 70 or 80 varieties, and shall be able to make up a great many sets of forms for different collections. There are all the various little ornaments so common at this period [which he illustrates]. With these are pieces of the frits and of the waste glass and pots. The puzzle is a great many cylindrical infusible pots about 6 ins. across, which have glaze on bottom, and run on to sides, but never any inside. They seem to have been used in the furnace, but how is unknown. The factories are much denuded, only a few inches of rubbish left, so the furnaces are lost." The statement that the stratigraphy was so shallow is a valuable one, indicating just how poor was the actual preservation of this particular area.

This was not to be the only factory, and on 10th–24th January, 1892 Petrie writes that "A fresh factory of pendants has been found, and more hundreds of moulds come pouring in, some fresh types among them." The circumstances of discovery of a further factory are also commented upon: "One glass factory has been grubbed in by the children who hunt the mounds, and pieces of glass rod are found, but no variegated glass or bottles. Some glass tube was found lately." Thus we have one workshop with poor, denuded stratigraphy, and another from which a collection was made, but which was turned over by the local children rather than excavated.

A further letter dated 24th–30th January, 1892 is more problematic. Petrie comments that "We have begun on a glass factory, and find hundreds of pieces of coloured glass rods &c, for making earrings. Evidently the glass was melted up in a lump, cooled, chipped clear of the pot, broken in bits, and then remelted and drawn out." However, it is not clear whether this is part of the factory found by the children or a separate one. The implication is that it is separate. It is also the factory which provided him with the clues he needed to reconstruct the glassmaking process: "I have found how they arranged the furnaces for the frits and glass making. Short pots [which he illustrates as 7" diameter and 5" high], were set mouth down on the furnace floor in rows, the bowls of frit rested between them, and then fire thus could be raked and fed immediately under the melting pots. This is shown by these pots which I find, always having runs of glaze down the outside from points on the base edge, there is no glaze in them inside; so they must have been mere stands for the flat bowls in which the frit and glass was prepared."

What cannot be discerned from these journal letters is where particular finds came from. Petrie does not think in terms of primary and secondary working, and does not differentiate finds from the dumps from those made in the factories. This is clear from his letter of February 28th–March 5th, 1892: "I have now collected nearly 2lbs. of variegated ("Phoenician") glass vases, no two of which are quite alike: many are of patterns which I have never seen before: light blue with large blue and white circles [which he illustrates] this since white with light and dark blue stripes [illustrated by him]..blue with white lines and spots besides all the usual variegations in every variety. W. Franks[12] will be well pleased to get such a great variety all dated to 1400–1350 B.C. I have also bags full of glass rods and pieces of all colours, from the factories and waste heaps."

On March 28th, 1892 Petrie describes his work clearing the Palace dumps and goes on to say that "I have also worked out the details of the glass factories: the materials, furnaces, mode of working &c. And I send a preliminary note on that to Griffith."[13] The implication is that some of this information has been gleaned from an examination of the dumps, rather than from his excavated evidence.

The picture one builds from an examination of the archive is that the carefully written account of glass production at Amarna is made up of a composite of surface finds, excavation of several sites, which may have had different roles in the production process, and work on the Palace dumps. This is no surprise, and is hinted at by the published account, but the variability of the information and poor state of preservation of the factories is not otherwise apparent.

Glass Summary

Reading of Petrie makes it very clear that he found no furnaces, other than the possible "charcoal furnace". It is not clear whether the white quartz pebble floors he postulates for the furnaces were exclusive to fritting furnaces or whether these were actually the same as the glass furnaces. Since no furnaces were found the pebbles could not be *in situ* and it is quite possible that such pebble floors did not actually exist. He is, however, explicit that glass is being made from its raw materials, hence the frothy surface on some of the glass, and that working is also taking place.

It is noteworthy that though Petrie clearly regards glass as being made from its raw materials at Amarna he also finds evidence of working. Sadly, he does not say if these took place at the same site or whether he is simply summarising the evidence of his three or four workshops. It seems likely that though he must be summarising, some of the workshops are in close proximity to one another if not actually the same sites.

Faience

Petrie (1894:25) speaks of "two large glazing works". These may have been in the same locations as the glass works, or immediately adjacent to them. No details are given, but if the area marked "moulds" (1894: Pl. xxxv, here Fig. 2.4) refers to a glazing works then it seems that glass and glazing were going on together, since this is close to the area now identified as site O45.1.

Petrie is keen to observe that "whole statues of glaze, and walls blazing with glazed tiles and hieroglyphs, shewed that the difficulties of size had been overcome" (1894:27–28). This view of Amarna as ablaze with faience inlays is significant in terms of the location and date of some of the workshops, as will be shown later. It also gives an impression of the scale of this industry when compared to that of glass production. Kemp has noted (pers. comm.) that the tiles may actually be from stone friezes rather than having been attached to mudbrick walls, and no examples of such bricks are, to my knowledge, known from the site.

After reviewing the types of architectural inlay and other items, notably figurines and finger rings, Petrie moves on to outline the glazing process (1894:28). The items were made in fired clay moulds, often with the mark of the palm of the hand on the back. A die was pressed into the clay, so producing the mould.

The manner in which Petrie believed these moulds were used was to press them against a lump of faience paste to leave the object in raised relief, and then trim it from the lump. He probably based this idea on the production of figures, such as those made by *Wedgwood*, in the pottery industry—a process known as sprigging (Rye 1981:92–93). Like many educated Victorians Petrie had a good general knowledge of craft practices, and had probably read works such as that by Muspratt (1860), and drew on this not only in this instance but also to inform his description of the making of frit (above, and see Nicholson 2006b). It should be noted that Petrie apparently had no evidence, beyond the moulds, for this view; it is purely his interpretation.

Once the sprigs had been produced they would, he thought, be "dipped in powdered glass and fired to glaze them" (1894:28). He further suggests that the "moulding paste" was made from a very fine sand "so white that perhaps powdered quartz was used, where the best blue had to be maintained free from iron" (1894:28). This is significant, since although (as will be shown below) Petrie's interpretation of the evidence is incorrect, there is, for him, a clear link between faience glazing and glass, which might further support the view that the workshops were in the proximity of, or identical with, the glass works.

After a discussion of the objects produced by the moulds Petrie observes that they are particularly well represented at Amarna and that he "brought nearly five thousand from Tell el Amarna, after rejecting large quantities of the commonest; and these comprise over 500 varieties" (1894:30). This gives some idea of the scale of production at those sites investigated by Petrie. Where he deposited those moulds which he rejected is uncertain, perhaps at the site marked as "moulds" on his map. They have not been relocated and may lie under the modern water tower (below) or —more likely—under the cultivation. They may also have been removed by local people after his time and distributed as part of the antiquities trade.

Faience Summary

The process as outlined by Petrie is essentially a potting process. A sprig mould is used to produce the items which are then glazed using powdered glass. The matrix may be made from white quartz, presumably the pebbles discussed earlier. The implication is that the glass and glazing operations may have gone on in close proximity. The glazing was certainly on a large scale.

Malkata

Malkata is the so-called "Palace-town" of Amenhotep III located on the West Bank of the Nile at Thebes. Although constructed under Amenhotep III it was not abandoned until the reign of Horemheb, whereafter it fell into ruin. It has been the subject of archaeological investigation on several occasions, some of the earliest work being of a poor standard. Part of the "town" comprises "villages" where workers are believed to have been housed, a North, South and West village, all having been identified.

Despite the wealth of finds from Malkata, made over many years, there has been no attempt to merge this information into a single coherent publication. As a result the relationship between parts of the complex is not as clear as might be desired, and the details of the industrial remains are, at best, sketchy.

The first evidence of a glass industry at Malkata seems to have been unearthed during the work of Newberry begun in 1900 (see Tytus 1903). However, this has never been fully published though Newberry states that Malkata was "the earliest known glass factory, in which were found small crucibles containing dark blue glass and a quantity of different coloured rods of the same material" (Newberry 1920:156 and note 4).

Most of the industrial evidence was recovered during the work of the Metropolitan Museum of Art's expedition between 1910 and 1921 (see Keller 1983:20). The areas identified as glass factories were located in the so-called South Village, a craft area for those who worked in the palace complex. A further factory was located in the middle of the main palace area. Details of this are few, but Keller (1983:20) quotes a letter from A. Lansing:[14] "The finds of the day [November 1st , 1917] indicate a glass factory—quantities of broken beads, bits of scalloped glass, fragments of glass rods and crucibles" (Lansing, letter of 8/11/1917).

Keller's overall impression of the glass produced at Malkata, based on the finds now in the Metropolitan Museum of Art "is, on the one hand of great variety in color, shape and textural interest and, on the other, one of a generally high degree of technical execution. The attachment of this atelier to the royal palace complex at Malkata indicates that the workshop was well established…" (Keller 1983:23). This suggests that the industry was becoming embedded within the range of Egyptian crafts by the reign of Amenhotep III. The technological evidence as it exists includes glass rods, canes and drips of glass along with slag and crucible fragments.

Faience objects, moulds for making them, and materials probably used in colouring were unearthed, but no kilns or furnaces were located. Tytus (1903:25) states that "a factory for the manufacture of small glazed objects yielded hundreds of moulds, fragments of rings, charms, pendants, beads etc." It is notable that Keller (1983) includes this discovery along with the glass finds, suggesting that, as at Amarna, glass and glazing probably went on in close proximity. Hayes (1959:254) is more specific in linking the two crafts. Amongst the finds of moulds from Malkata were several filled with a whitish or tan paste.[15] This has usually been regarded as the raw material for faience production, but an analysis made by Wypyski (1998:265) suggests otherwise. The work of the Metropolitan expedition has not been fully published however, and as a result its value is, for the moment, limited.

Overall then, what is known of the finds from Malkata suggest that they are similar to those from Amarna, and they have generally been interpreted in the same way.

Medinet Gurob

The site of Medinet Gurob (also known as Medinet Ghurab, or Gurob),[16] close to the entrance to the Fayum, is a town of the 18th to 20th Dynasties, but there are earlier burials in the area. The town may have served at least in part as a royal harem. Bryan (1991:105–6, also Kozloff 1992:377) has suggested that this was the domicile of the queens of Thutmose IV, and was the site at which Amenhotep III grew up.

Gurob was first investigated by Petrie in two seasons of work between 1888 and 1890 (Petrie 1890, 1891) and later by Brunton and Engelbach in 1920 (Brunton and Engelbach 1927). These latter identified what they believed to be the remains of glass production close to a building believed to be a fort. Kilns are said to have been present, but whether these were actually connected with the glass industry is unknown.

The date of the glass industry at Gurob is problematic. It may be contemporary with Amarna, or possibly have predated both Amarna and Malkata, being abandoned during the period of active production at Malkata only to resume on a more limited scale later (Kozloff (1992:377). The products seem mostly to have been amulets and possibly miniature vessels; both classes of product could have been made from small pieces of glass, such as cullet.

At present, evidence for the industry is so limited that it cannot feature significantly in discussions of New Kingdom glass production. Work currently being undertaken by Ian Shaw of Liverpool University may help to remedy this situation.

Qantir/Piramesse

The area around Qantir in the eastern Nile Delta has been identified with ancient Piramesse, Egypt's Ramessid capital city. Excavations were carried out at the site by two prominent Egyptian archaeologists, Mahmoud Hamza (1928, see Hamza 1930) and Labib Habachi (1940–43 see Habachi 1954). More recently it has been examined by a team from the Roemer und Pelizaeus Museum at Hildesheim, under the direction of Dr. Edgar Pusch (for summary see Pusch 2001).

The work of Hamza and of Pusch has revealed important industrial remains, particularly for the manufacture of faience and glass.

According to Hamza (1930:42) over ten thousand moulds for the making of faience objects were discovered, some containing traces of coloured paste. Along with these were faience tile fragments, cylindrical vessels and "lumps of the favourite blue colour"[17] (Hamza 1930:42). His opinion was that these were the remains of a substantial factory operation, but he makes it clear that none were found *in situ* and that "the original workrooms had actually vanished, but the debris was full of hundreds of fragments which illustrate the finished objects and furnish us with almost every stage and detail of the mode of manufacture" (Hamza 1930:45). However, he does not attempt to reconstruct the manufacturing process in any detail.

The recent work directed by Pusch has identified remains from the production of glass, though in a different area of the site to that investigated by Hamza. Once again all the remains are from dump contexts, rather than occurring *in situ,* and as yet there has been no evidence of kilns or furnaces for the production of faience or glass. A glass kiln was reported from Qantir some time ago (Aref 2003) but is actually for the production of lime (Thilo Rehren: pers. comm. 22/1/2005). There is however, substantial evidence for the production of glass at the site including an ingot of red glass[18] (Rehren and Pusch 1997:134–35).

As yet there has been no definitive publication of the glassmaking evidence, though aspects of it have been published (Rehren 1997; Rehren and Pusch 1999; 2005) and recent work has been disseminated at conferences. The evidence has been reconstructed as showing that the raw materials of glass production are first fused together in a sealed vessel. This seems to be a reused beer-jar, or similar biconical vessel. However, a cylindrical vessel, closely similar to those found at Amarna, has been unearthed containing what is believed to be a mixture of the raw materials,[19] suggesting that they too may have been used in fusing the raw materials. The biconical jars have a white, bubbly, residue inside suggesting that they have been used to produce frit in the conventional sense.

The material produced in these, usually, closed vessels is then transferred to a cylindrical vessel. Rehren believes that these vessels show "hot spots" around them where they have been heated using blow pipes. The writer would see such marks as the result of close packing between the vessels, so that they are akin to "flashing" marks on pottery as seen when removed from a kiln. On top of the cylindrical vessels is placed a wide funnel made from coarse, sandy clay. These have been found as fragments, and are responsible for the damage evident on the white lining layer at the rim of the cylindrical vessels. These funnels facilitated the addition of raw material or crushed glass to the crucibles whilst they were in the furnace (Rehren and Pusch expected 2007).

There can be little doubt that both glass and faience were being produced at Qantir, even though evidence of the actual workshops (or workyards) and furnaces are so far absent.

Lisht

This site on the west bank of the Nile between Dahshur to the north and Meidum to the south, is probably in the vicinity of, or to be identified with, the Middle Kingdom capital of *Itj-tawy* (see Simpson 1984), and there is good evidence for faience production at the site during that period. However, this pre-dates the introduction of glass, and it is to the later levels of the site that one must turn for evidence of glass production.

The Metropolitan Museum of Art's excavations between 1906 and 1934 covered large areas of this complex site, but were undertaken at a time when interest in crafts was less than it ought to have been. On the northern side of the pyramid of Amenemhat I a workshop was unearthed (Mace 1908:185) in an area of "poor housing" at first thought to be Roman (Keller 1983:20 and note 19) and later to belong to the 22nd Dynasty (945–715 B.C.). More recent work puts it in the latter half of the New Kingdom (Keller 1983:24), but the excavation was poor, the finds are scattered, so that a more certain dating cannot be given. The finds of glass at the workshop, and on the site generally, are quite scattered and any relationship to areas where faience may be being produced is therefore uncertain.

New Kingdom Lisht was not under direct royal patronage, and the location of the workshop supports this view. Keller (1983:25) also notes that the blue glass here is coloured with copper, rather than cobalt, and it might be suggested that this is a secondary workshop, not associated with the kind of trend seen at Amarna, Malkata and Qantir. Kozloff (1992:378) makes the interesting observation that there are two qualities of production here, one of a high quality comparable to Malkata and Amarna, and a second poorer in both fabric and design. She suggests that the raw material may have come from Ramesside scavenging of 18th Dynasty tombs at Saqqara for use as cullet at the site, and describes it as a "bootleg operation" (1992:379). Given the uncertainties over date and the poor excavation we should not put too much reliance on this site at present.

Menshiyeh

The identification of this site located north of Abydos on the West bank of the Nile in Upper Egypt as a centre of glass production stems from the work of Newberry (1920). The site itself is one of those which saw building activity in the time of Amenhotep III. Kozloff (1992:378) believes that it is possible to identify vessels of Menshiyeh type[20] as being milky white, wide necked *Krateriskoi* and pilgrim flasks. The vessels are of thick fabric and often heavy in design. Rims may have twisted blue and white rod decoration, which she sees as a "stylistic holdover from Malqata" (1992:378). She goes on to note that the finest vessel is, however, an opaque yellow *Krateriskos* with S-shaped ribbon handles trimmed with two tone twisted cane, the glass and handle being very comparable to Amarna glass. "Possibly the Mansha factory was started up by an Amarna glassmaster, after the dissolution of those factories, and continued for a generation or so" (Kozloff 1992:378).

Keller (1983:20) however, has cast some doubt on Menshiyeh as an actual production centre for glass. She implies that the site was shown to Newberry as the find spot for glass vessels which were on sale in antiquities dealers in Luxor, and that it was in fact a fake provenance for vessels looted from elsewhere. This may be so, but it should be noted that Newberry did actually visit the site and picked up rods of coloured glass, and pieces of slag suggesting that working of glass, at the very least, went on there irrespective of whether it was the provenance of the vessels concerned (Newberry 1920:156 and note 11). Sadly, it is not possible to say much more about the site.

Ingots

The question of glass ingots has, in the past, been much confused. Newberry (1920:157 note 10) notes that he was aware of four glass ingots, two of them turquoise and two red. Although he gives the locations for these, two of them seen in dealers shops' in Cairo, he does not illustrate them. Fortunately, the one in the collection of Lord Carnarvon is well documented and is now in the Metropolitan Museum of Art in New York.[21] Charleston (1963:58–59) also comments on the ingots, though noting that the opaque turquoise blue colour is known in Islamic as well as pharaonic times.

Subsequently, Cooney (1981:31–32) has shown that the turquoise ingots are in fact part of a frieze from the Mosque of Sultan el-Muaiyad acquired by various museums in the 1870s. Cooney makes no mention of the red ingots described by Newberry, and although Charleston (1963:59 Fig. 3) illustrates a "slab" of red glass it is clearly not the same kind of artefact as that described by Newberry. Cooney (1981:32) does refer to two possible ingots of red glass from Tell el-Yahudiya dated to the 20th Dynasty. However, his own catalogue of glass in the British Museum (Cooney1976:124) lists six fragments of ingot from the site.[22] These pieces do not seem to be of the same sort as listed by Newberry, and are not part of one of the slabs illustrated by Charleston. It is interesting that Newberry thought that such ingots were probably products of the Western Delta, since it was there, in his view, that glass making ingredients might be found.[23]

It seems likely that the red "slabs" and the red "ingots" are actually "ingots" only in the sense that they are partially prepared raw materials, rather than that they are the primary ingots produced in glass melting. Rather, they may represent smaller castings of some of that glass for distribution to secondary workshops. The red ingots which Newberry noted, are no longer known, and it is not certain from his description if they had the same form as the blue ones, though this might be inferred from the fact that he does not state that they were markedly different. If so then they too may have been fragments of Islamic decoration, if not, then, perhaps they are what might be described as "secondary ingots" or fragments of inlay. It could be that the slabs are related to the "plates" referred to by Rehren and Pusch (1999:173).

In summary, the only certain (primary) glass ingot which is known from Egypt is that found by Hamza (1930) at Qantir and now in the Egyptian Museum, Cairo. The glass ingots from the Uluburun shipwreck found off the Turkish coast (Bass 1986, 1987, Bass *et al* 1989, Nicholson *et al* 1997) probably came from Egypt but as yet this cannot be proven beyond doubt.

There is, in fact, a hitherto unpublished ingot in the collection of the Garstang Museum, SACE, Liverpool University.[24] This piece[25] was probably acquired in 1920 or 1921, since the University Yearbook for 1921 refers to the Egypt Exploration Society giving finds "including a group of objects illustrating the famous glass manufactures of Tell el Amarna, from the raw flint to the finished bead" (Liverpool University 1921:14). Only half of the original ingot is preserved, but its original diameter would have been c.139mm with a maximum thickness of 37.8mm (Fig. 2.3). The preserved weight is 600grams. The piece is therefore thinner than the cobalt blue ingots from Uluburun, though of similar thickness and diameter to some of the copper ingots from the site. It is sufficiently well preserved for it to be clear that the piece is not coloured by cobalt, and appears to be a piece coloured with copper. However, the colour and texture are not exactly similar to the pieces examined from Uluburun (Nicholson *et al.* 1997). The smoother texture may simply be the result of a different burial environment, but the colour, which is a rather muddy greenish-blue suggests that the ingot may be made from recycled glass.[26] This may well be an example of a secondary ingot.

Kemp (pers. comm.) has pointed out that it would be difficult, if not impossible, to tell whether a broken

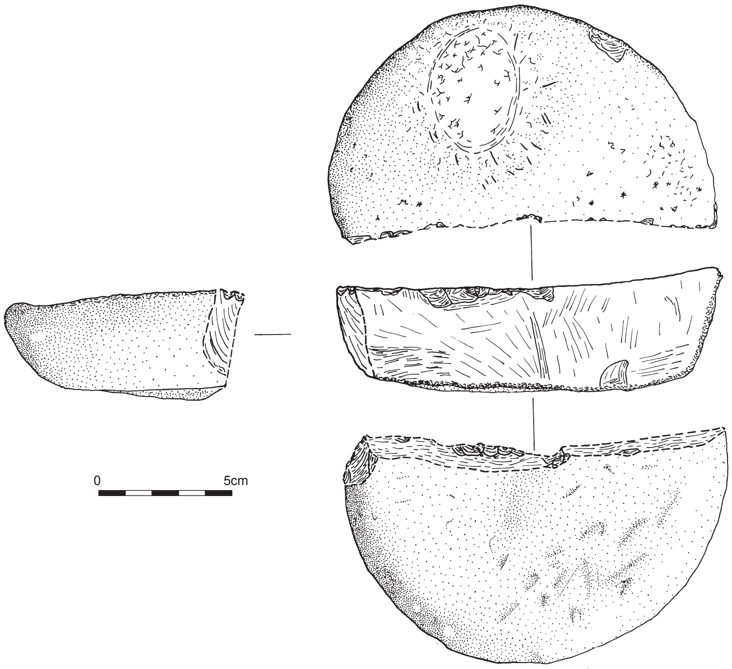


Figure 2.3. Glass ingot from Amarna. (Garstang Museum E5654). (Drawn by Dorn Carran, reproduced courtesy of SACE, Liverpool University).

lump of glass came from a primary ingot, made from raw materials in a cylindrical vessel, or a secondary one, the result of cooling re-melted glass in a crucible. Such a distinction would, particularly in hand specimen, be very difficult to make. It is made more difficult by the likelihood that the cylindrical "ingot moulds" are used for a variety of purposes within the vitreous materials industry, and do not seem to be confined to those workshops where primary production is taking place.

Kemp is correct to see the lumps of glass from his excavation at Amarna Grid 12 as fragments of ingot, but they occur in a situation where evidence for substantial kilns or furnaces is absent. This might suggest that these lumps are what remained after these secondary workshops received primary ingots from their places of manufacture. It is also possible that such lumps result from several re-meltings of an ingot, perhaps with additions of glass of the same colour. Since such re-meltings might take place in cylindrical vessels the "secondary ingots" produced would be difficult to distinguish from primary products.

As a result one can only talk of "primary ingots" in the strictest sense where (1) they appear in quantity, as at Uluburun, and were intended as an item of trade, (2) where they might be found in a workshop awaiting melting to be made into finished products or (3) where there is evidence for the production of glass from its raw materials.

Chapter 2

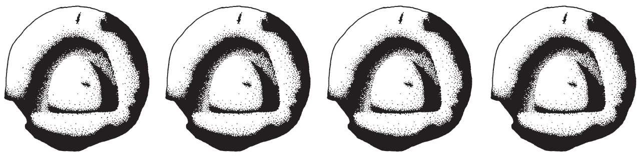
Endnotes

1. Diggers for mudbrick to use as fertiliser—known as *sebbakh*.
2. Petrie was assuming that Amarna was occupied for a period of approximately 15 years.
3. Probably UC36457, though I would consider this to be blue rather than violet.
4. Some years ago I examined some of this material at the Petrie Museum along with Professor M.S. Tite and Dr. Chris Doherty. All of us were of the view that the runs were often coming from the rim toward the base. However, work by Shortland (2000:34) demonstrated that there were no flow structures in the glass to indicate which way up they might have stood.
5. W.E.S. Turner's interest in Egyptian glass technology may have been inspired by his son, the papyrologist Sir Eric G. Turner (1911–1983).
6. See UC40568.
7. I have observed Ababda Bedouin making charcoal for sale by setting a fire on a fallen tree trunk and smothering it with sand so that combustion is slow and starved of oxygen. However, in the Nile Delta burning takes place in pits,the timber being covered with straw and earth. There is no superstructure (see Kelley 1996).
8. Though it may well be UC25042.
9. E.g. UC22889A. Kemp (pers. comm.) notes that this description resembles material from the excavations at Grid 12 at Amarna, and may be related to bead making.
10. Actually a series of letters to his mother. These are now held in the Griffith Institute Oxford and I am grateful to Jaromir Malek, Elizabeth Fleming and Alison Hobby for facilitating my work there.
11. UC36457.
12. Augustus Wollaston Franks (1826–1897) of the British Museum and Society of Antiquaries.
13. Francis Llewellyn Griffith (1862–1934) a friend and colleague of Petrie then working in the British Museum as an assistant in the British and Medieval Antiquities Department.
14. Ambrose Lansing (1891–1959).
15. MMA11.215.666-8.
16. Mistakenly referred to as Abu Ghurob in Redford (2001).
17. i.e. Egyptian blue.
18. Cairo JE64296.
19. Qantir 00/0344.
20. Which she refers to as el-Mansha.
21. MMA26.7.1162.
22. BM 1445 to 1450.
23. According to Kozloff (1992:379) Cooney believed that Tell el-Yahudiya was a production site, but probably only for the making of temple decorations. As such it is not further treated here.
24. I am grateful to Dr. Birgitta Hoffmann for bringing this to my attention, and to Dr. Stephen Snape and Ms. Pat Winker for arranging for me to examine it.
25. Liverpool E5654.
26. However, this cannot be said with confidence, since the piece has not yet been analysed.

Chapter 3

Excavations At Site O45.1

Paul T. Nicholson and Rowena Hart



Introduction

This chapter draws on the work of all those who have acted as site supervisors during the period of excavation at site O45.1, namely: Susan Cole, Rowena Hart, Cara Jones and Phillip Macdonald. The debt to all of these will be obvious.

Site O45.1 lies at the western edge of the "research strip" of the city as identified for study in 1986 (Kemp 1989:v; Bomann 1995:1–4). Shortly after the definition of this strip, it became necessary to move most of the resources of the Amarna project to work at Kom el-Nana (Kemp 1989:vi). *The Amarna Glass Project* was, however, separately funded, and its excavation area had been chosen on the basis of Petrie's map (1894:Pl. xiii, here Fig. 2.3) and modern geophysical survey (see Appendix 1), and so was not affected by this move.

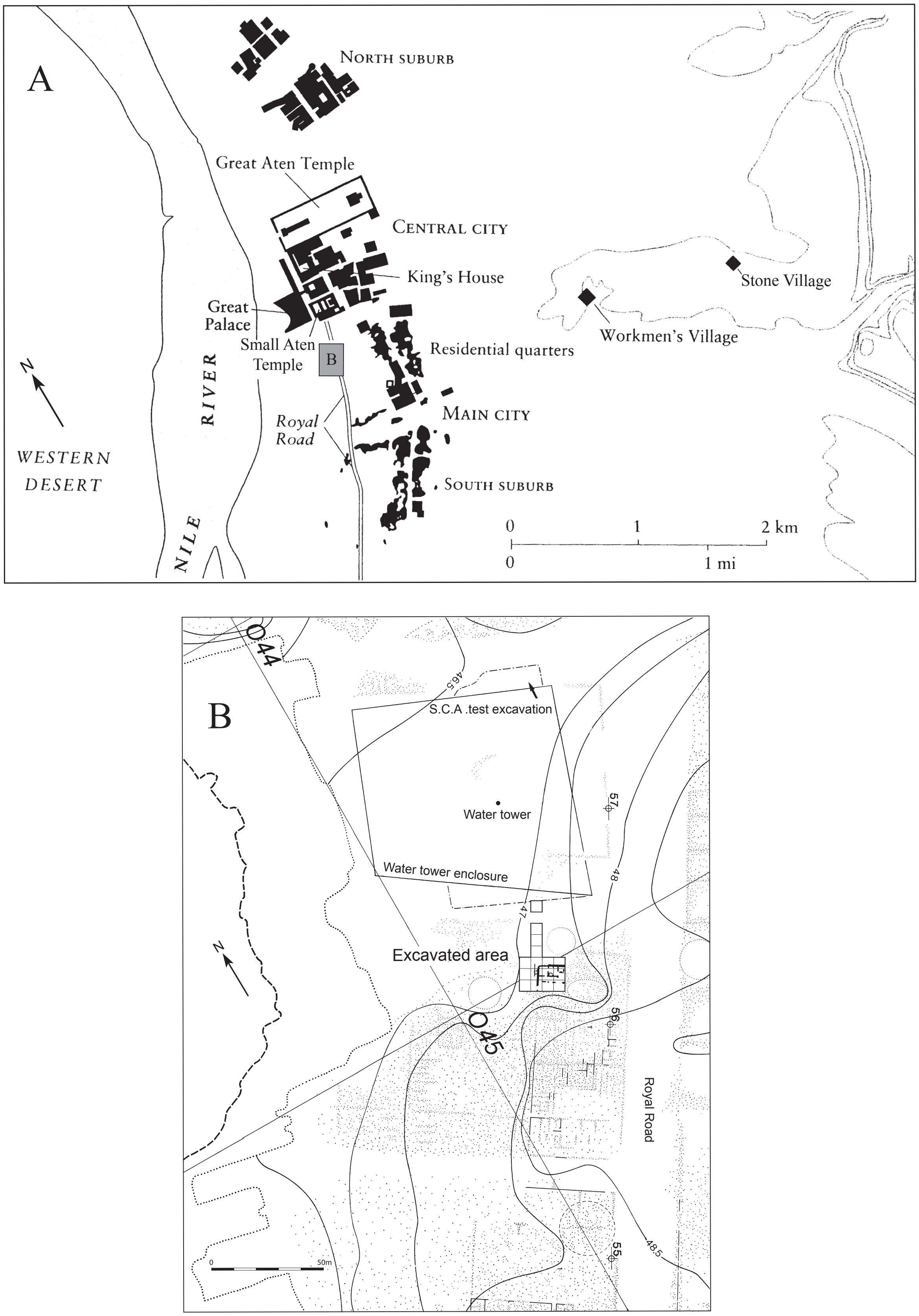
Bomann (1995:7) notes that the sites of O45.1 (see Map 3.1) and N45.1 appear to be two large rectangular enclosures, whose walls decline in height as they extend westwards toward the cultivation. Their condition probably derives from the long period of use of this area by farmers. Bomann also notes that the walls of these buildings feature on the plans of Amarna made by J.G. Wilkinson (1797–1875) and by G.G. Erbkam (1811-1876) (working for K.R. Lepsius (1810–1884) see Kemp and Garfi 1993:16–17 and Fig. 4), showing that they had already been exposed by treasure hunters in the nineteenth century.

The supposition that these areas had been subject to disturbance over some time was confirmed by a pottery survey undertaken by Dr. Pamela Rose and the writer which showed mixing of 18^{th} Dynasty pottery with modern material. The survey did not suggest any particular use for the area, though there were more finds of Canaanite amphora fragments than of Egyptian ones, and a greater proportion of open forms than normally represented (over 17%) (Rose 1989:108).

Excavation Method

The excavation at site O45.1 was begun in 1993 (Nicholson 1995a) and continued in 1994, 1998 and 2003, the intervening seasons being taken up by experimental archaeology, post excavation and, later, work at Memphis (Nicholson 2003). The squares excavated in any given season are shown in Figure 3.1. Over the four seasons of excavation 15 squares each of 5 x 5m were opened, giving a total excavated surface of $375m^2$. This area is Grid 8 in the Amarna recording system.

It was decided from the outset that work would be conducted using only a small team of workmen and site supervisors. This would allow careful and controlled excavation of what might be fairly ephemeral features. The decision seems to have been justified in that, despite the relatively shallow stratigraphy at the site, there are several phases, some of them represented by quite scanty remains.



Map 3.1. The location of the excavated area (Map 3.1B) in relation to the principle monuments of Amarna (Map 3.1A).

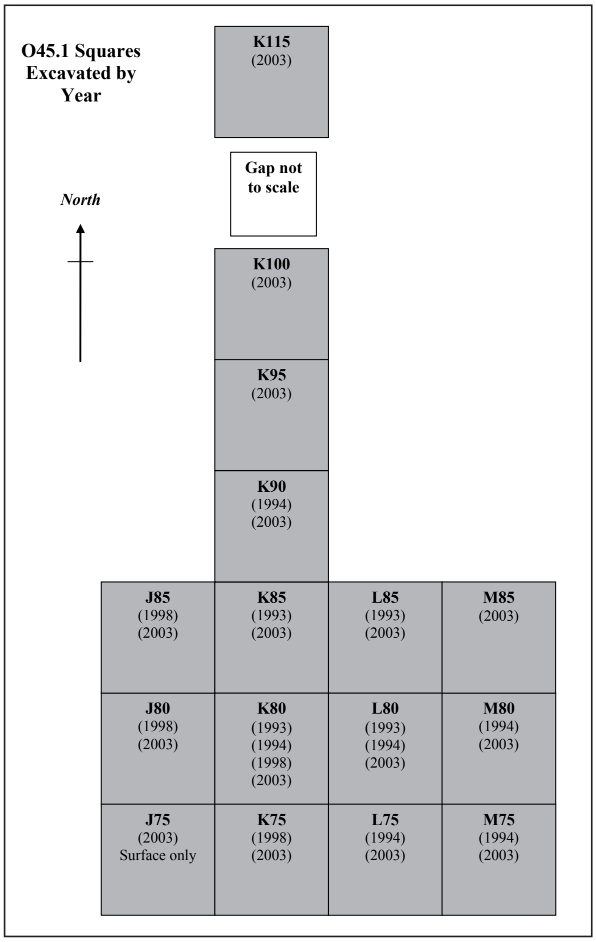


Figure 3.1. O45.1 Squares excavated by year.

Excavation was carried out using trowels and hand-shovels. Large shovels and *tourriers*[1] were used only for back-filling. All of the material removed was sieved through a 5mm mesh, and samples of deposits were sieved using geological sieves with mesh of 2mm or less in order to record their composition. This latter process also provided an opportunity to examine deposits for environmental remains. These however, were few in number—perhaps because of the turning over of much of the site by treasure hunters in the past.

Finds were generally picked out by the excavators during the excavation process, with the smaller ones being recovered at the sieve. Pottery, "slag", and brick fragments were present in some quantity and although much was picked out by the excavators the rest was retrieved during sieving. All of the pottery was given a preliminary sort at the site, and the same was done with the slag and fragments of brick. In this way nothing was discarded without having been seen and recorded.

At the end of each season the entire site was back-filled with spoil from the excavation. In this way it was possible to protect the features from erosion and potential vandalism between seasons. During the backfill process undiagnostic[2] pottery, slag and brick fragments were also re-buried. At the close of the excavation in 2003 the whole site was again back-filled.

The Natural Topography

The pre-excavation topography of O45.1 was one which gently sloped toward the west, this area having been most severely damaged by foot and hoof traffic over the preceding centuries. It would also have provided a ready source of mudbricks, and a tempting area for looting by those working in the adjacent fields. The main walls of O45.1 were clearly visible, along with a depression at the north, where a well probably existed.

The whole site was set below the level of the present road, which has been built up somewhat in recent years. The modern water tower is immediately north of the site and, as will be discussed later, probably obscures some of the ancient industrial area.

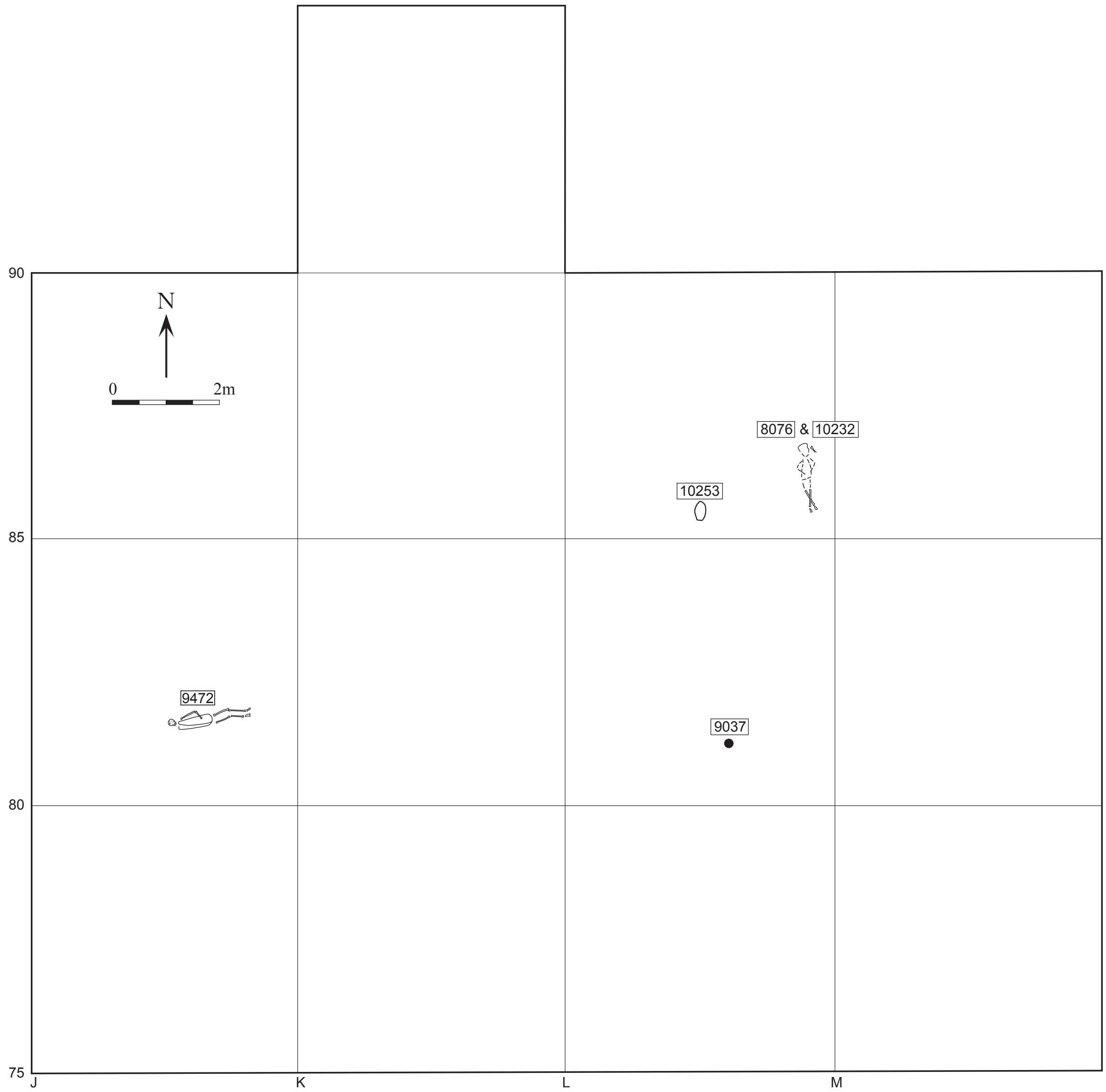


Figure 3.2. O45.1 Cemetery phase.

The ancient topography however, seems to have been somewhat different. Excavation suggests that the area under what is now the north-west corner of O45.1, and which has been excavated within the boundary wall of the building, was originally a low mound which sloped away on the south and south-east. To the north and west it may have had a somewhat steeper slope as suggested by the cutting of the later walls [7978] and [9044/8038] into it.

To the west and north of the later building the surface is generally much more level, with the exception of the area immediately around the well [10220], and has probably always been so. The modern water tower stands on part of this northern level area.

Summary of Site chronology and Phasing

Since most users of this volume will be interested in the overall history of the site, and the reconstruction of the industrial processes which took place there, it was thought best to give a summary of the archaeology of the site prior to discussing it in terms of the individual excavation squares into which the site was divided. This has the advantage of providing the reader with an overview of the excavated areas and their key features before examining individual squares.

The chronological development of the site may be summarised as follows:

1. Natural Topography.
A low mound, sloping to the north and west, and with a gentler slope on the east.

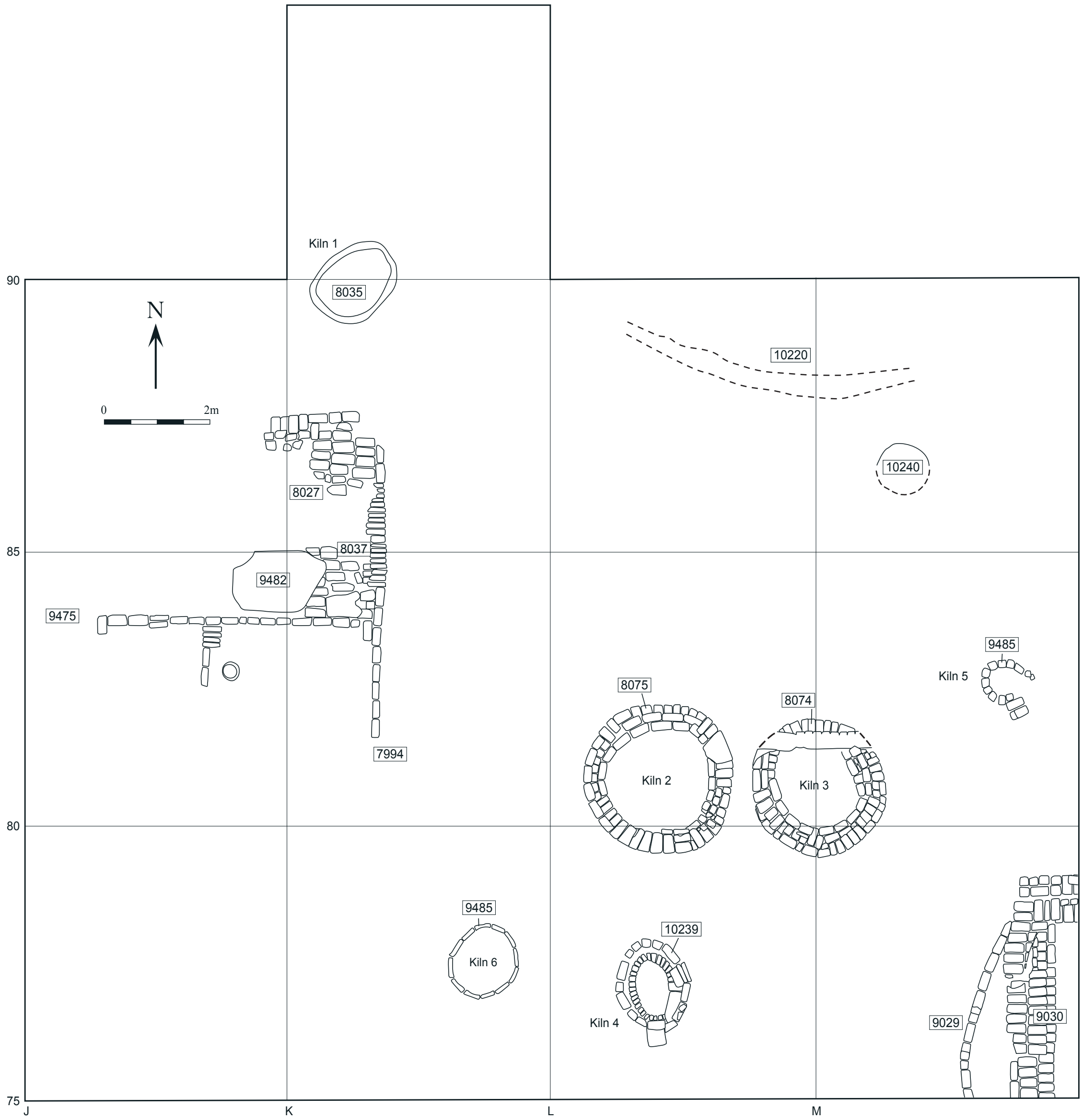


Figure 3.3. O45.1 Main industrial phase.

2. Cemetery (Figure 3.2)

The date of the graves cut into the mound and area around it is uncertain. It is possible that they predate the establishment of Amarna—though by how much cannot be ascertained without radiometric dates. Alternatively they may be the burials of some of the first workmen to be brought to Amarna for the construction of the site. This latter view is, perhaps, less likely than the former, since if this were a recent cemetery there might be a reluctance to disturb graves already placed there, and also because if the burial in L85 [8076 and 10232] is correctly interpreted its head had been pushed forward into the rib cage, suggesting that it was already defleshed when unearthed. It would also seem that these burials belong to a time which not only predates the construction of building O45.1, but also the industrial phase. This can be said because the skull found at the bottom of Kiln 2 [9037] probably comes from a burial disturbed when that structure was built. A complete grave [9472] was found in square J80. It is possible that human bones found in the Palace Dumps by Petrie (1894:16) resulted from such disturbances at the site.

3. Potters' workshop/Glass furnaces (Figure 3.3)

This phase of activity on the site would seem to be important but short lived. It can be suggested that the kilns were established primarily for the production of faience and glass for temple and palace use. It is likely that the primary purpose of the faience production was the making of inlays for use in the construction of the temples and palaces, and when these were completed, the installation, along with that for glass production was abandoned or moved elsewhere. The glass was probably being produced primarily from raw materials and being redistributed to other areas of Amarna and beyond for working. It is likely however, that some working also took place here, though the scale is hard

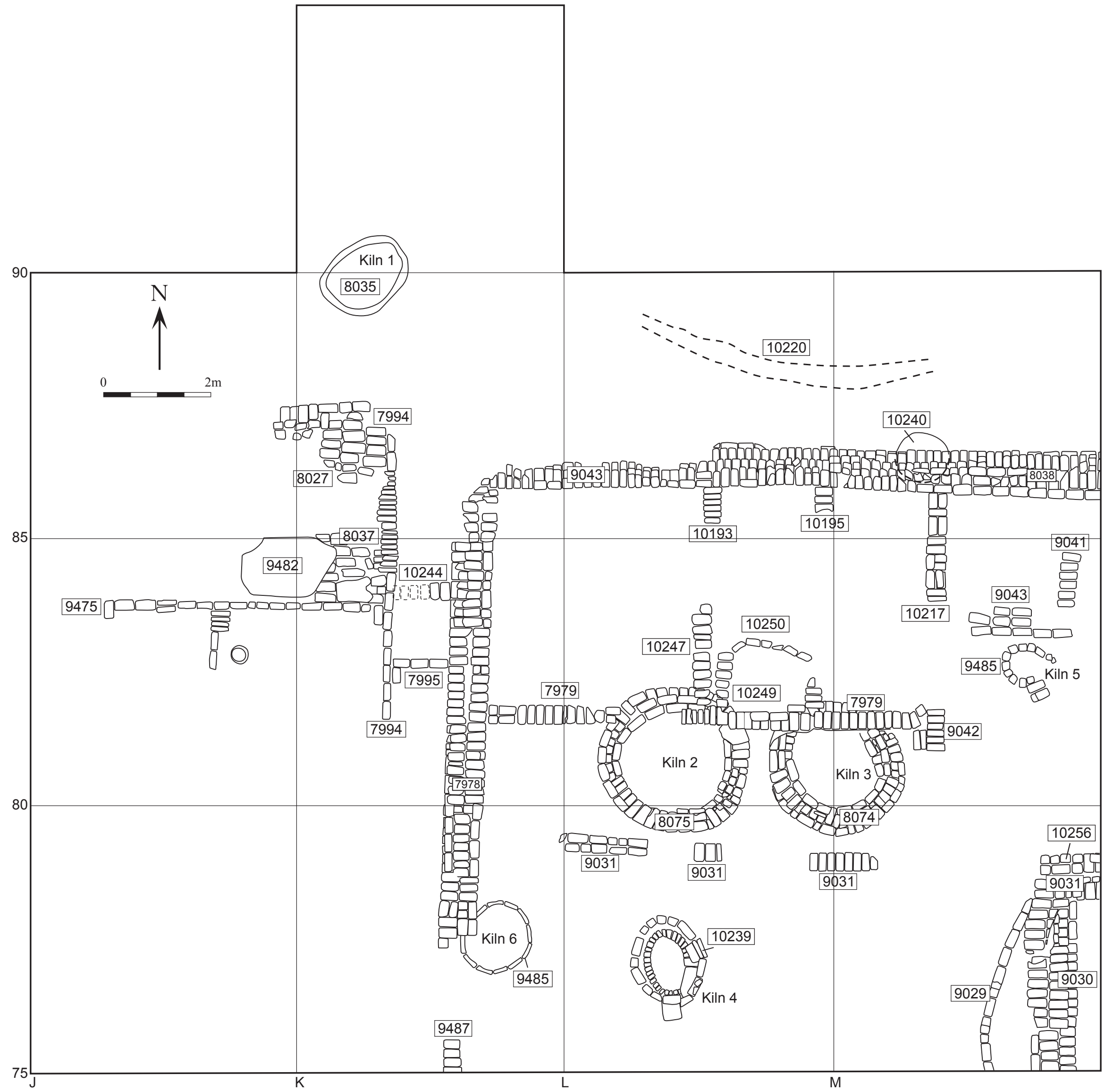


Figure 3.4. O45.1 Construction of O45.1 building and casemates. Pottery workshop may still be in operation.

to estimate. The plan (Fig. 3.3) shows the Kiln numbers as well as the unit numbers for their structure.

4. Main east-west wall [8038] as far as the "entrance" (Figure 3.4)

This wall, which forms the northern wall of building O45.1, is probably contemporary with wall [7978] and its construction heralds the end of (at least most of) the industrial features. That it is later than the workshop is apparent since it overlies part of pit [10240] which is cut from the same level as the graves and has industrial material in the fill. The kilns are cut into the same surface. Construction of this major wall cuts into the *gebel* mound, and industrial material is used as fill behind it.

5. Main north-south wall [7978] (Figure 3.4)

As noted above, construction of this wall and [8038] are probably contemporary and mark the end of the (main) workshop phase. There seems to be a gap/entrance between the north-west corner of [7978] and the start of wall [8038] proper in L85. This gap is eventually closed with the somewhat narrower wall [9044]. In the fill around this gap on the south side of the wall there was somewhat more domestic rubble than found elsewhere, including jar sealings. The brickwork in this area is badly preserved, making certainty over this "entrance" difficult. The possibility remains that [9044] may simply be a very badly robbed part of [8038], or represent the work of a different "gang".

6. "Casemates" (Figure 3.5)

Within the rectangle now formed by building O45.1, of which we have excavated parts of the north [8038] and west [7978] walls, smaller walls were now constructed on top of a fill of rubble and debris, much of it industrial. These casemate walls are [10193], [10195], [10217], [9041], [10247], [7979] and [9031].

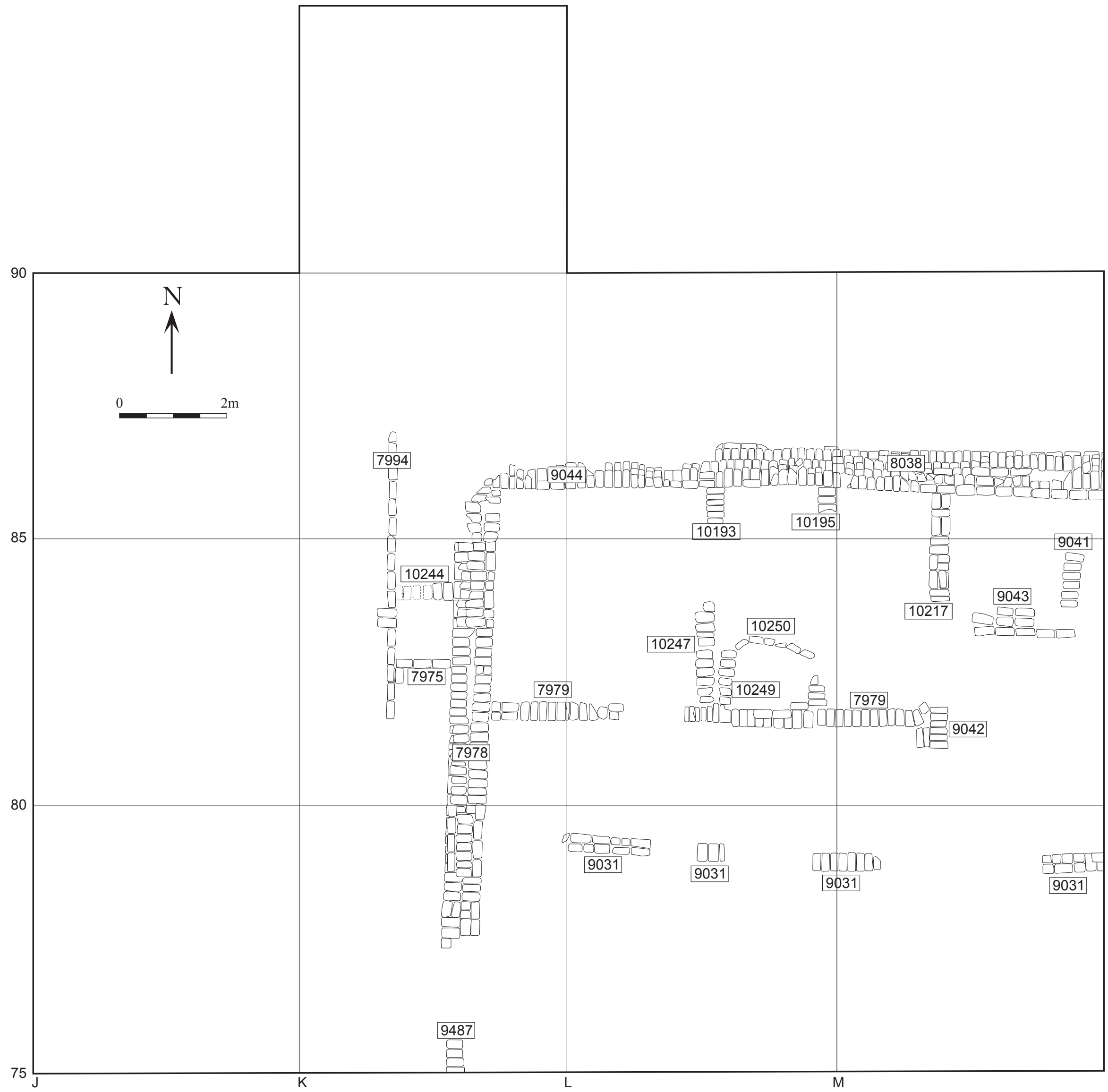


Figure 3.5. O45.1 The casemates (and robber pit [10249] and [10250]) marking the end of the industrial activity at the site.

Unit [9043] may be an area of flooring associated with such a casemate.

The distance between the north-south running casemates at the north of the site is approximately 1.75m apart where preserved. It may be that these walls are to be seen as narrow rooms, perhaps for storage, rather than true casemates, in which case wall [7979] which marks the southern border of these, might be seen along with wall [9031] as forming a corridor from which access to these rooms might be gained. Finds from within the walls were more consistent with the filling of them with rubbish to level the site than with the debris from their use as rooms (though they might still be the foundations for such).

7. Steps are added on the west of [7978] (Figure 3.4 and 3.5)

The relationship between the potters' workshop and building O45.1 is a problematic one. Extending east from wall or kerb [7994] are east-west walls [7995] and [10244]. These meet wall [7978] and they appear to have been constructed after it, as though forming steps up to the platform created by the construction. The fact that these steps exist on the edge of the potters workshop might suggest that it remained in use for a time after the rest of the industrial features were abandoned. Some support from this view may be found from the building over of Kiln 6 [9485] by wall [7978=9486] in square K75, and the possible construction of Kiln 1 [8035] in Square K85/K90. Kiln 1 would thus be the replacement for Kiln 6 and the workshop would continue in use. The fired bricks used to construct the trampling floor [8037] (Fig. 3.3

Plate 3.1. Overview of site O45.1 showing the main features. Looking East.

and 3.4) must be reused from a kiln, and it would be tempting to see Kiln 6 as being the source of these, thus making the workshop complex as a whole later than the other industrial features. However, because of the need to dismantle the dome of the glass furnaces on a regular basis there would have been no shortage of fired bricks, and so one need not automatically assume the source to have been Kiln 6. Indeed, it seems more likely that the potters workshop was in production at the same time as the other industrial features, but may have outlived them by some time.

Phasing

The phasing within the site can be reduced to three distinct phases: the cemetery phase (Fig 3.2), the industrial phase (Fig. 3.3) and finally the construction and use of building O45.1 (Fig. 3.5). This last phase may also include the continuation of the pottery workshop but this is uncertain (Fig. 3.4 and 3.5). An overall view of the site is shown in Plate 3.1.

It should be noted that the cemetery phase is almost certainly more extensive than it would appear from the phase plan. The grave cuts are not apparent in the sand, and it is possible that other graves remain to be discovered in areas where there was no trace of industrial features and which were therefore not dug down to solid *gebel.* Furthermore, the industrial features themselves were generally left in place as rare survivals of such activity. It is quite possible that further burials underlie some of them.

The Structures

This section details some of the more important structures at site O45.1 in more detail than is relevant in the general overview of stratigraphy given above.

The "Kilns"

The term ''Kiln'' was applied to any high temperature structure discovered at the site. Some of these are better described as "furnaces" or "hearths" and these are discussed below. Site O45.1 offers the greatest number of such high temperature structures within an area of this size so far excavated at Amarna. Since most of these seem to be contemporary, or at least to belong to the same chronological phase, it is fair to describe the site as that of an "industrial estate".

Kiln 1 [8035] (Figure 3.6)

This is an ovoid structure located on the boundary between K85 and K90. It was excavated in two seasons, the part in K85 was dug in 1993 and the other half in 2003 (Plate 3.2). Only the half in K85 was fully excavated.

The exterior of the structure measures approximately 1.75m on its longest axis, which runs roughly NE-SW, by 1.28m on its short axis. It is constructed from

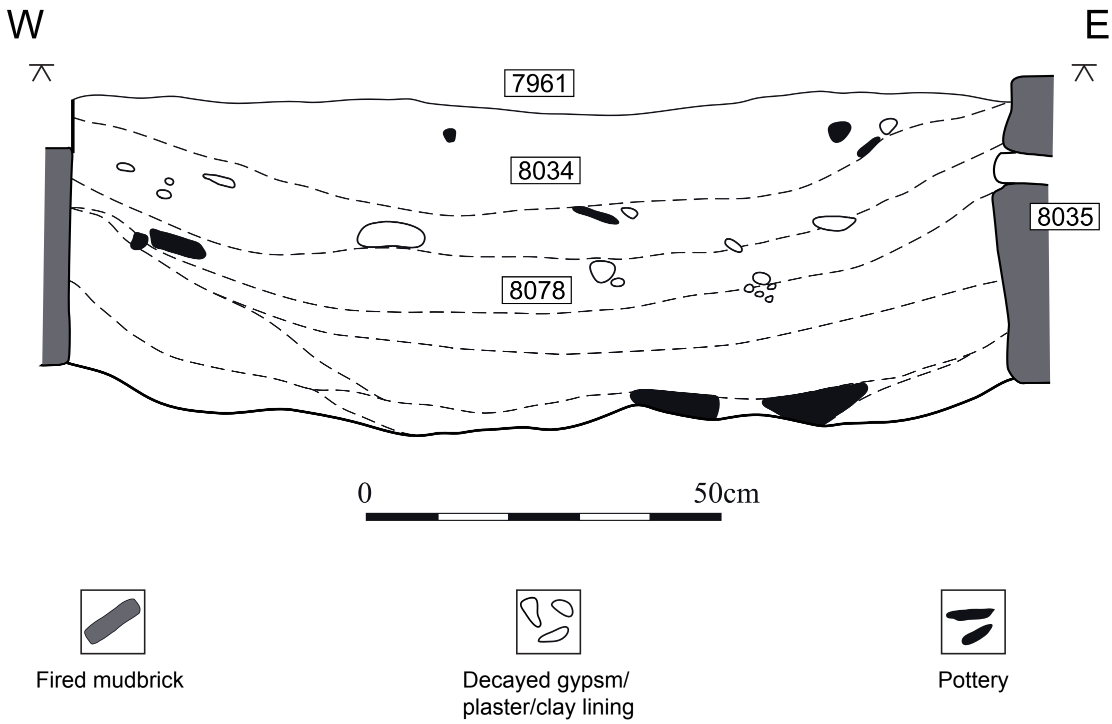


Figure 3.6. East-West section of Kiln 1.

Plate 3.2. View of Kiln 1 (top left) showing full extent of structure. The trampling floor (8037) is to the right (south).

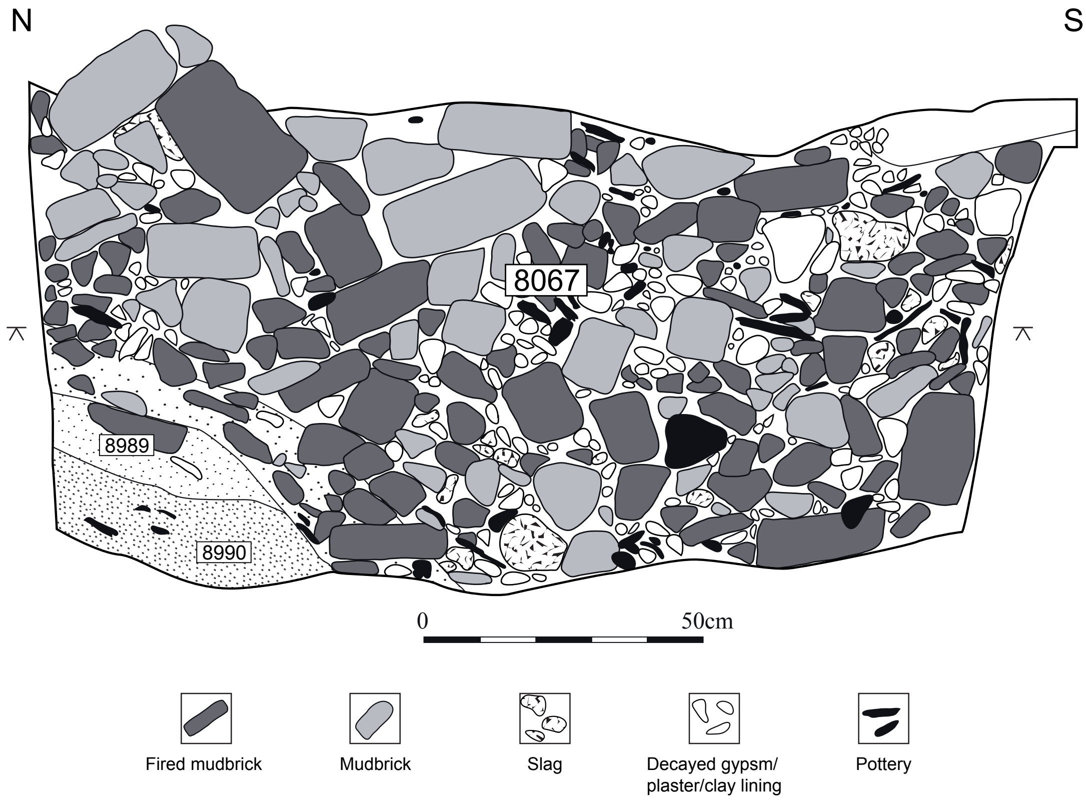


Figure 3.7. North-South section of Kiln 2

mudbricks which have become fired *in situ.* The fully excavated half of the structure revealed 13 bricks standing on end and arranged as the strakes of a barrel (Plate 3.3). Above these was a course of horizontal bricks, laid on their narrow edge. Most of these had been robbed out or had decayed, so that only one at the east side of the kiln was clear. It is likely that above this, at the level of the old ground surface, the horizontal bricks would have continued, but this time laid on their broadest surface, i.e. the most common orientation for brickwork. The result of the walls only surviving as far as the first horizontal course is that the brickwork survives only to the thickness of a single brick laid on its side, and is therefore only about 10cm thick. Above this level the walls would probably have been about 16–18cm thick.

The kiln top, as preserved, lay immediately under unit [7961], within the walls, taking up the uppermost part of the kiln was [8034] a layer comprising lenses of ashy sand, small stones and occasional fragments of brick. Below [8034] is [8078] a layer of darker ashy material. This is likely to be remains of the last actual firing of the kiln, whilst the layer above represents gradual collapse of the structure—hence the mixture of ash and sand. The fact that there are very few actual mudbricks from the fill suggests that the brickwork may, in part, have collapsed outwards and been removed, or have been robbed from the still-standing structure.

There is a precedent for such outward collapse at the House of Ramose Complex (P47.20) (see Nicholson 1995b:229, unit [4107] on Fig. 7.3).

The construction of the kiln, with horizontal courses laid over a lowermost course of vertical bricks is a pattern which has been recognised as typical of kilns for the firing of pottery at Amarna (Nicholson 1989a, Nicholson 1995b). This interpretation is further reinforced by the close proximity of the kiln to an area apparently used as a trampling floor for potter's clay [8037].

The depth of the structure as preserved is c.0.50m.

Kiln 2 [8075] (Figure 3.7 and 3.8)
This is an approximately circular structure located mostly in square L80, though part of its wall on the south extends into L75. Its exterior diameter is approximately 2.90m. Its preserved depth is c.0.90m.

The kiln was discovered in 1993 and was half-sectioned at that time before being backfilled. Full excavation took place in 1994 (Plate 3.4). The reason for the incomplete excavation in 1993 was to allow partial excavation of Kiln 3 (below) to take place so that similarities between them might be identified and consideration be given as how best to excavate them in 1994.

Plate 3.3. Kiln 1 looking south and showing the course of bricks arranged on their ends with their broadest faces making up the lowermost part of the kiln wall.

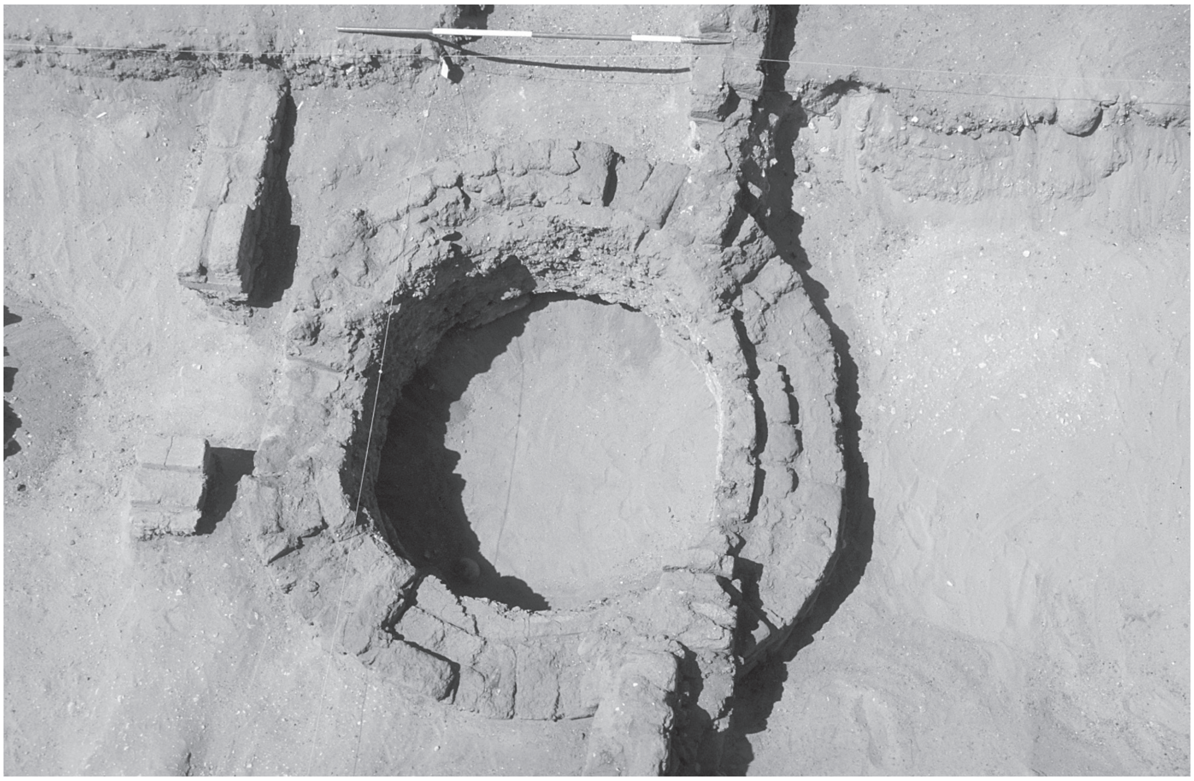


Plate 3.4. Kiln 2 looking west and viewed from above. The later casemate wall [7979] can be seen running over the northern edge of the kiln and the less well preserved casemate [9031] to the south of it.

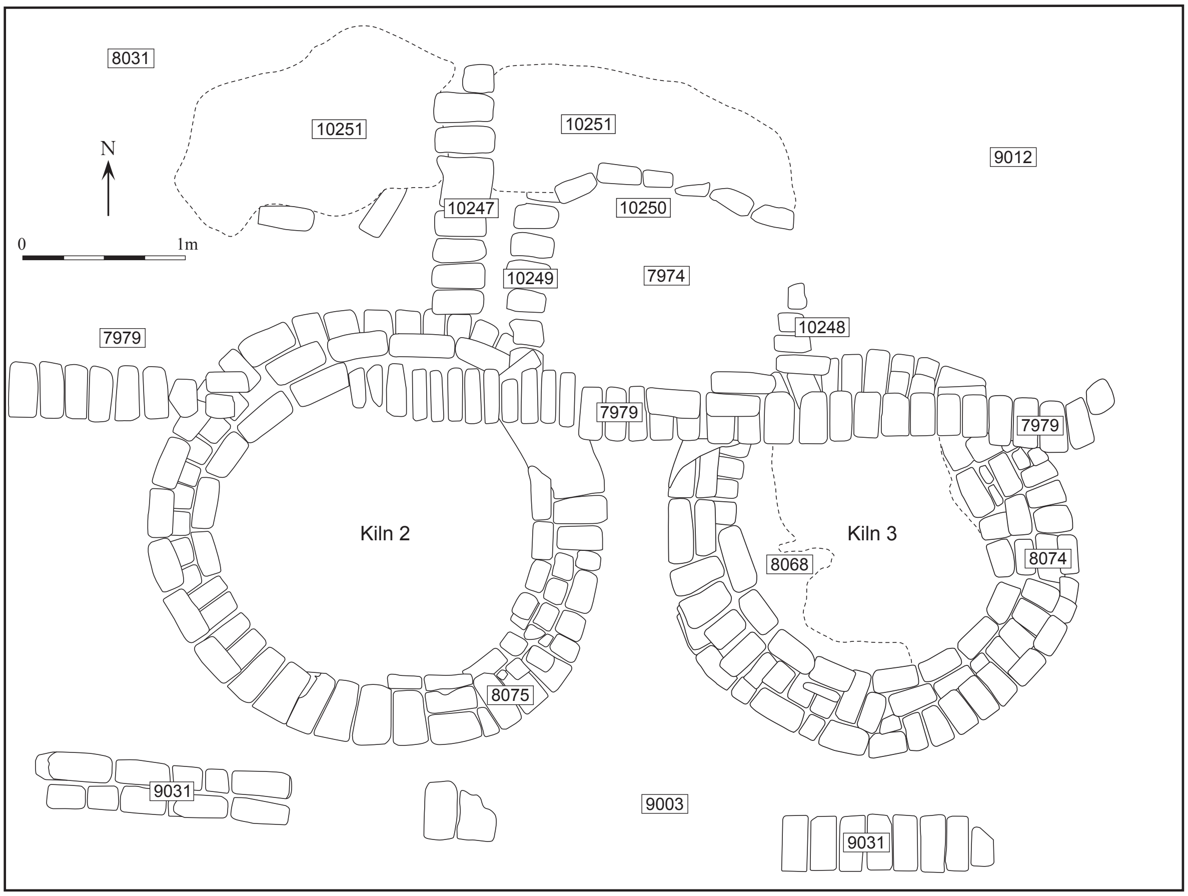


Figure 3.8. Overall plan of Kilns 2 and 3, with later casemate walls and pits.

The brickwork of this structure is quite unlike that of Kiln 1 (Plate 3.5). The walls are much thicker, at approximately 0.50m, and are built in a complex pattern (see Fig. 4.1, Chapter 4) in which there are courses of headers, courses of stretchers and mixed header and stretcher courses. The structure is clearly designed for maximum strength and for maximum resistance to thermal shock, as well as maximum retention of heat. There is no other obvious reason for such a complicated walling pattern.

The structure lay beneath surface context [7961=8976], which was mainly sand with fragments of pottery and slag material. The uppermost fill of the kiln, within its walls, may be a continuation of this and has been designated [8066=8980]. Below this was a layer of mudbrick collapse [8067] and on the north side a deposit with ash, ‘‘clinker’’ and charcoal [8989]. This overlay unit [8990], an ash and charcoal deposit.

On the eastern side of the kiln, immediately below the foot of the wall, a skull [9037] was recovered. This had part of the jawbone with it, which may suggest either that the builders of the kiln were unaware of the burial a few centimetres below their kiln, or that they disturbed the burial, re-burying the head below the floor of the furnace. No sign of any cut for a grave, or secondary burial pit, were observed in the burned sand. However, the presence of other burials at O45.1 might argue that this is yet another individual in this cemetery.

Kiln 3 [8074] (Figure 3.8 and 3.9)

Like Kiln 2, this is a roughly circular structure measuring approximately 2.50m in diameter. Its walls are constructed in exactly the same way as Kiln 2 and are of the same thickness (c.0.50m). Its preserved depth is c.0.65m.

The Kiln was discovered in 1993, but only that part of it in L80 was excavated at that time. It was then backfilled and completely excavated in 1994 (Plate 3.6). Its location is at the junction of four grid squares: L80, M80, L75 and M75.

Kiln 3 is clearly of the same general size and construction as Kiln 2, and is believed to have served the same purpose—probably the manufacture of raw glass. However, it differs from its neighbour in two important features, both of them accidents of preservation. First, it preserves a thick layer of vitrified clay over its western half. This material, which we have, for convenience, referred to as “slag”[3] is generally jet black in colour, though it can contain

Plate 3.5. Kiln 2 during partial excavation in 1993, showing the thick brickwork pattern of the wall. Looking East. Scale rod is 2.0 m.

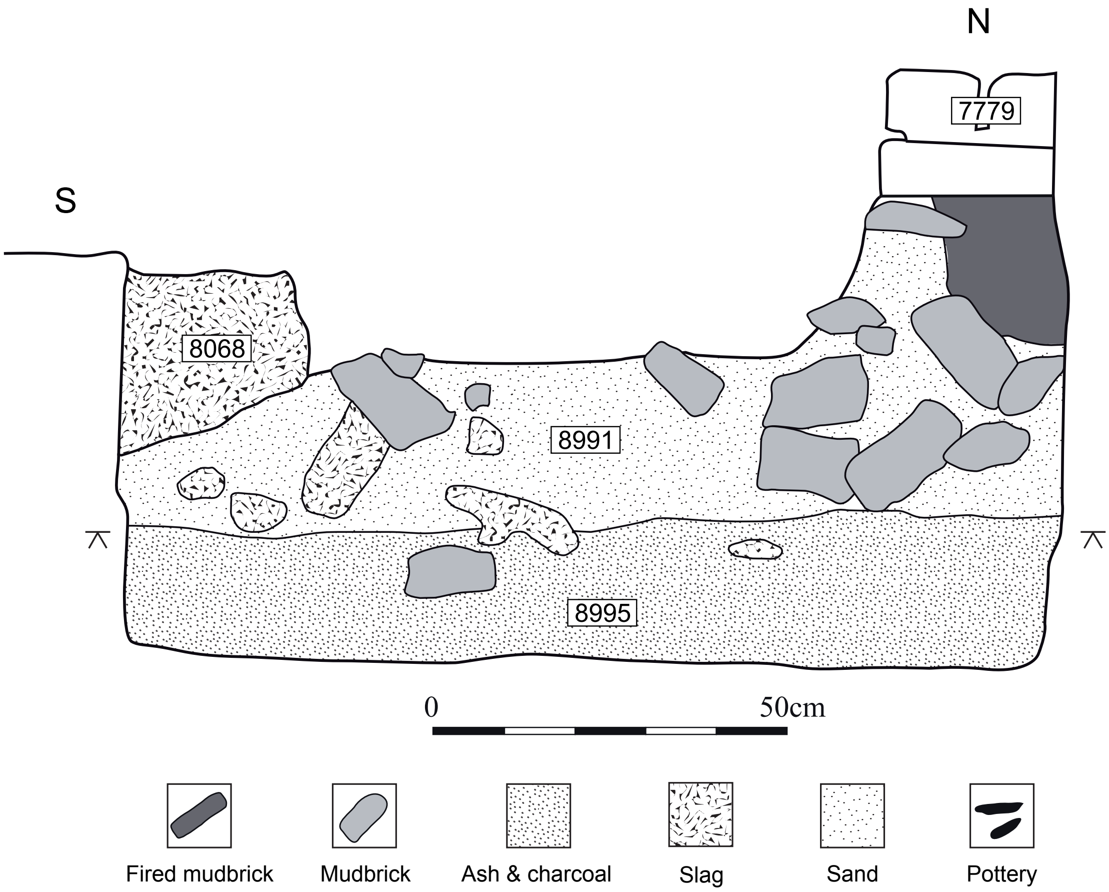


Figure 3.9. North-South section of Kiln 3.

Plate 3.6. Kiln 3 after excavation in 1994. Looking south from above and showing the extensive slag layer on the south and west sides. The 2.0m scale rests on the later casemate wall [7979].

areas of red, orange and dark olive green. The material may be completely solid, but is often vesicular, with some of the vesicles containing lime. Lime is also found on the surface of some of the slag, or adhering to its underside.

It is worth giving some consideration to this slag material. Much of that recovered from Kiln 3 remained adhering to its walls and projected from them, in places appearing to be shelf-like [8068]. Indeed the most shelf-like part had a vertical crack suggesting that it might have formed from the fusion of a projecting brick shelf. Behind it was an area where the slag extended into the thickness of the kiln wall, suggesting that here the superstructure had had an opening in it, perhaps a siege or embayment where crucibles were placed (Plates 3.7 and 3.8).

The projecting slag tended to be fairly smooth on its upper surface, though there were occasional areas where molten material had obviously fallen onto the surface from above, suggesting that it had come from a dome above the fire itself. The underside of the slag was much more irregular, with small projections where the molten material had evidently come to rest on ash and charcoal and had flowed between this material. In places large pieces of carbonised wood were found embedded in the slag. These have been identified by Dr. Gerisch (Appendix 3) as *Acacia nilotica.*

It is worth noting that the area of slag gives way on the eastern side to an area of plaster. This plaster is intended as a "sacrificial render", a plaster coat which can be broken away taking the slag with it so that the kiln can be re-lined without the need for extensive re-building (Plate 3.9). That this coat was missing on Kiln 2 suggests that that structure was in the process of being re-lined when the site went out of use. It is possible that the structures were used alternately, one being repaired whilst the other was in use and vice versa.

The second area of evidence not present in Kiln 2 concerns the presence of a dome over the kiln. On the eastern side of the kiln a part of the superstructure is preserved near to wall [7979]. This area of the structure shows a clear curvature where the wall begins to curve inwards into a dome (Plate 3.10). Further evidence for the presence of a dome is provided by a brick from surface context [7961] in square M80 (Plate 3.11). The brick has long "stalactites" of slag hanging from it, these are at an angle to the brick itself, and since they must have dripped vertically the brick itself cannot have been horizontal. This suggests that it is a loose brick from the dome of the kiln. The same is true of a similar fragment from M80 [8981] (Plate 3.12).

The kiln (Fig. 3.9) is covered by deposit [8065], beneath on the western half is the slag layer [8068]. On the north, partly overlain by wall [7979] is an area of mudbrick tumble [8993] which grades into a layer comprising dirty sand and white lime [8991]. Within

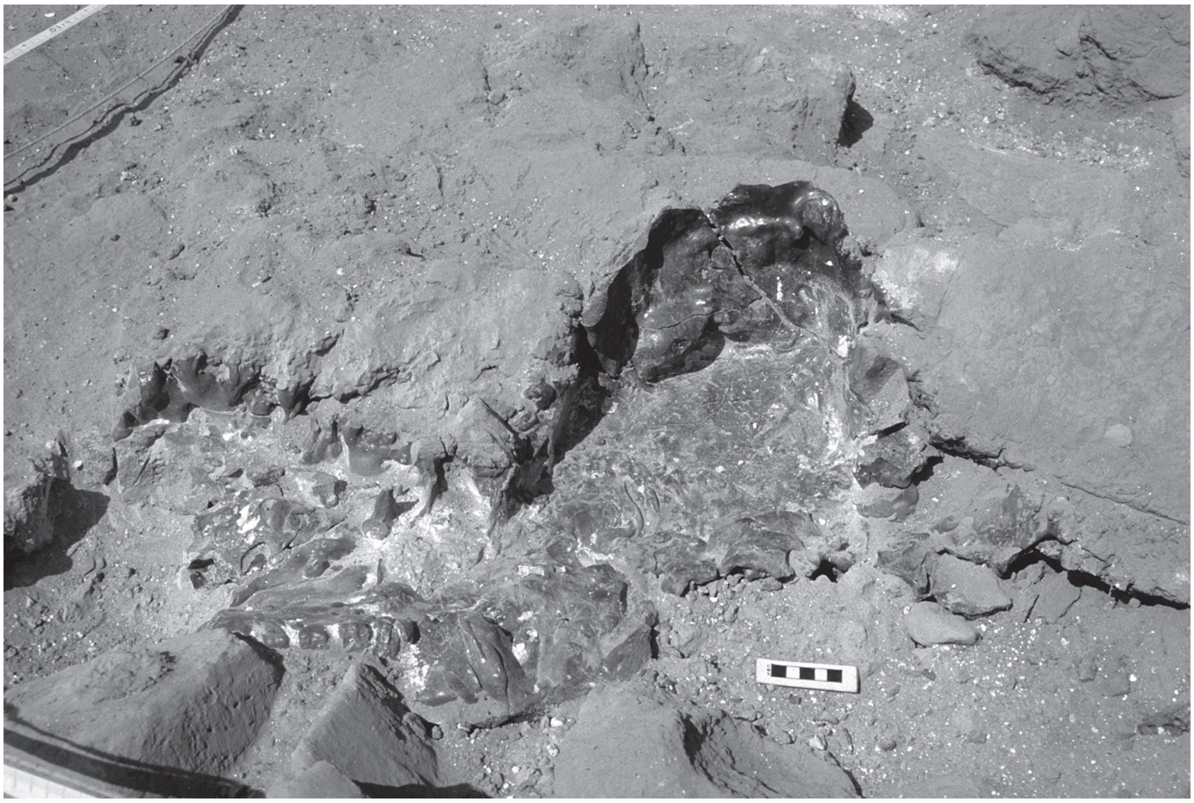


Plate 3.7. The "embayment" of slag on the west side of Kiln 3 at an early stage of excavation in 1993. The scale is 5.0cm long.

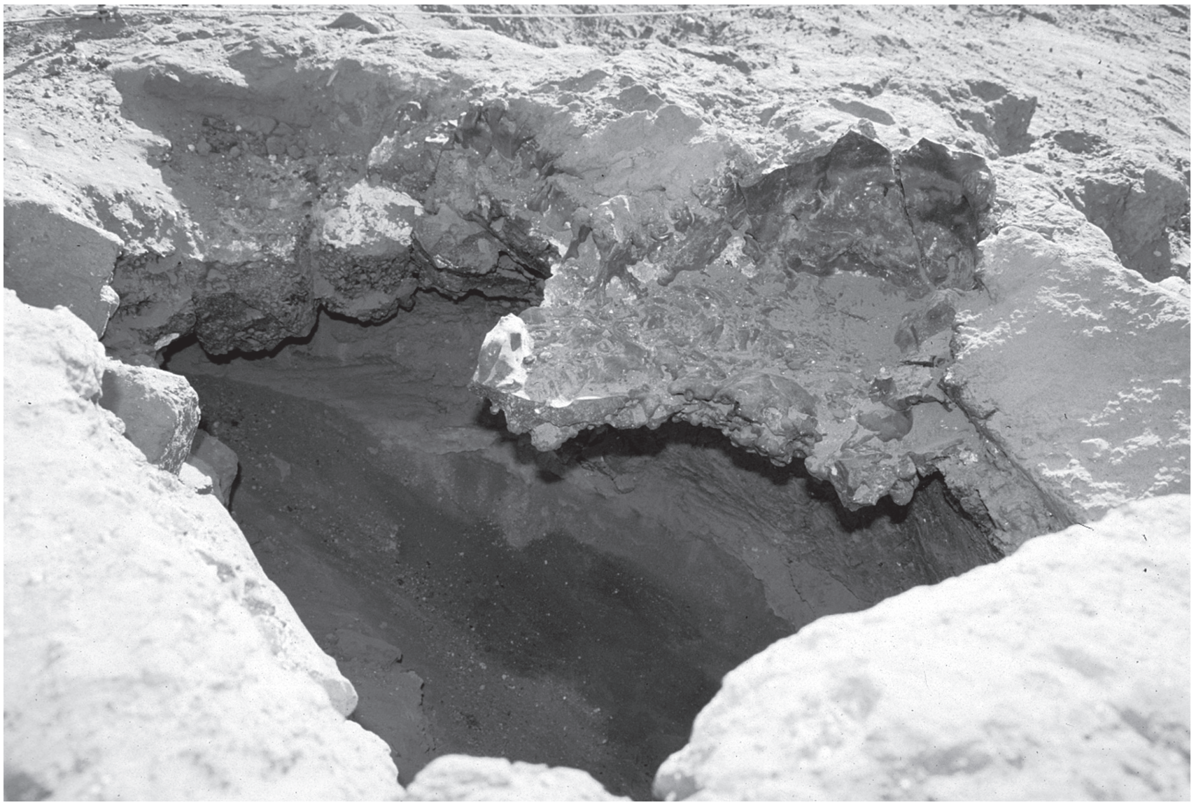


Plate 3.8. The slag layer on the west side of Kiln 3, showing the embayment, and next to it (right) a sloping brick, believed to be the lowermost course of the dome. The slag layer is thick and brick-like on the south (right) of the embayment, and suggests vitrified brick. The view was taken during excavation in 1993.

Plate 3.9. The east side of Kiln 3 during excavation in 1994, looking north. The east side remains partly filled with backfill. The west clearly shows the layer of sacrificial render, and also some of the curvature of the upper part of the structure.

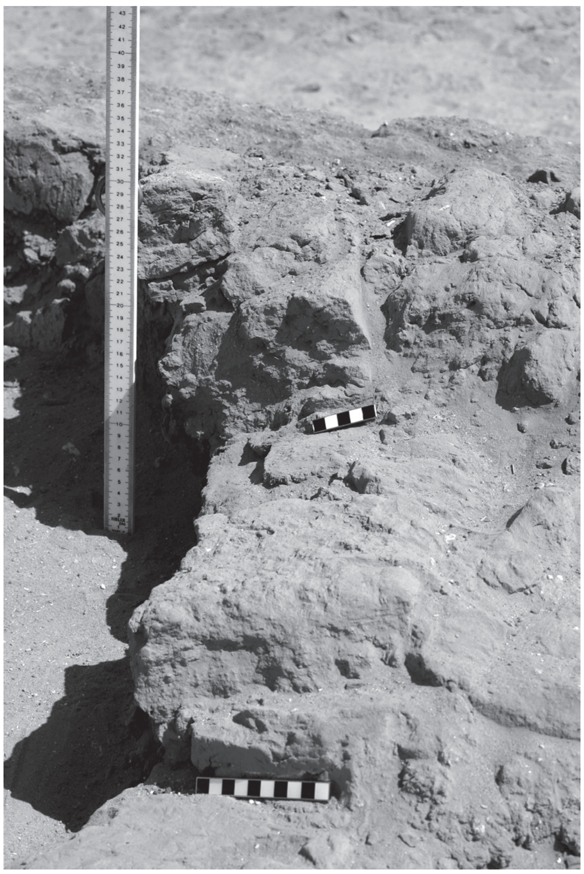


Plate 3.10. Detail of the curvature of the upper part of Kiln 3 as it becomes domed.

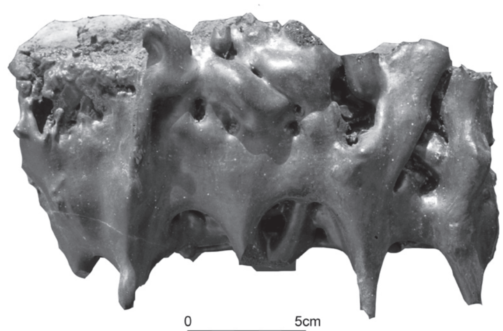


Plate 3.11. Brick with slag hanging from it at an angle showing that it had been part of the dome of the kiln. M80 [7961].

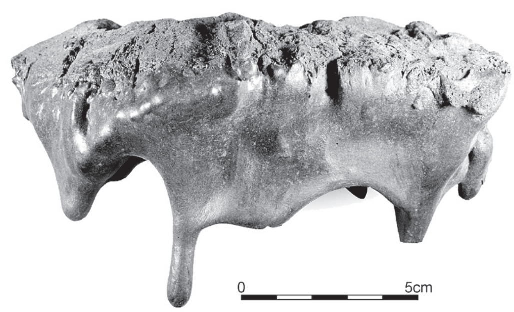


Plate 3.12. Plaster or part of a brick face with a curtain of slag hanging from it at an angle. M80 [8981].

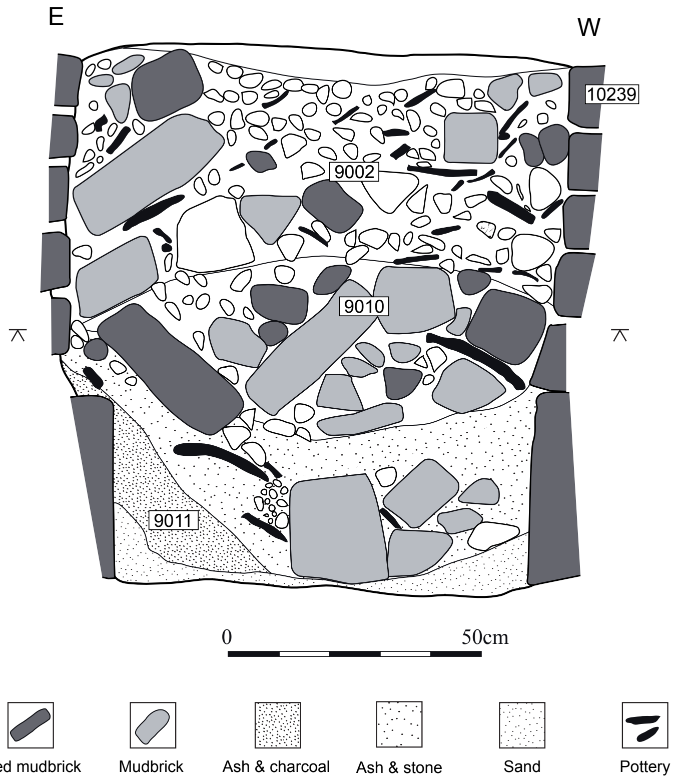


Figure 3.10. East-West section of Kiln 4.

the kiln itself, wall [7979] sits over what is probably the original stoke hole, which has been blocked with bricks to support the later wall (Plate 3.13). The lime is very clean where it occurs under [8068] and is presumably undisturbed by the slighting of the kiln superstructure. Underlying all of these is unit [8995] compact grey ash with charcoal and burned limestone.

Kiln 4 [10239] (Figure 3.10)
Located in square L75 Kiln 4 is an oval structure aligned north-south and measuring c.1.75m x c.1.40m. An area on the south side is the stoke hole and extends the length to 2.0m. The preserved depth is 1.08m. The kiln was excavated in the 1994 season (Plate 3.14).

The structure of the kiln [10239] is fairly typical of pottery kilns at Amarna, with the lowermost course of bricks standing on their ends with their broad face outwards like barrel strakes, the same arrangement as seen in Kiln 1. The south-east quadrant of the kiln has a large mudbrick "shelf" against the wall. It was considered that this was probably part of the perforated floor, and had fallen in. However, closer inspection suggests that the block had been deliberately placed there. Both sides of the kiln, at their widest point, have areas of brickwork which suggest that a perforated floor was sprung from these points. The northern edge of the kiln has some damage too, but there is no obvious point of suspension for a floor.

Beneath the topsoil is unit [8979], a stony deposit with mudbrick fragments which covers most of the square. Beneath this, within the confines of Kiln 4, is [9002] comprising fragments of fired and mudbrick, and burned clay. The underlying unit [9010] is similar in composition, but there are more fragments of pottery. This layer overlies [9011] which is comprised of ash with fragments of charcoal on the east grading into

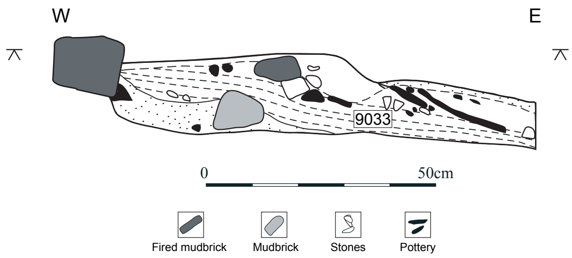


Figure 3.11. East-West section of "Kiln 5"

rubble on the west side. [9011] probably represents the remains of the last firing. This western unit is probably to be regarded as part of [9010]. The bottom of the kiln comprises burned sand, the decay of the natural *gebel* through heating.

Kiln 5 [9034] (Figure 3.11)
This structure is located in square M80. As it survives it has a horse-shoe shaped ground plan. However, it appears that it was originally almost circular, but may have had a wing or wings, turning out from it, which

Plate 3.13. The north side of Kiln 3 underlying wall [7979]. A row of bricks on edge support the later wall and are probably blocking the stoke hole of the kiln.

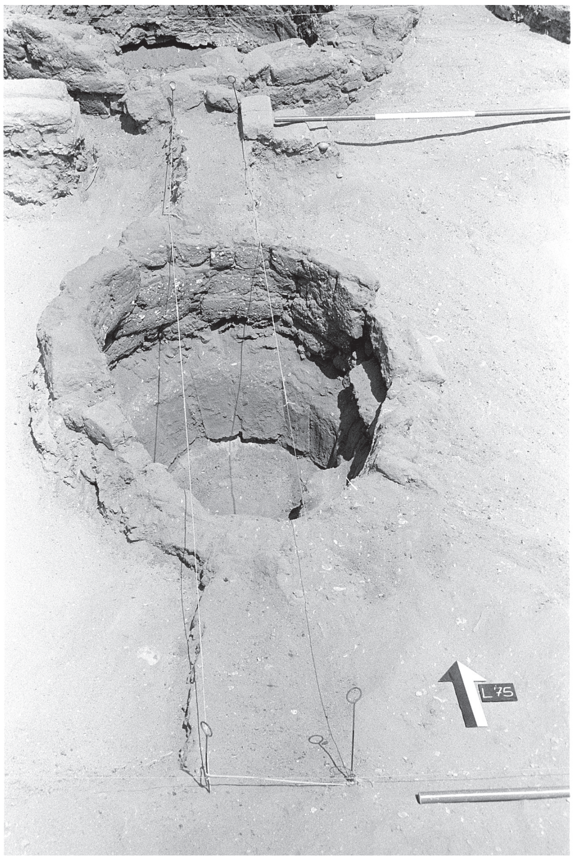


Plate 3.14. Kiln 4 looking north, with Kiln 2 visible in the background. Note that the contruction of the kiln is markedly different to that used in Kilns 2 and 3.

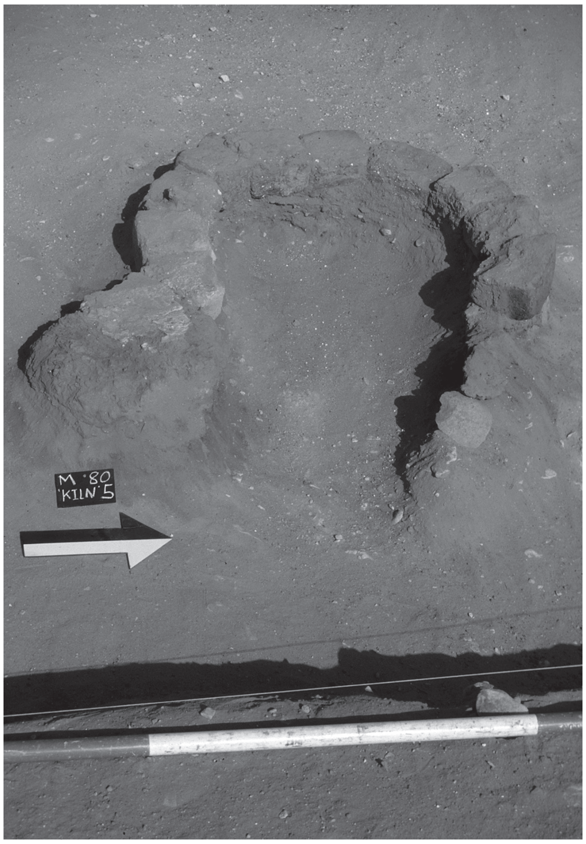


Plate 3.15."Kiln 5", which is probably a hearth, looking east.

now gives its present shape. It measures about 0.80m in diameter, extending to 1.0m if measured across the wing. The maximum depth is c.0.20m. The structure was excavated in 1994 (Plate 3.15).

This structure was thought to be the bottom part of a kiln at the time of its discovery. However, subsequent work makes it clear that it is probably to be regarded as no more than a hearth. However, since it was referred to as "Kiln 5" in the supervisor's notes that designation has been retained here.

The hearth may be for working glass or for metallurgy. It is mostly made up of half-bricks, and survives to only one course high. It is not clear whether it ever stood any higher than a single course. The bricks are very reddened, suggesting that it was subject to quite intense firing. However, it is possible that the bricks were reused, and since the sand around the hearth is reddened it may be that some of the contents were raked over the walls and so helped to redden them.

The kiln fill was removed as a single unit [9033] and comprised ash, stone and brick fragments.

Kiln 6 [9585] (Figure 3.12)
This structure is located in square K75. It is roughly circular in shape and measures c.1.40m across. The maximum preserved depth is 0.70m. It was excavated in 1998 (Plate 3.16).

The construction of the kiln is, once again, consistent with those known to be for pottery production at Amarna—a ring of 20 bricks standing on end with their broadest face into the kiln, and tilted back at a slight angle. Many of these bricks are marked with a diagonal finger groove. The gaps between them are chinked with sherds. Above these comes a ring of bricks laying on their sides, broad face in, and above them, very poorly preserved, a ring of bricks laid on their broad face. This would have been the lowermost course of conventional brickwork. The kiln is important stratigraphically because it is very clearly overlain in its north-west quadrant by wall [7978=9486]. This is consistent with the overlying of Kilns 2 and 3 by wall [7979] and suggests that the building of O45.1 put an end to the industrial phase (with the possible exception of Kiln 1 and the pottery workshop).

Wall [7978] is overlain by topsoil unit [9431], and the kiln structure [9485] lies below the wall on its north-west quadrant. Originally the wall would have extended over the whole west side of the kiln. Over the rest of the kiln the upper fill is [9481] comprising mudbricks, some of them fired, sherds and stones. This is interpreted as being material from the demolition of the kiln and used to fill it before construction of [7978]. The lower fill of the kiln is [9484], an ashy deposit, probably representing the last firing of the kiln. There is no windblown sand between this deposit and that overlying it, suggesting that the interval between the last firing and the sleighting of the kiln was not a long one. A layer of windblown sand [9507] underlies this.

Plates 3.17 and 3.18 show Kilns 2, 3, 4 and 5 in relationship to one another as discovered at the end of the 1994 season and with all dug out to their full depth. Plate 3.19 shows these in relation to Kiln 6 and other features of the site.

***The Potters' Workshop* [8037], [9482] and [9475]** (Figure 3.13)
The potters' workshop is located in squares J85, K85, J80 and K80 on the north-west side of the excavated area. It covers an area of approximately 2.50m east-west by 5.50m north-south and was excavated in 1993, 1994 and 1998, and then the whole re-cleared (along with the rest of the site) in 2003 (Plate 3.20).

The workshop is located outside the later building O45.1 and immediately south of Kiln 1, which raises the possibility that this part of the industrial complex continued after the rest had gone out of use. The most substantial part of the surviving workshop is the

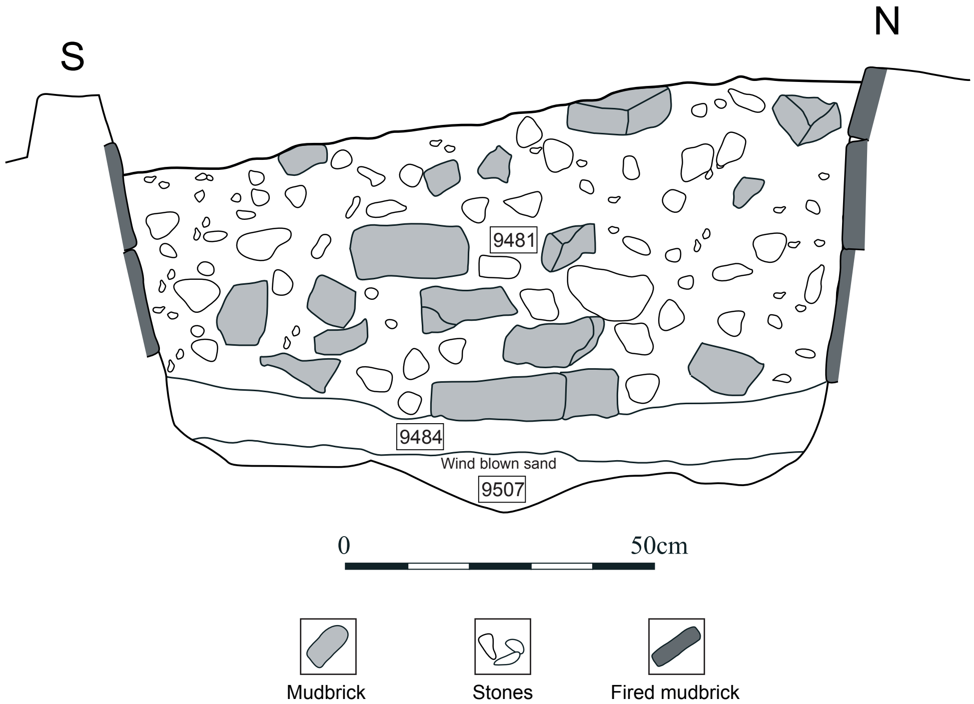


Figure 3.12. North-South section of Kiln 6.

Plate 3.16. Kiln 6 overlain by the main north-south wall [7978] in square K75, looking north. This demonstrates that the building marked the end of the industrial phase within what became its confines.

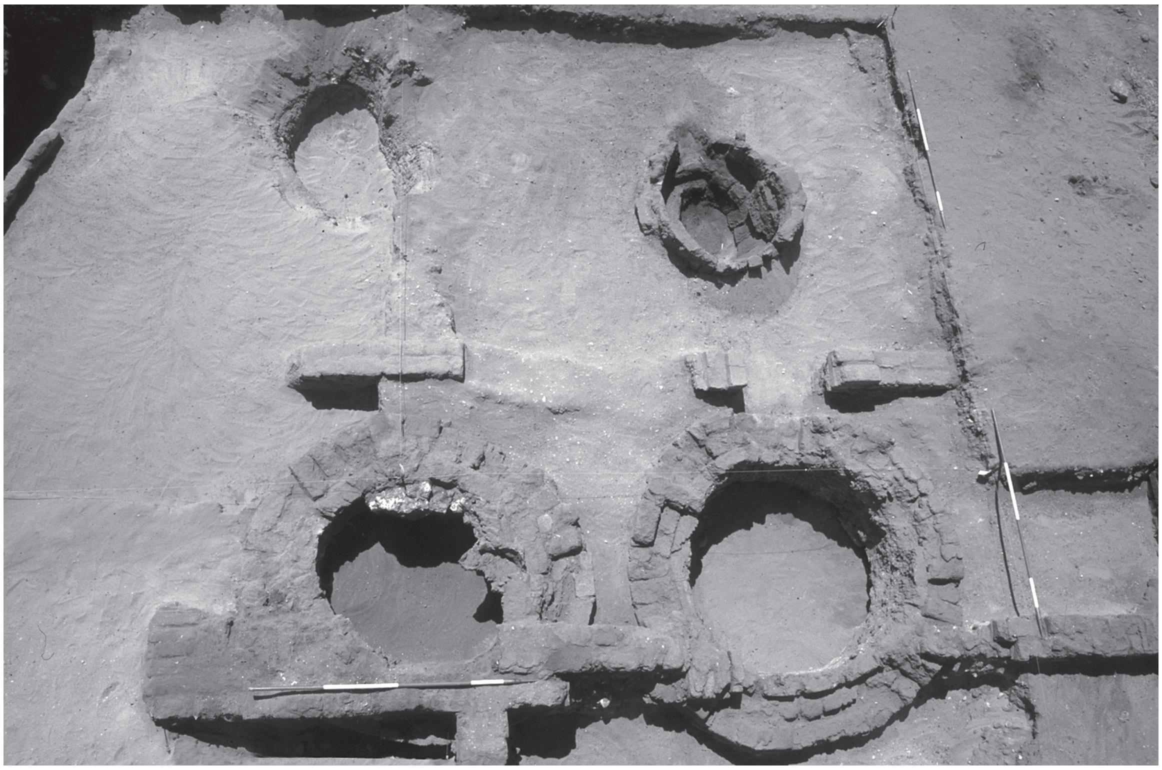


Plate 3.17.General view over O45.1 at the end of the 1994 season looking south. Kiln 3 is at bottom left, Kiln 2 at bottom right with Kiln 4 to its south (above it). A pit to the south of Kiln 3 is unconnected with the kiln activity in the area. (Photo: Caroline Jackson, E.E.S.).

Plate 3.18. General view over O45.1 at the end of the 1994 season looking east from the photographic tower. Kiln 2 is at bottom left, Kiln 3 above it, and to the left above Kiln 3 is Kiln 5. Kiln 4 is at bottom right with a pit above it. (Photo: Caroline Jackson, E.E.S.).

Plate 3.19. General view over O45.1 during the 2003 season, looking west from the photographic tower. The kilns have not been dug out to their full depth, but Kiln 6 is clearly visible at the south west (top left), at the end of wall [7978], with Kiln 4 west (below) it. Kilns 2 and 3 can be seen in the centre of the picture. Kiln 5 has been removed and Kiln 1 is out of view to the far right, although part of the trampling floor [8037] can be seen at the top of the picture.

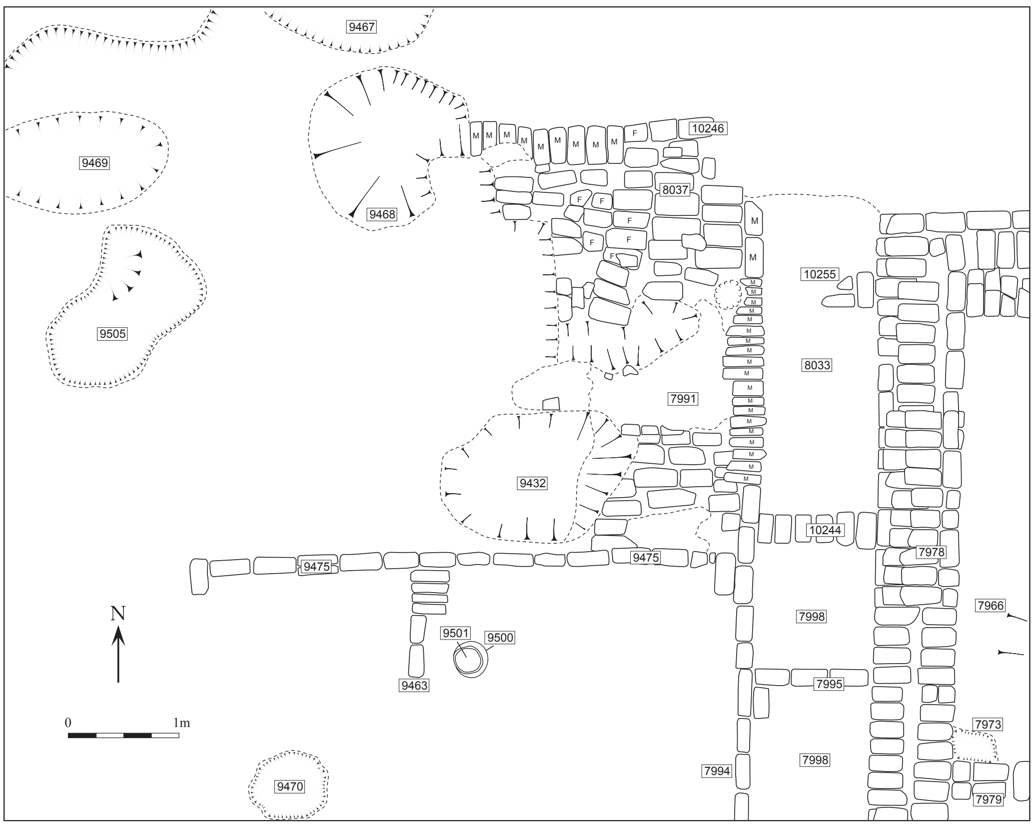


Figure 3.13. Main features of the potter's workshop.

Plate 3.20. The potter's workshop area of O45.1, as re-cleared in 2003, looking east. Kiln 1 can be seen, half-sectioned, to the left, and the trampling floor at bottom right.

Plate 3.21. The brick trampling floor [8037] as discovered in K80 in 1993. On the west (bottom) is the edge of the clay puddling pit. The wall or kerb [9475] is visible to the east (rear).

trampling floor [8037], made up of fired mudbricks (Plate 3.21). Fired mudbricks are very uncommon at this time, except where they are reused from a kiln or furnace, and it is likely that this is the origin of these bricks. However, the existence of this fired brick floor need not mean that it was constructed only when the other industrial features—Kilns 2, 3, 4 and 6—were being demolished and the area redeveloped. It could be that the bricks came from an earlier rebuild of Kiln 1. It is, however, tempting to see the construction of wall [7978] over Kiln 6 as leading to the re-modelling of the potter's workshop and the re-siting of the kiln from south of the workshop to a new location in the north. It may be that at this time the trampling floor was constructed, or enlarged.

As it survives, the trampling floor has a neatly finished eastern edge, and is bordered on the south by a wall or kerb [9475]. It is not certain whether the area was originally roofed, but there is some circumstantial evidence to suggest that it might have been. The evidence for this comprises the series of east-west walls [10255], [10244] and [7995] which run from the edge of the workshop to meet the major north-south wall [7978]. It is tentatively suggested that these walls were in fact intended to make up a series of long low steps, and if that is so the eastern wall of the building would have been higher than it now survives in order to form the western side of the step. It may not have been built to roof height, but must have been more

Plate 3.22. Clay turnings in the clay pit [9482].

substantial than its present state suggests. A second line of argument is a purely practical one. Where clay trampling floors are known in contemporary Egyptian potters workshops, such as those at Deir el-Gharbi in Upper Egypt, they are usually roofed over to prevent the clay becoming too dry (Nicholson and Patterson 1985:226–27).

When discovered, most of the trampling floor was covered in a layer of grey clay [7991] which was probably a trample of material [9480] from the clay preparation pit [9482]. That the floor was covered in a layer of such clay might be further evidence to suggest that if this area was covered then it was well ventilated, since to have been fully enclosed would have meant that the floor would have been continually slippery, whereas a layer of clay which dried when trampling was not taking place would not have caused any substantial difficulty. It may be that the workshop therefore had walls only for half its height, allowing light and breeze to enter the building but providing sufficient shade to keep clay moist whilst being trampled or stacked. That the pit in the floor is indeed a clay preparation pit is witnessed by the discovery of pieces of turned clay and unfired sherds in it (Plates 3.22, and 3.23). The practice of throwing prepared, but waste, clay back into the puddling pit for recycling is well known ethnographically (e.g. Nicholson 1995c:288).

The southern limit of the trampling floor is made up of wall or kerb [9475]. The height of this structure is not clear. It may have been simply a kerb bordering the edge of the floor, since grey clay runs onto the preserved brick in places. However, the clay does not run so far onto the bricks, or onto so many of them, as to be certain that it has not simply filled areas of damage in what might have been a taller brick structure. Some support for the view that it was never much higher than it now survives might be found from the location of a *zir* vessel [9501], sunk into the earth to the south of this wall and to the east of wall [9463] which runs south from it (Plates 3.24 and 3.25). It seems likely that the function of this *zir* was to provide a readily accessible water source for the workshop—so that clay could be dampened without the need to regularly go to and from the nearby well. Ease of access to the *zir* would be facilitated if the bricks were a kerb rather than a taller wall. No clearly defined access point, indicative of a doorway through a wall, was found.

It is certain that the pottery workshop is not fully preserved since the western extent of the trampling floor is missing, probably robbed out. It is possible however, that wall [9463] running south from [9475] was never much higher and simply served as a boundary for the *zir* area. It is tempting to see this as a simple lean-to or verandah area, shading the water jar with the somewhat more enclosed trampling floor to its north. The location of the potter's wheel is unknown, and no wheel-stones were found. However, it is common for the potter's wheel to be located near to the clay preparation pit so that misshapen pieces or excess clay

Plate 3.23. Detail of clay turnings in clay pit [9482]. Some of the larger pieces show clear striations from the turning process.

Plate 3.24. The zir vessel [9501] sunk into the workshop floor in J80. Looking east.

Plate 3.25. The zir vessel [9501] after removal of its fill [9500] before lifting.

can be thrown back into the pit for recycling, as at Deir Mawas (Nicholson 1995c).

The thin deposits overlying the potters workshop are described below in discussing the stratigraphy of the relevant squares and are not repeated here.

***The Well* [9029] [9030]** (Figure 3.31)
This feature, located in square M75, has not been fully investigated because it is located so close to the edge of the square as to make excavation impractical. As unearthed, the feature has a maximum width of 2.25m east-west and a length of 4.10m north-south. The original depth cannot be determined (Plate 3.26).

The well comprises two main elements. The earliest is probably the substantial wall [9030] running north-south and making a turn to the east. The western side of [9030=8982] is bordered by a curving wall of a single brick thickness [9029]. There is one point on this curving wall, near its junction with the southern edge of the square, where a buttress is present. The gap between [9030] and [9029] is 0.70m on the southern boundary of excavation and c.0.80m at its widest point. Wall [9030] is 0.40m away from the edge of the excavation on the east, making excavation to any depth on this eastern side impossible.

The slightly greater width between the two walls on the west side did allow somewhat more excavation, and some 14 courses of brickwork (c.1.50m) were exposed before it became impossible to excavate this area further. However, it is clear that both walls continue to at least this point, and probably considerably further. Where wall [9030] makes its turn to the east there is a slight gap of c.0.10m at its centre. It may be that the northernmost part of this wall is actually part of [9031], one of the casemate walls, but this is not certain.

The deposits removed during excavation of these features were the topsoil unit [8976] under which lay [8981] stony deposit with sherds of pottery and some charcoal. When discovered the supervisor believed this to be a pit fill and assigned a cut number to the edge of the feature [8983], but it is likely that this deposit is in fact make-up thrown into the depression around the well area when O45.1 was constructed. Below [8981] the wall [9030=8982] was revealed and to its east the unit of sand with some rubble was given [9015] whilst to the west, between [9030] and the curving [9029] was [9016] a sandy fill deposit. As previously indicated, these deposits to either side of [9030] could not be excavated fully for reasons of safety and lack of space.

***The Well* [10220]** (Figures 3.24 and 3.25)
This feature, located in squares L85 and M85 was discovered during the final season of excavation in 2003 (see Plate 3.19). It comprises a curving wall, in poor condition in its eastern section, and was not excavated to any depth. It is not, therefore, certain that the feature is actually a well, but a depression in

Plate 3.26. The well in square M75, looking north.

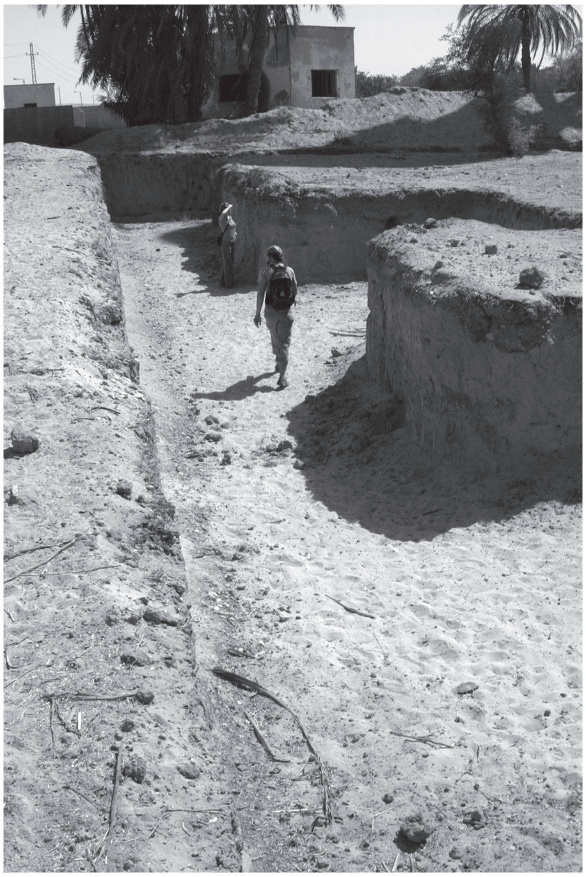


Plate 3.27. The deeply excavated trenches of the "Slaughterhouse Site" looking south. The archaeological layers account for no more than 0.50m at the top of the sections. The building of the Water Tower enclosure are visible at the top of the picture.

the ground in this area strongly supports the view that it is.

The feature was overlain by [10202] a layer of brownish sand, underlying topsoil/backfill from previous excavation in L85.

***Building O45.1* [7978], [8038/9044]** (Figure 3.4)
This is the most obvious feature on the site and is that from which the excavation takes its name. It is however, later than most, if not all, of the industrial features as has already been discussed (Plate 3.19).

As excavated, there is a substantial north-south wall [7978] which is 0.7–0.8m in width, and which is still preserved to a height of 5 courses over much of its length. The wall runs through squares K75, K80 and K85, in the last of which it makes a turn to the east. At this point the wall, as preserved, is thinner and has been numbered [9044], it continues into L85 and there becomes thicker and runs into M85. This thicker portion has been numbered [8038]. What is less clear is whether [9044] is simply a robbed out section of [8038] and is therefore uniform with [7978] or whether it was the last section of wall to be built, linking the two thicker walls. What is clear is that both [7978] and [9044] have lime underlying them, whereas [8038] does not. This may simply reflect the absence of lime on the eastern side of the site, or it may reflect a chronological difference.

The opinion of the excavators is that [9044] was put into place to close the gap between the two (now) thicker walls when the area was being infilled and the casemate walls constructed within it. It is also possible, however, that [9044] and [7978] are a piece with [8038] built up to them. In either scenario it is possible that the area of [9044] is thinner simply because of robbery from the sloping northern side. That the corner of [7978] itself is robbed out in K85 may support this view. Whatever the case the different parts of the wall are well joined, making certainty over the order of construction (if this is not a single operation) uncertain.

The "slaughterhouse site" (Plate 3.27)
Early in 2004 a local entrepreneur from El-Till sought to build a slaughterhouse immediately to the north of the present water tower site. The local inspectorate of the Supreme Council for Antiquities made it clear that this was Antiquities land and the project was abandoned before the foundations could be completed.

However, the site was left with a trench some 2.5–3.0m in depth extending north-south beside the Royal Road, and extending west toward the cultivation. Because its southernmost extent was almost at the fence line with the water tower enclosure, underneath which it is suspected that one of Petrie's sites might lie, the slaughterhouse site was examined with the permission of the S.C.A. Minya inspectorate.[4]

Examination of the spoil heaps from the excavation of the foundation trenches quickly revealed a number of faience moulds and occasional fragments of other industrial material. The sections cut by the foundation trenches were also examined. These showed very few discernible features, one or two shallow trenches running north-south were revealed, and though these appear to be ancient they were not excavated, since we did not have permission for such work. What is clear is that such features as were visible were shallow, as noted in O45.1 where only the kilns themselves were of any significant depth. It would appear that this area is indeed part of the industrial complex, perhaps mostly devoted to faience production. This would suggest that the industrial area stretches from at least row 75 of the excavation to beyond the water tower, albeit with areas including no obvious features—as in K95 and K115.

Kemp (pers. comm.) has pointed out that there seems to be little if any stratigraphy remaining within the water-tower enclosure, and it may be that this has been lost during building.[5] Unfortunately it is not possible to follow the features visible in the slaughterhouse trenches into the enclosure itself.

Site Stratigraphies

This section discusses the evidence on which the chronology of the site has been based. Where alternative interpretations are possible, because evidence is lacking for one view over another, this is made clear.

The evidence is discussed according to excavation square, and the links between squares made clear. Obviously, units of archaeological stratigraphy are not confined to individual squares, but cross numerous boundaries, so linking the squares of the grid. However, because the need to control the excavation recording has been by square, an attempt to describe the site purely by context becomes confusing. Therefore rather than treat the squares in purely numerical order they are described in groups where a significant feature crosses several boundaries. In some cases the archaeology of two squares is discussed together rather than repeat the same information for each. In later sections particular areas or features will be discussed in connection with the activities carried out in them. Particular features of the site have been discussed above.

There are often several plans for any particular excavation square, according to its complexity. Only significant phases are discussed here and shown on the published plans. The excavation archive, with all features shown will be lodged with the Egypt Exploration Society.

The symbol ≈ is used to indicate where two units of stratigraphy, believed to be the same unit, cannot be *proven* to be identical because they are physically separated by another unit, for example a wall.

Square J80 (Figures 3.14, 3.15, 3.16, 3.17)
Into the natural windblown desert surface [9448=9463] was made cut [9473] in which a body [9472] was laid with its head to the west and feet to the east (Plate 3.28). The grave was infilled with [9470] and overlain by deposits [9440] and [9431] (Fig. 3.14).

Also into the natural [9448=9463] was dug pit [9492] which was filled with [9471] which was unexcavated, over which lies the same modern contexts [9440] and [9431]. Another sand deposit [9446], overlays part of the lower wind blown sand [9448=9463]. The final two contexts above [9448=9463] are mudbrick collapse [9447] and a yellow/brown coarse sand deposit [9461=9462] (Fig. 3.15).

Into deposit [9461=9462] were made two cuts. One [9458] containing a coarse charcoal and pottery rich industrial fill [9457] and the other [9460] a pebbly fill [9459] with jar stoppers, faience moulds and glass. On top of this was laid a brick wall [9475]. This wall is partly overlain by an area of brickwork, possibly part of a floor surface [9474].

Overlying fill [9457], mud collapse [9447] and floor [9474] (Fig. 3.16) was a deposit of decayed mudbricks which underlay a sand deposit [9445] which in turn was overlain by modern deposits [9440] and [9431], in that order.

A thin gypsum layer [9455] was sealed by a mud trample surface [9456]. These features occurred in patches, and the site supervisor assigned the same unit numbers to the similar patches. Unit [9463] underlay this and into it was placed a zir [9501] and its fill [9500] (Fig. 3.17). This zir belongs with the pottery workshop described below in squares K90, K85, K80 and J85.

Square K85, K90 and J85 (Figures 3.18, 3.19 and 3.20)
In the south-east quadrant of square K85 a large pit ([9038]=[10243] ≈ [9044]) was cut into the natural *gebel*. It is clear from the section which underlies the wall [7978] at its junction with [9044][6] that this pit actually comprises several fills or lenses which were not recognised during excavation (Fig. 3.18). A lowermost fill [8036] which contains sherds with adhering glaze, as well as pigmented sherds and faience moulds, was overlain by an uppermost deposit [7962] which comprised fragments of mudbrick, large amounts of pottery and lenses of lime as well as slag fragments. These lenses may help to account for the complicated stratigraphy below wall [9044=8038]. What is very clear is that a concentrated layer of lime immediately underlays this wall and was probably mistaken for a lens from where it protruded from beyond the wall.

On the west side of the square was a trampling floor [8037] (Plate 3.21). This was bordered on its northern edge by an east-west line of unfired marl bricks [10246]. This extends into square J85 (Fig. 3.20).

Toward the north-western corner of the square where it joins K90, Kiln 1 [8035] overlaps the gridline and was excavated in two separate seasons. The southern half of the structure was excavated in 1993 and the northern half in 2003.[7] The kiln, which falls partly into K90, where it is the only significant feature, is typical of the type found elsewhere at Amarna and known to be pottery kilns (see Kirby and Tooley 1989, Nicholson 1989a) (Plate 3.21).

In the north (i.e. K90), the deposit immediately around the kiln is a thin sandy layer [10185] and the kiln cut extends through [10205], which is a thin crust over the actual *gebel* [10208=7976] (Fig. 3.19). In K85 only the natural *gebel* [10208=7976] was noted, there seems to have been no equivalent of the sandy layer [10185]. From this unit surrounding the kiln [10185] come a number of faience moulds.

To the north of the kiln in the north west-corner of the square is a thin layer of limestone/alabaster chippings [10186] which is overlying [10205]. Immediately east of this, a pit [10209] has been cut through these chippings and into [10205]. These features are buried by the sandy layer [10185], itself covered by the top soil [10184].

Square K80 (Figure 3.21)
This is immediately to the south of K85 and continues the features there. Onto the natural *gebel* [7977] a trampling floor [8037] of brick was constructed and, perhaps soon after it, a north-south wall [7994] was built. On the western side of this wall there was an east-west wall or kerb [9475] running off it and extending into J80. This feature may be contemporary with the wall itself.

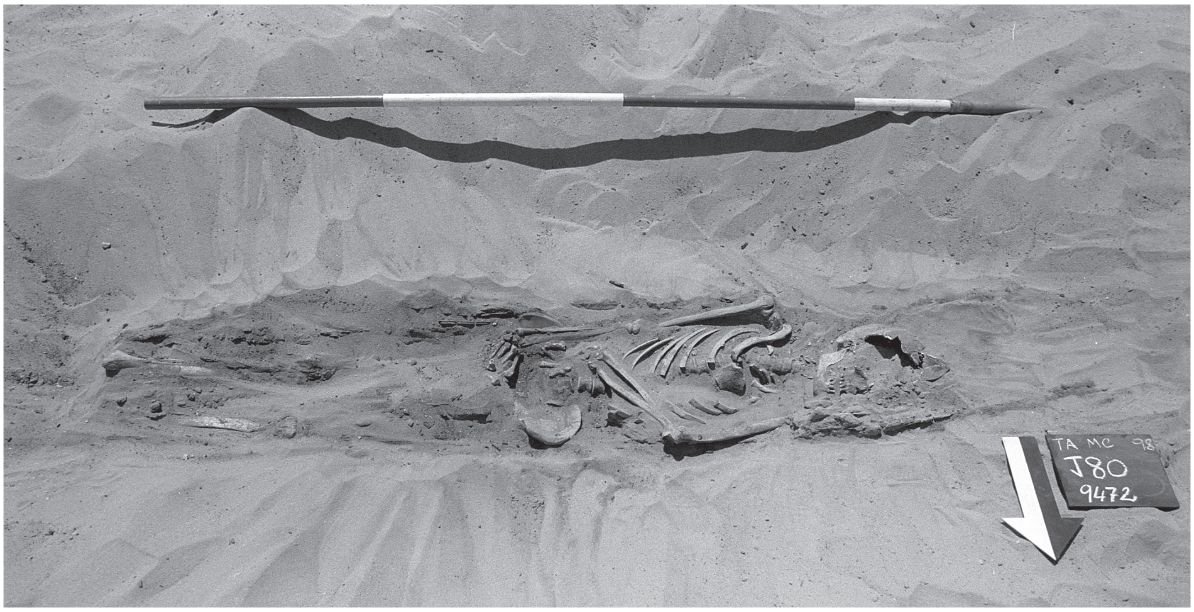


Plate 3.28. The burial [9472] in J80. Looking south.

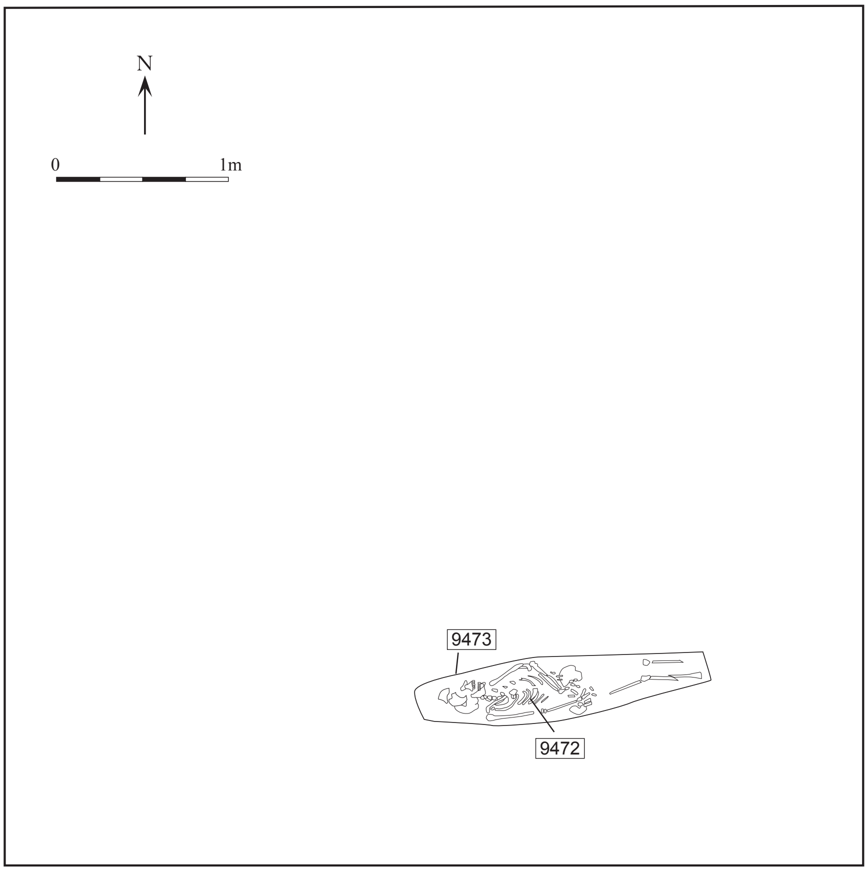


Figure 3.14. J80 Cemetery phase.

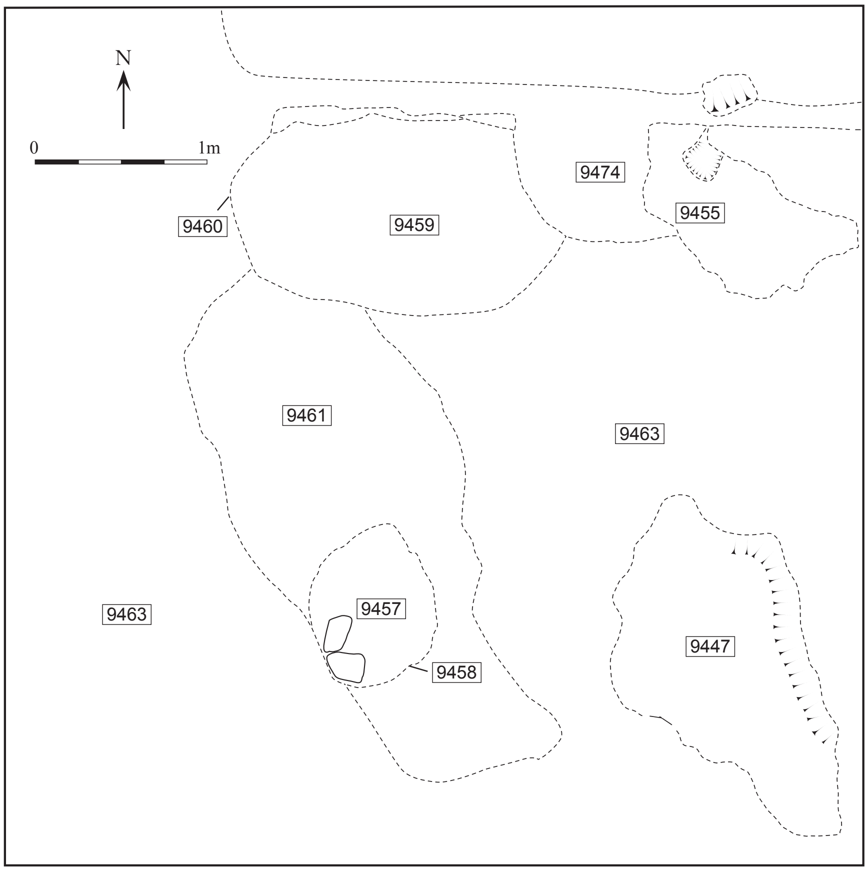


Figure 3.15. J80 Pits and fills.

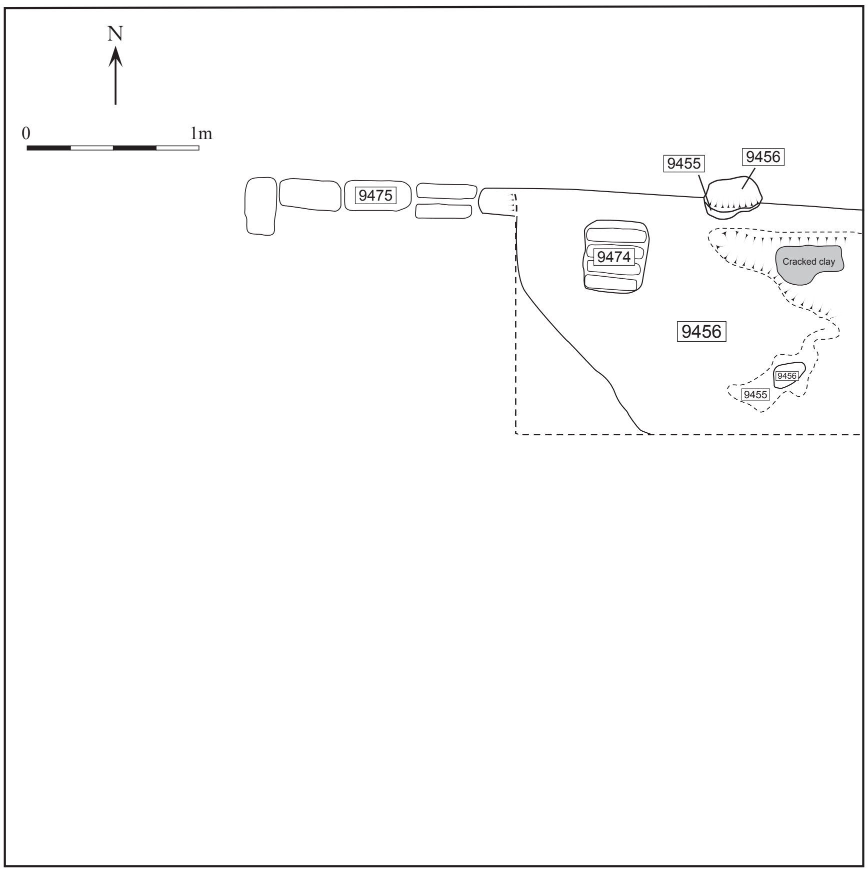


Figure 3.16. J80 Deposits overlying wall [9475] and zir.

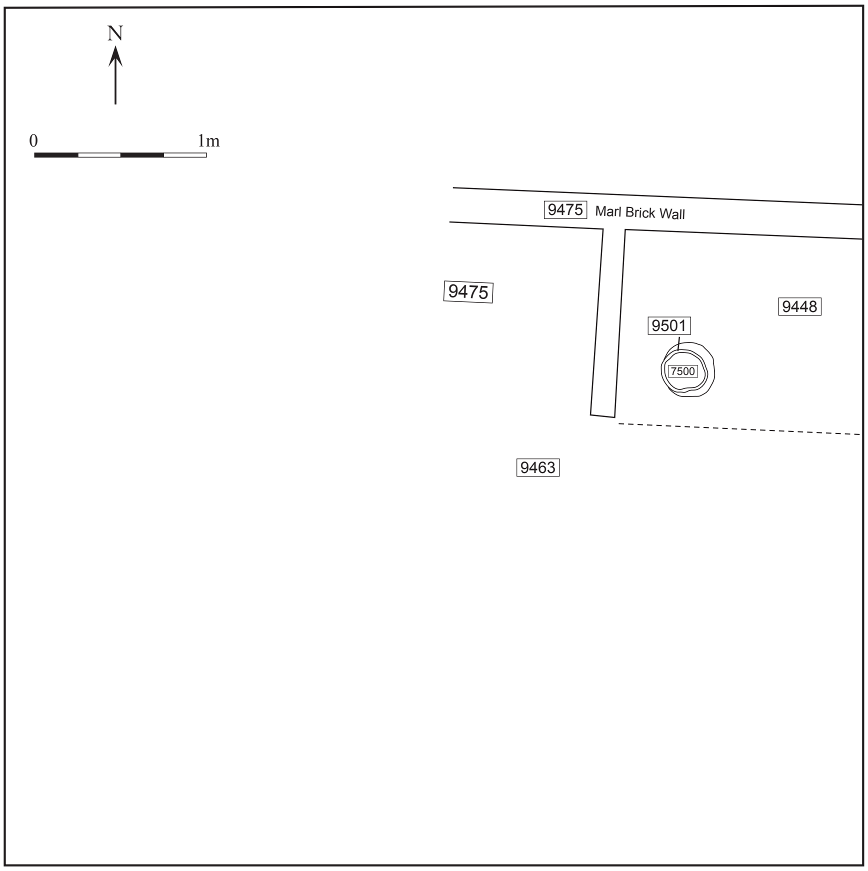


Figure 3.17. J80 Zir emplacement in relation to wall [9475].

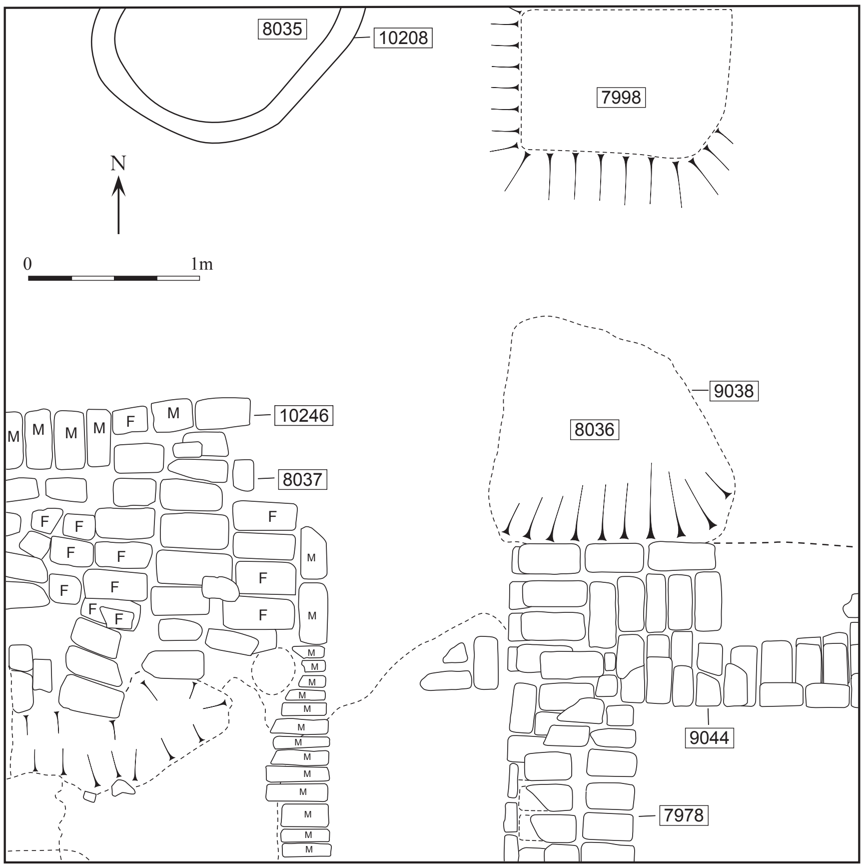


Figure 3.18. K85 showing pit [9038].

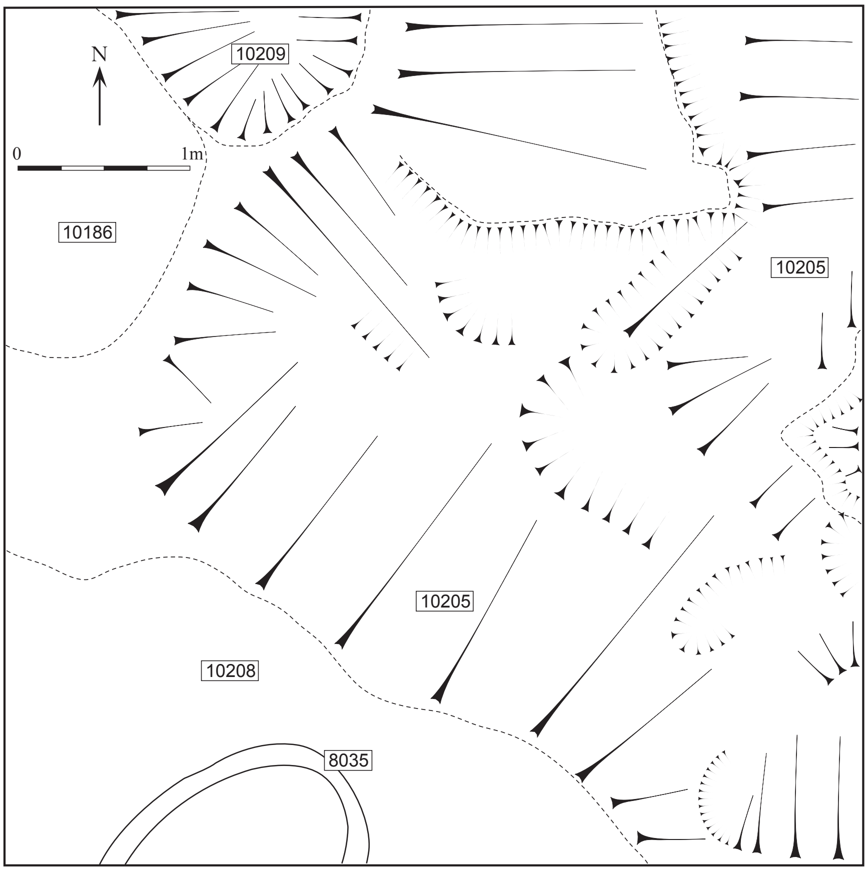


Figure 3.19. K90 showing Kiln 1 [8035].

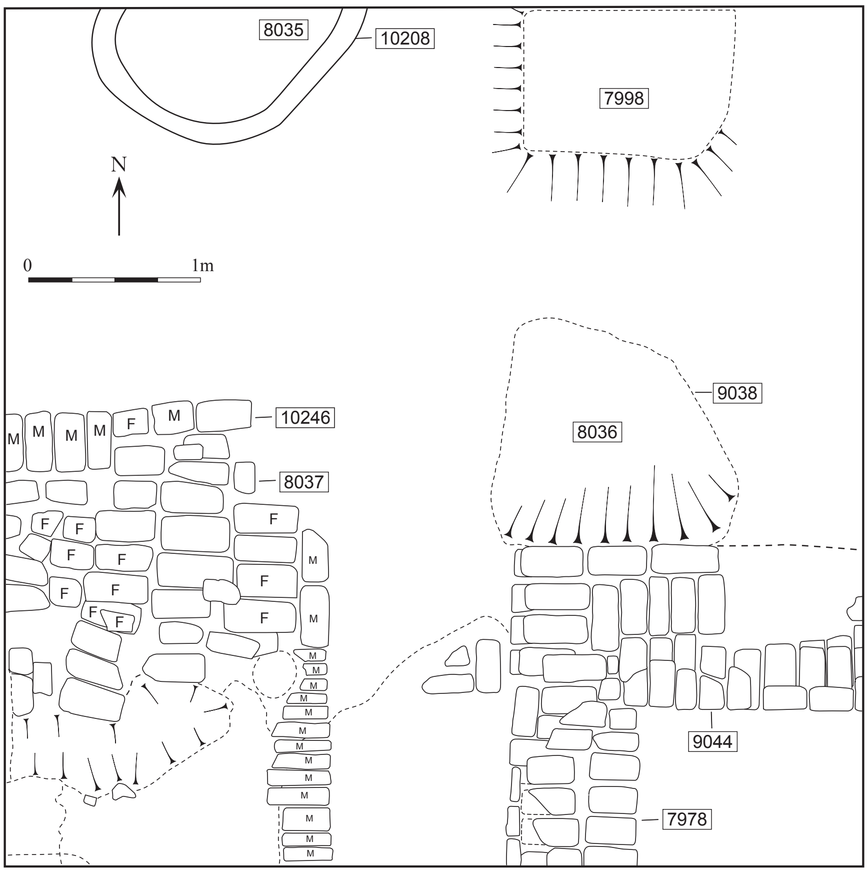


Figure 3.20. J85 showing the continuation of the trampling floor [8037] from K85.

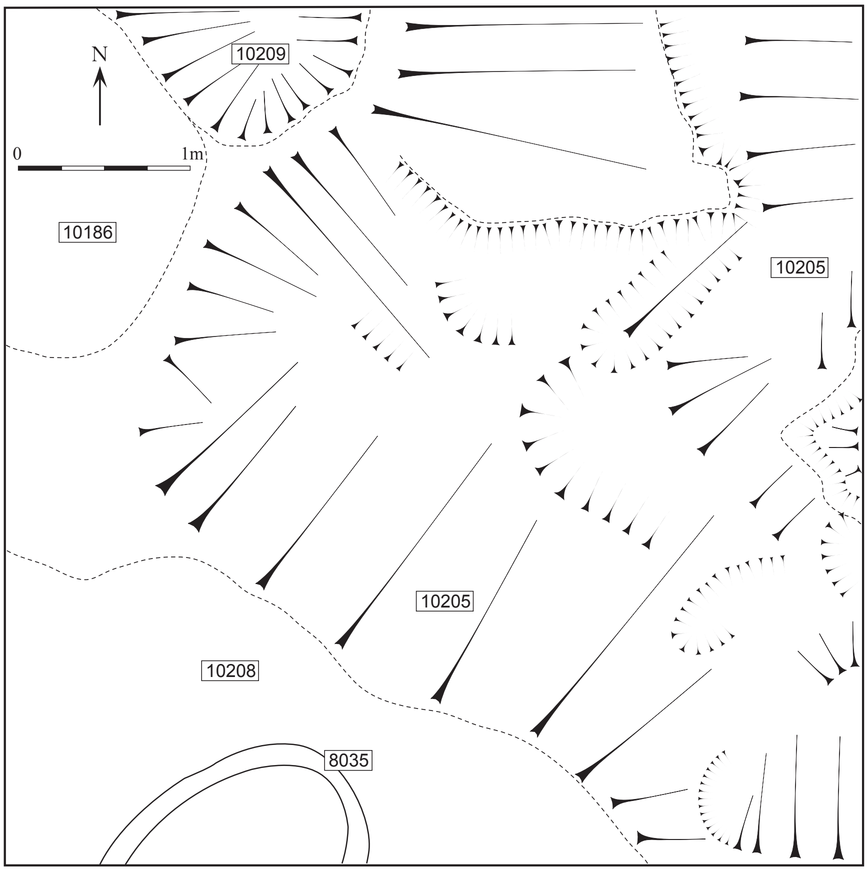


Figure 3.21. K80 showing part of trampling floor [8037].

It was to the west of wall [7994] that the trampling floor [8037] for clay preparation was found and which included a clay trampling pit [9482] in which unfired clay turnings [9483] were found (Plate 3.22). The pit extends into J80. Clay spreads across the trampling floor and runs up to wall/kerb [9475]. The clay continues to the south of wall/kerb [9475] suggesting either a separate trampling area, or that [9475] can only have been a low wall or kerb when the trampling floor was in use.

To the east of wall [7994] was an extensive layer of white lime [7973] which abutted the east face of the wall and overlies the *gebel* surface [7977]. At some time a construction cut [7975] running north-south was made into the *gebel* [7977] and presumably through the lime [7973]. Into this cut the substantial wall [7978] was built. This wall seems to sit on top of some lime [7973] which presumably blew back into the cut before the wall was constructed.

Construction of wall [7978] seems to have involved digging out some of the lime [7973] and throwing it to both the east and west of the proposed wall. To the west it came to rest against wall [7994]. At this west side of [7978] the layer of lime has been called [8033] and [7973≈8033]. On top of [8033] on this west side is a rubbly layer [8032≈8027].

At a later time another, smaller, wall [7979] was built running east-west and abutting wall [7978] on its east side. In the south-west corner, on the north face of wall [7979], there remained traces of what may have been a brick floor [7972]. This floor, of which only one brick and some mortar remained, rested on top of the white lime layer [7973] and is mortared to, i.e. abuts, walls [7979] and [7978]. It is known that [7979] is later than furnaces labelled Kiln 2 [8075] and Kiln 3 [8074] because it overlays them (see below) (Plate 3.4).

The construction of wall [7978] would effectively have left a corridor between itself and wall [7994]. This space would have contained lime and rubble due to the digging of cut [7975]. At some stage it appears that some of the lime was dug up and thrown southward on top of a rubble layer [8027≈8032], and this new lime layer contained some rubble and has been numbered as [7998] (Plate 3.29).

On top of [7998] an east-west wall [7995] was constructed and met the east face of wall [7994]. As excavated in 1993, a single brick [10254] at the junction of the walls [7994] and [7995] suggests that this area had a brick floor and formed a kind of terrace (Plate 3.30). To its north however are the remains of another east-west wall [10244] which, where it abuts wall [7978], the mortar spread suggests that it may

Plate 3.29. Looking east across K80 in 1993. The ranging pole is lying on the unexcavated J80, with the trampling floor at its north (left) end. The east-west walls running between [7994] and the substantial wall [7978] are clearly visible, as is some of the lime [7973].

Plate 3.30. Looking east over K80. Wall [7995] is at the north (left) end of the picture, where it abuts [7994] a single brick, perhaps part of a floor, can be seen can be seen in the north-west (arrowed) corner of the structure.

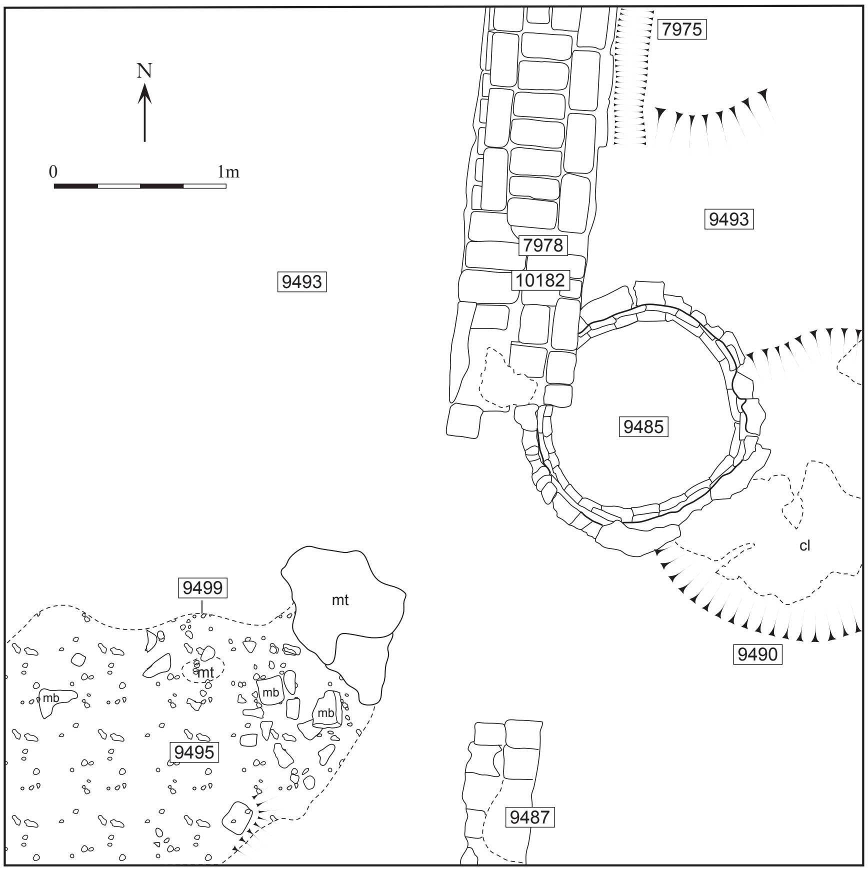


Figure 3.22. K75 showing Kiln 6 [9485] and main features.

have been part of a brick floor [10245] which would have met the face of wall [7995] to give a shallow step. It may be that here we have a series of broad, sloping, steps going upward toward the top of wall [7978].

Overlying these deposits was unit [7969] comprising mudbrick collapse, and lying in the "corridor" between the major wall [7978] and the smaller [7994]. This same deposit also ran over [7978] south of its junction with [7979]. Amongst the debris in this collapse unit [7969] was a substantial roofing fragment, offering the possibility that either part of the potters workshop, or more likely part of O45.1, was roofed.

As it currently survives within the excavation area, wall [7978=9486] at its south end overlies Kiln 6 [9485] (see K75 below). This may suggest that the potter's workshop if it remained in use had to construct a further kiln. If so, this new kiln might be Kiln 1 [8035], to the north. The fired bricks which make up the trampling floor must have been reused from a kiln such as Kiln 6, or indeed any of the others within the 045.1 complex.

Square K75 (Figure 3.22)
South of K80 is K75. A pit, lined with clay, [9490] was cut into the natural *gebel* surface [9493] of this square and may be connected to the preparation of the bricks that were used to build the kiln (Fig. 3.22). This pit was cut through to construct Kiln 6 [9485] (Plate 3.16). This kiln too is of the typical form known to be for pottery production. Inside this kiln are two fills, the lower fill [9484] is very ashy, likely to be the remains of the last firing of the kiln; and the upper fill [9481] which comprised burned and unburned mudbricks, pottery sherds and stones, presumably thrown into the kiln following disuse to level it before wall [7978] was laid over it. Clearly it belongs to an industrial phase prior to the construction of the major building at O45.1.

Abutting the main north-south wall [7978] was a mixed stoney and wind-blown sand deposit [9488]. On top of this was a mudbrick trample and sherd concretion [9479]. In turn, overlying [9479] are two different deposits. One was an area of decayed mudbricks [9452] and the other a deposit of wind blown sand [9477].

Remains of another wall [9487] are also found below [9452] and in perfect alignment with the main wall [7978] (Plate 3.31). It is likely to be the continuation of the main wall. Immediately west of this smaller wall is a robber cut [9499] and its fill [9495] which comprises jumbled mudbricks which may have come from the wall [9487] itself, and mud trample. This is also found below [9452].[8]

Plate 3.31. Looking north along the K row of squares (as excavated in 1998) with wall [9487] at bottom centre and Kiln 6 in K80 in beyond wall [7978] clearly visible to its left. The potter's workshop is just visible to the left of [7978] . In the background is the modern water tower, immediately beyond which is the slaughterhouse site.

The decayed mudbrick unit [9452] had a modern pit [9450] cut into it and a deposit of windblown sand [9451] over it. The pit was filled with the overlying topsoil [9431] which also overlay the two windblown sand deposits [9477] and [9451].

Squares L85 and M85 (Figures 3.23, 3.24, 3.25 and 3.26)

Because the east-west wall of O45.1 effectively splits these squares the stratigraphy is discussed in two parts according to its position relative to the wall.

North of wall [8038/9044]

In L85 and M85 there was a relatively deep stratigraphy sloping to the north from wall [8038/9044] and in part overlying it ([10174] and [10176=7989] in L85/1993). Beneath these deposits is unit [10196] which covers all but the wall [8038/9044]. In this area there is a mound [10201] including mudbrick tumble on the south side [10197]. Toward the middle of the north side of the wall in M85 is pit [10240] (Fig. 3.23), this contained industrial debris and was also sealed by unit [10196] and by wall [8038] itself.

North of wall [8038/9044] is a curved feature [10220] made of, now very decayed, mudbrick (individual bricks not discernable) (Figs. 3.24 and 3.25). This marks the edge or curb of a large well, the depression for which is visible on the ground surface. The overlying deposits were built up to and covered the major east-west wall [8038/9044].

The east-west wall seems to mark a major change in the function of the area. As noted, it overlay pit [10240] in M85, apparently ending the industrial phase, and in L85 it cut into a grave, apparently disturbing the body whose head would have protruded to the north of the wall (Fig. 3.26). The head seems to have been stuffed back into the top of the rib cage and the body, except for the area below the knees, was covered by the wall (Plate 3.33). This lower part of the body was excavated in 2003 (below Plate 3.34).

The wall itself is of some interest in that it has a pronounced batter. The rear of the wall (south side) is vertical but the north face is sloping, a feature which would be consistent with forming a buttress for an infilled platform. The natural mound to the south of the wall is cut into in order to construct it. At one point on the south side of the wall in L85 some six bricks protrude from the wall though their purpose is unclear. On their eastern edge they overlie the cut of the grave [10228] (Fig. 3.26).

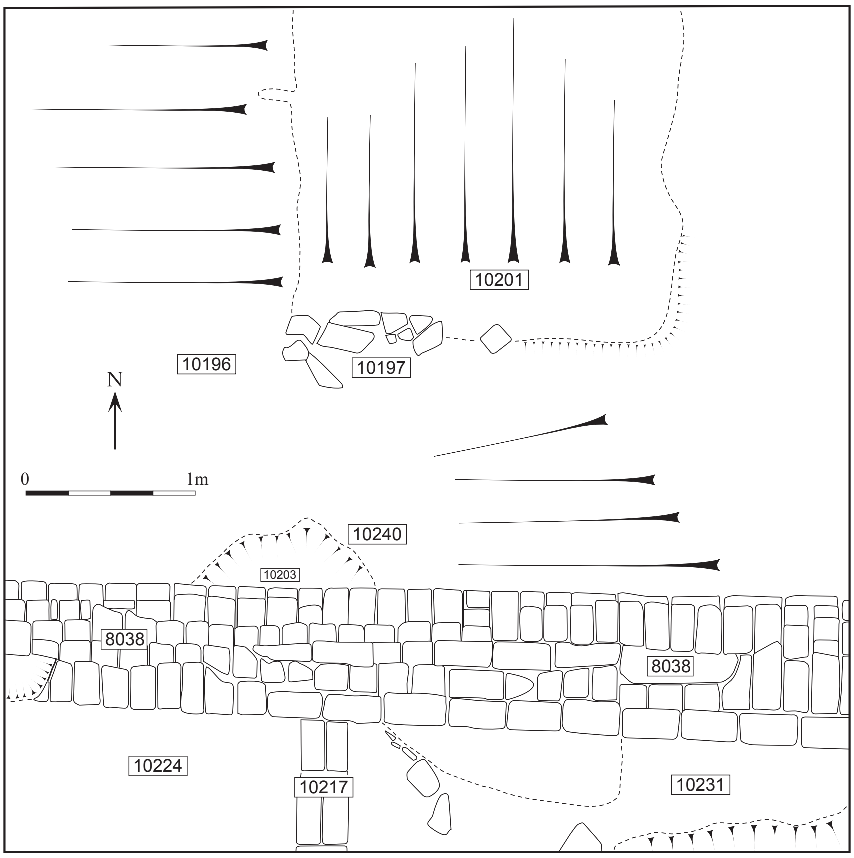


Figure 3.23. M85 showing pit [10203] underlying wall [8038].

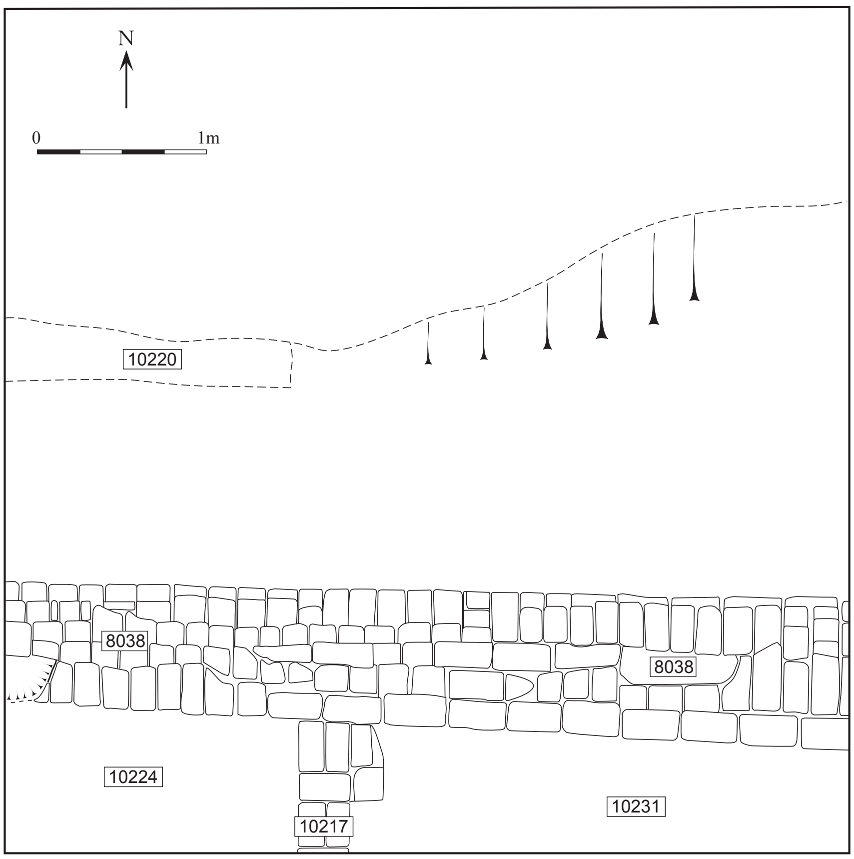


Figure 3.24. M85 showing feature [10220] which may be the end of a much decayed wall around a well.

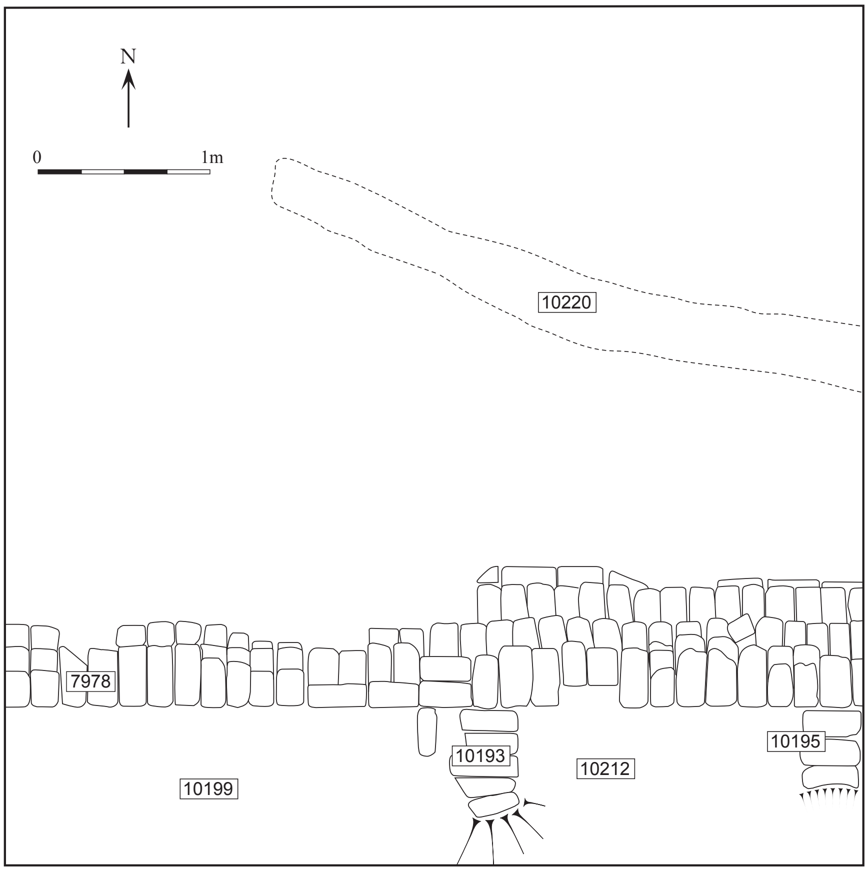


Figure 3.25. L85 showing feature [10220] and casemate walls [10193] and [10195].

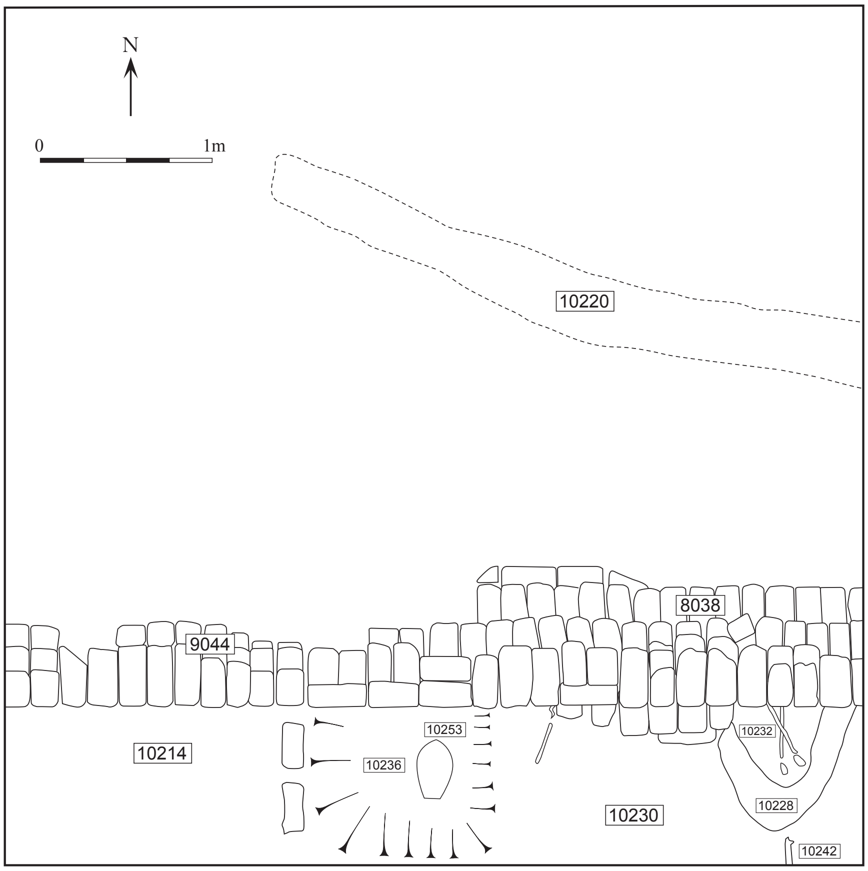


Figure 3.26. L85 showing the grave beneath wall [8038] and the impression of the "box" [10242] which extends into square L80.

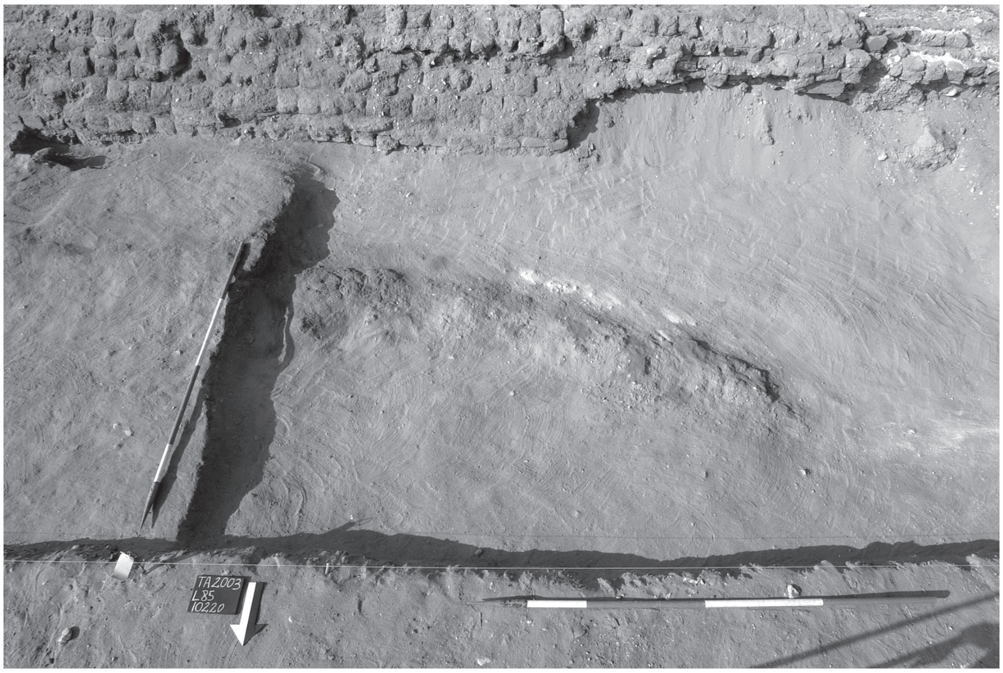


Plate 3.32. Feature [10220] in L85 believed to be the edge of a well during excavation in 2003.

Plate 3.33. The skull of body [8076] in L85. This is the same body as [10232] though only the upper and lower parts were recoverable, the rest is sealed by the wall.

Plate 3.34. The lower legs of burial [10232] protruding on the south side of wall [8038].

Plate 3.35. Burial [10232] with the impression, thought to be from a box or similar item, impressed into the compact gebel surface immediately south of the burial.

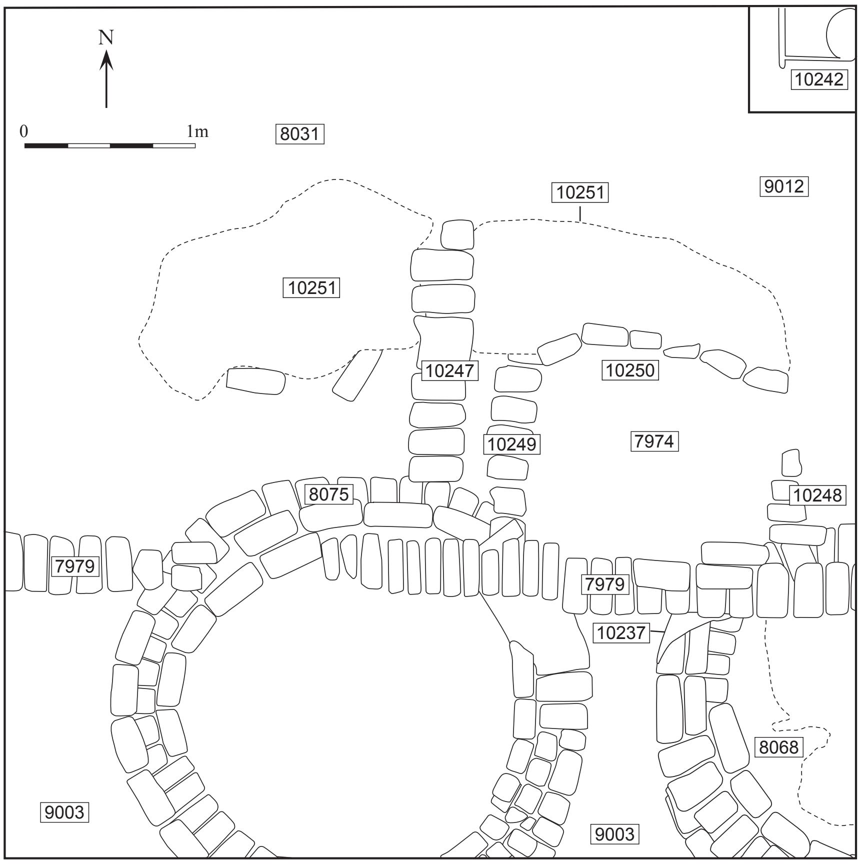


Figure 3.27. L80 showing Kilns 2 [8075] and 3 [8074] with its extensive "slag" layer [8068]. The box at top right shows the continuation of feature [10242] impressed on the natural gebel surface (at a lower level than the other features shown here).

South of wall [8038/9044].
Into the hard natural *gebel* surface [10230] a grave [10228] was cut (Fig. 3.26 and Plate 3.34). The natural surface in this area is flat. To the south of the grave, and into the *gebel* surface is what appears to be the impression of a "box" [10242] (Plate 3.35). This extends into square L80 to the south.

After some time desert sand covered the "cemetery phase" leaving a more undulating topography. A cut was made into this loose windblown sand to build the main east-west wall [8038/9044]. After the cemetery phase, but before the construction of [8038/9044] there was an industrial phase, and it is the waste and refuse from this activity that was used to fill the cut for wall [8038/9044] and it also spilled out beyond the line of the cut. This industrial debris is piled up against the main wall [8038/9044] to its uppermost course as it currently survives. On top of this industrial waste were built casemate walls abutting [8038/9044] on their north and [7979] on their south. The remains of three of these walls still abut [8038/9044]; they are [10193], which is laid into mud pack [10216] upon industrial waste [10224]; [10195] which is laid directly onto the industrial waste [10192]; and [10217] which is laid into mud pack [10226] upon industrial waste [10199]. All of these industrial layers overlie the natural windblown sand [10214]. Another casemate wall [9041] survives in M80 although it does not survive where it would have met [8038/9044].

Square L80 (Figure 3.27)
Into the natural *gebel* is made cut [10237] to take Kiln 3 [8074]. A similar cut must presumably exist for Kiln 2 [8075] but it was not recognised in this area. The ground surface between Kilns 2 and 3 on the north side is undulating and to the west of Kiln 3 it slopes downward.

Inside Kiln 2 [8075] the lowest fill was largely mudbrick collapse [8067] and above this the sandy top fill [8066] all of which was overlain by the top sand [7961]. The lowest fill inside Kiln 3 was ash presumably *in situ* from the last firing ([8071] (=[8995] in M80), sealing this was a loose tumble layer [8069] (=[8993] in M80) which in turn was partly overlain by a slag layer [8068]. The kiln structure and the slag layer were themselves overlain completely by a pale sandy deposit containing fired bricks and slag [8065] (=[8991] in M80).

Plate 3.36. The pit left from removing deposit [7974] in 1993 before the walls surrounding it were fully excavated. Wall [7979] is clearly visible at the south (bottom) as are the bricks of [10250] at the north (top).

Once the kilns had gone out of use, an east-west wall [7979] was built across the top of the slighted kiln walls. On Kiln 3 for some reason the northern inside edge of the kiln [7979] was supported on a row of a few bricks placed on edge (Plate 3.13). These were probably where the stoke hole was placed. The fact that it did not show on the exterior is probably because the angle of the stoke hole was such that whilst it was visible on the interior the exterior is lost.

Butting against wall [7979] and running north-south was another wall [10247] which probably would have joined wall [10193] in L85. There was also a mudbrick wall [10248] which would probably have run north to join wall [10195] in L85.

At some time, possibly when the new building went out of use or remained uncompleted, a large pit seems to have been dug through the floor destroying much of the brickwork in the angle between wall [10248] and [7979] on the east side (Plate 3.36). This pit may have been dug by robbers who were unaware of the presence of wall [10247], in other words at a time when the surface features of the site were obscured by sand. The reason this is thought to be the case is that a poorly built wall, [10249], is inserted running north-south only a few centimetres away from the substantial wall [10247]. Another wall, [10250], ran roughly east-west from [10249] and was again poorly constructed. Walls [10249] and [10250] may have been made by robbers to prevent sand falling into their excavations, although this is uncertain. The fill [7974] from within the area bounded by walls [10248], [10249], [10250] and [7979] contained many fragments of glass and faience waste. Much the same kinds of finds came from the surrounding deposit [7986] and it is possible that [7974] was actually some of that deposit plus other material which was later used to disguise the robber's hole.

It may be that some of this material [7974] was scraped into the pit [8024] and raised up as a slight mound around which [7986] built up. Possibly at around the same time as pit [8024] was constructed and walls [10249] and [10250] built, a further pit [10251] was also cut. The people who cut this were also unaware of the existence of wall [10247] which the pit encounters. This pit is subsequently filled with windblown sand deposit [7970].

Square L75 (Figures 3.28 and 3.29)
Into the natural *gebel* [9018] was cut Kiln 4 [10239] (Fig. 3.28 and Plate 3.14). The desert surface slopes upward toward the north and east at this point. Ash from the stoke hole of the kiln was thrown out to the south forming deposit [9035] (Fig. 3.29), and in the stoke hole itself was [9036]. At some unspecified time, and bordering this ash on the east, a deposit [9021] of mudbrick rubble and brick collapse is created. This possibly came from the demolition of a structure in square L70 which has not been excavated, or possibly from the demolition of Kiln 4 itself. This "demolition

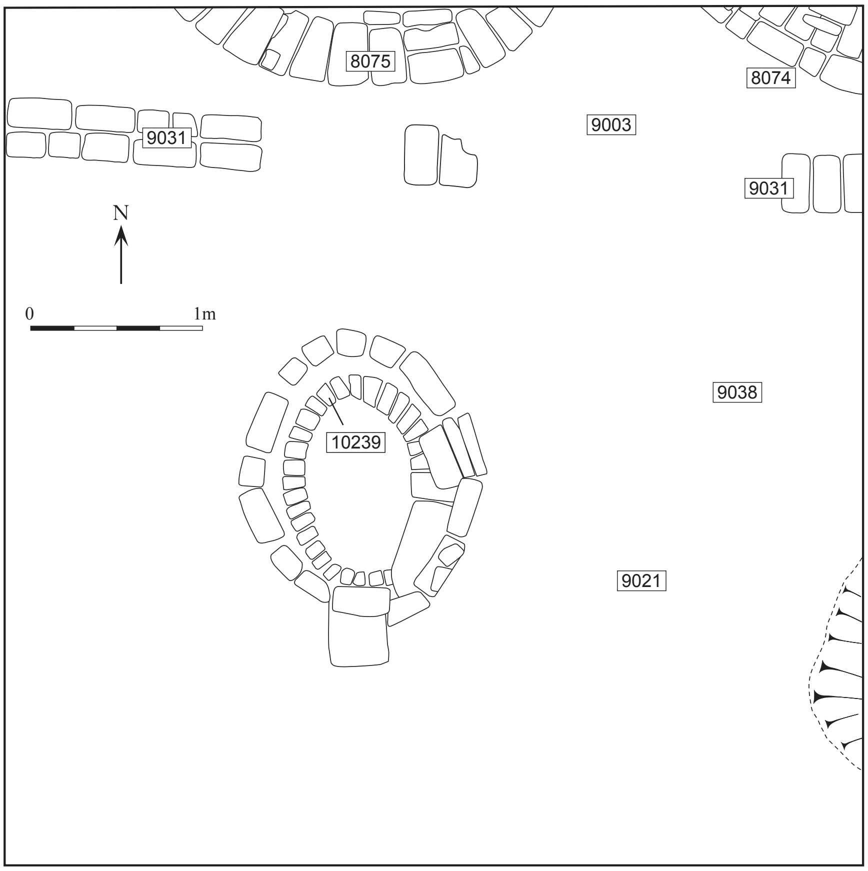


Figure 3.28. L75 showing Kiln 4 [10239].

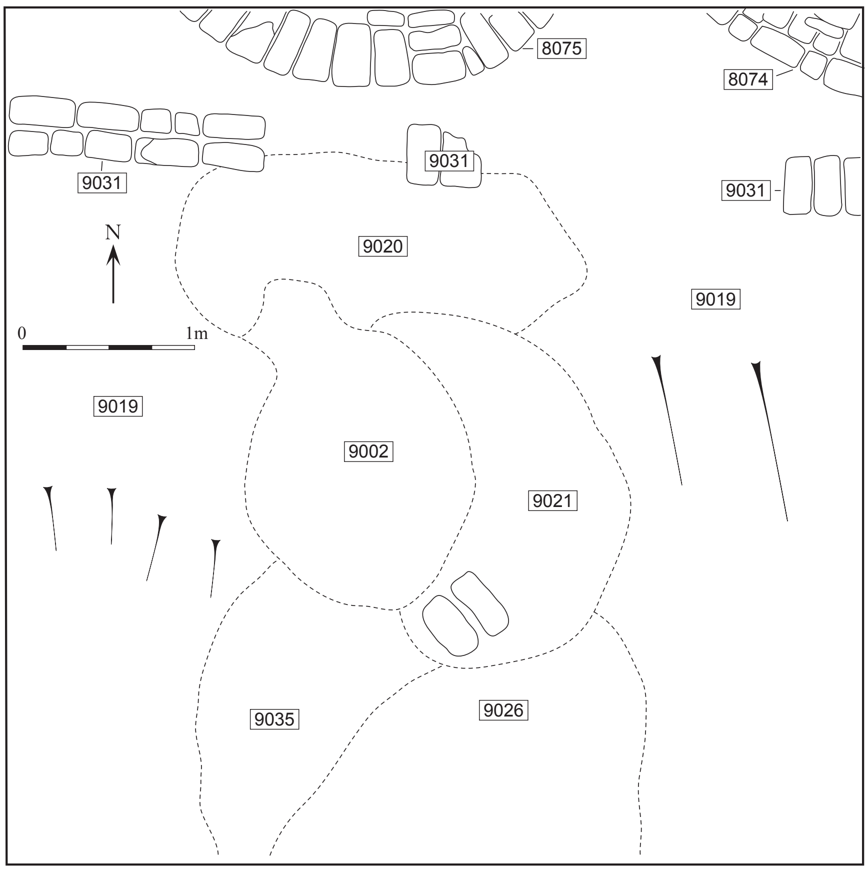


Figure 3.29. L75 showing deposits above and around Kiln 4.

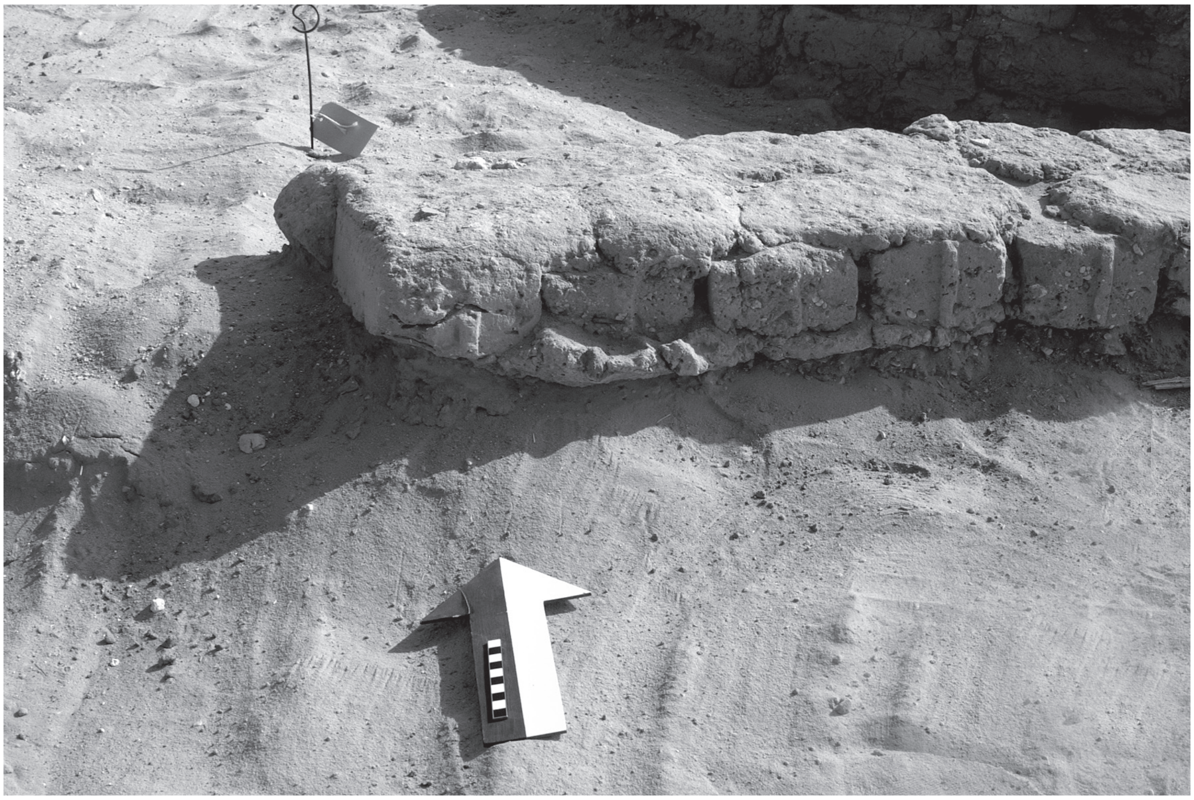


Plate 3.37. Wall [9031] in square L75 looking north. The westernmost (left) brick rests on gebel, the rest on fill. Note the distinctive vertical mould marks on the bricks which is repeated elsewhere along the line of this wall.

deposit" [9021] fills some of the naturally sloping topography of the *gebel*. It joins a mudbrick floor/trample unit [9026] in infilling the natural slope of the *gebel*.

On the northern rim of Kiln 4 [10239] and stretching between it and the southern rim of Kiln 2 [8075] was a further ashy deposit [9020] (Fig. 3.29). This deposit may have been the result of cleaning out Kiln 2 when it was necessary to replace its dome. It is thought (but cannot be proved) that the stoke hole for Kiln 2 was on the north side. Thus it might be expected that such ash deposits would be on the north, rather than south. Hence the suggestion that deposit [9020] comes from cleaning out Kiln 2 when its dome was removed, rather than during normal cleaning via the stoke hole.

An east-west wall [9031] was constructed with its westernmost portion resting on natural *gebel* whilst a single brick, apparently from the structure, sat directly on the ash [9020] with the central part of the wall sitting on the natural *gebel* (Plate 3.37). Several bricks, marking its easternmost part are to be found in M75 (below). All the bricks in this wall show a distinctive vertical mould-mark, so although the three parts of the wall cannot be *proved* to be the same structure, their mould mark, their alignment and the fact that they are all marl bricks, suggest that they are indeed part of the same structure. This east-west wall probably belongs to the phase succeeding the industrial features and may be part of a casemate structure within walls [7978] and [8038].

A large homogeneous deposit [9019] of weathered mudbrick, with lenses of ashy material and fragments of fired brick, covered the east and west thirds of the square. On the east, part of it overlay the eastern edge of demolition deposit [9021], itself bordered to the south by [9026]. Both contained mudbricks and brick rubble and serve to further level this area of the site.

Square M80 (Figure 3.30)
In order to understand the stratigraphy in M80, it is necessary also to look at aspects of L85 and L80. It would seem that the topography of the site as a whole was that of a low mound which sloped downward to the east and west as well as to the north. The industrial features of L80 and M80 sit toward the highest point of this mound. The surface of the mound was not entirely smooth but seems to have been undulating. These undulations collected sand and in some cases cobble stones.

From an examination of the construction of Kiln 3 [8074] in M80 and L80 a construction cut [10237] is visible. This cut is made into the same hard surface [10230] as that for the grave [10228] in L85. However, it seems that what we are seeing in Kiln 3 is actually

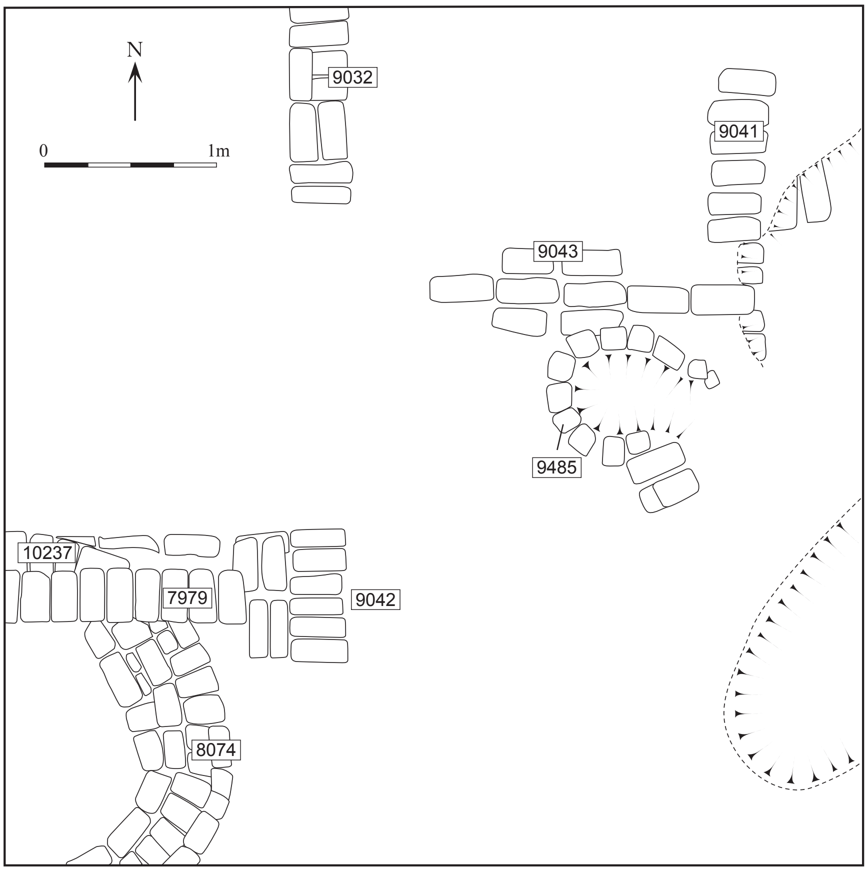


Figure 3.30. M80 showing the so-called "Kiln 5" [9485] and some of the casemate walls.

the bottom of the cut which was made into compacted sandy material from a higher level, whereas the grave seems to have been cut into the compacted *gebel* surface to begin with. Support for the view that Kiln 3 was cut from a higher level is to be found in the stratigraphy beneath wall [7979] which runs across the kilns at the end of their use. It is clear that the eastern end of [7979] in M80 is sitting on clean, compact sand and this same sand is seen underlying the south end of wall [10217=9032] in M80. There are virtually no finds from this sand suggesting that it was undeveloped ground at the time the industrial features were built, and the industrial debris built up from this level.

It is onto this clean compacted sand level [10230] that the so-called "Kiln 5" [9485] (probably an industrial hearth) (Plate 3.15) was constructed, suggesting that it is roughly contemporary with the other kilns/ furnaces.

It should be noted here also that the large east-west wall [8038/9044] seems to be cut into the compacted *gebel* surface into which the grave was built. The wall does not sit on any of the compact sand at the level of the kilns.

To the north of wall [8038] in square M85 is the pit [10240] (above), which contained slag material and fired brick [10203]. This pit partly underlies [8038] and because it contains slag it is believed to be contemporary with the industrial features (Fig. 3.23). The height of the surface into which the pit is cut is approximately 60cm lower than the topmost surviving course of bricks in Kiln 3 which seems to mark the ground surface at the time this kiln was cut. This supports the view that the site did slope downward toward the north. It must be pointed out however that the sand deposits to the north of [8038/9044], which overlie the pit just described, are seemingly different to those to the south of the wall. It is suggested that the sand south of the wall built up in a large dished hollow within the mound, or that the sand north of the wall was completely removed when the well in L85/M85 was constructed.

Once wall [8038] was constructed in M85 a north-south wall of less substantial construction was built [9032=10217]. This might have met up with wall [9042] which was found at the eastern end of [7979], which ran across the top of the kilns and probably formed part of the post industrial casemate structure. It is presumably at this time or shortly afterward that "Kiln 5" is buried. Parallel to wall [9032] was another wall of similar size [9041], again, part of the casemate structure. Between these two walls is evidence of a laid mudbrick floor [9043]. After the areas between

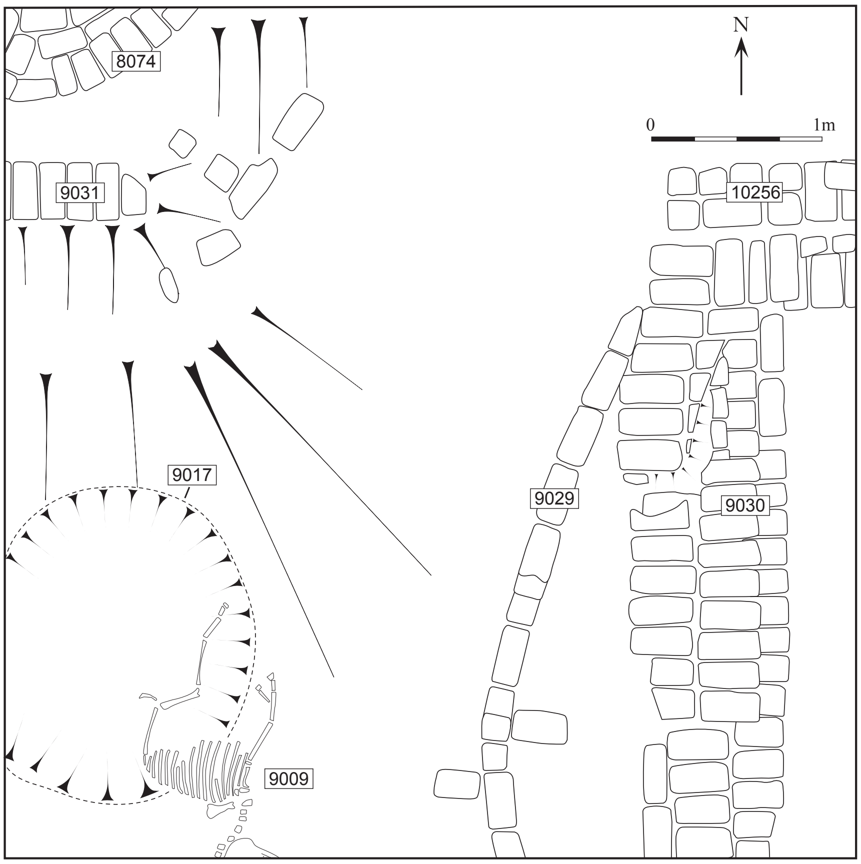


Figure 3.31. M75 showing the well features [9029] and [9030].

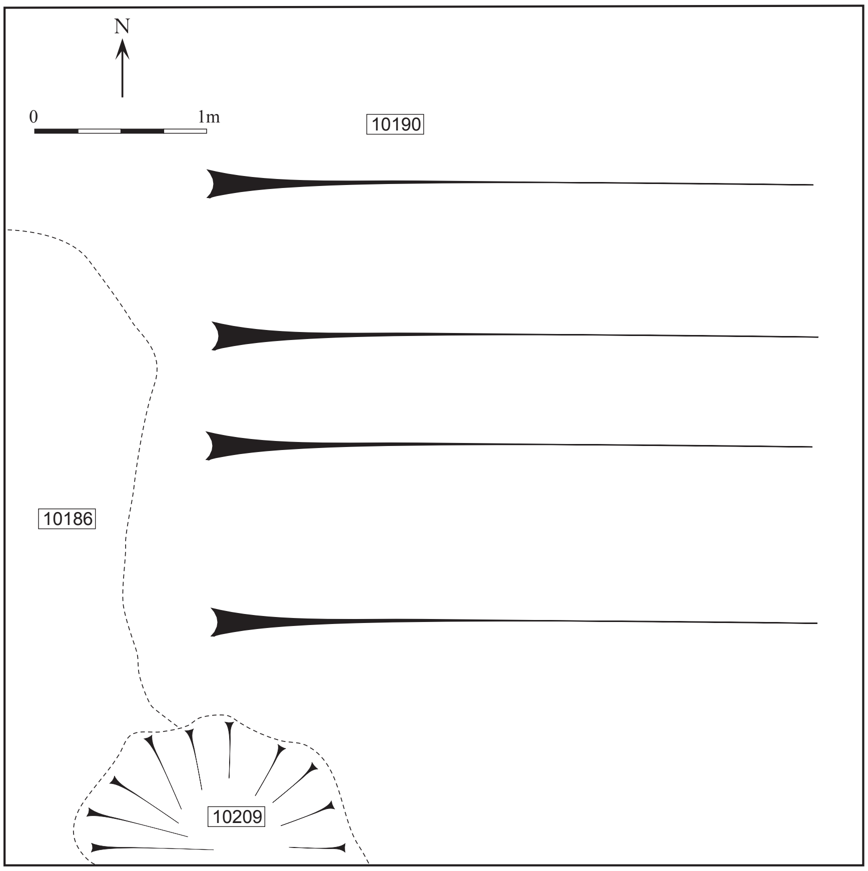


Figure 3.32. K95 showing major features.

Plate 3.38. Articulated skeleton of donkey [9009] in square M75. Looking north. The white part of the scale bar represents 0.50m.

the casemates was levelled with sand and industrial debris, bricks were then laid to seal the make-up and to further tidy up the area. (South of the wall was deposit [9024] which actually seals "Kiln 5". This deposit may have been tipped against the wall whilst backfilling in the rest of the area was going on.) At an undetermined time two pits [9027] and [9007] were cut into the backfilled surface.

In the north-west quadrant of M80, bounded on its east side by casemate wall [9032] there was a stony infill deposit [8994], into this a pit [9000] has been cut, perhaps at the same time as pits [9027] and [9007].

Square M75 (Figure 3.31)
In the south-east corner of M75 was a curving wall which is only one brick thick [9029] (Plate 3.26). Its northernmost point is obscured by the junction of two other walls. One of these, [9030], is a substantial wall running north-south and built inside the curving wall. It is not clear whether the two structures are approximately contemporary or not. At the northern end of [9030] the wall seems to make an east-west turn, and immediately to its north is another area of brickwork [10256≈9031], that was originally identified as part of this wall [9030] but we now believe that it may be the continuation of the casemate wall [9031] with which it is aligned. It may be that [9029] and [9030] are both part of a well structure and the western side of [9030] was excavated to a depth of c.1.50m without reaching the bottom. Excavation had to be discontinued because of the confined space and potential danger of working in this area.

Immediately west of [9029] and running into the southern baulk of M75 was the articulated skeleton of a donkey [9009]. Its head was partly under the baulk. The donkey was buried in a shallow pit [9017] (Plate 3.38).

The chronological relationship between the donkey burial and the well feature and the rest of the industrial phase of the site is unclear. However, if we are right in believing the brickwork of the northern edge of the well [10256] is a continuation of wall [9031], the well feature would seem to be out of use when the casemate walls are put in. It is possible that the donkey burial is substantially later than the other features discussed here, but as its pit is stratigraphically unrelated to any other features on the site it is impossible to be certain.

Square K95 (Figure 3.32)
This square was excavated in an attempt to determine whether the workshop area continued beyond square K90. Removal of the surface layer [10190] quickly revealed compacted *gebel* surface. Because of constraints on time this was not further investigated, but appeared to be the same as the natural surface in adjoining square K90. The only other features [10209] and [10186] continue from K90 to the south.

Square K115 (Not illustrated)
Like K95 this square, detached from the main block, was excavated in the hope of defining whether further features existed in this area. Excavation was not completed here, but from unit [10207] it was evident that it had been disturbed in modern times, probably from use as a convenient area for preparing and storing chopped straw (Arabic: *tibn*). On the basis of the limited evidence provided by K95 and K115 it is not possible to determine whether the industrial area did in fact extend further north, though finds at the "slaughterhouse site" (below) suggest that it may have done, albeit with a lower density of archaeological features.

Chapter 3

Context List

Below are listed all the contexts from the excavation at O45.1. These have been summarised and classified according to Bomann (1995:33) with some modifications. The codes used are:

fd floor deposit
st structural element
fn furnishing
ud unturned ancient deposit, i.e. undisturbed in recent times
sf modern surface
c cut
n natural

Context	Equal to	Square	Square	Square	Character	Type
7961		K80-85	L80-85	M80-85	Top soil	sf
7962		K80	L85		Deposit	ud
7963		K80			Deposit	ud
7964		K80			Mudbrick rubble	ud
7965		L85			Deposit	ud
7966		K80			Deposit	ud
7967		K80			Deposit	ud
7968		K80			Cut	c
7969		K80	L80		Mudbrick	st
7970		K80	L80		Deposit	ud
7971		K80			Cut	c
7972		K80			Mudbrick floor	st
7973		K80			Lime surface/"floor"	ud
7974		L80			Deposit	ud
7975		K80			Cut	c
7976		K80			Deposit	ud
7977		K80			Natural	n
7978	9486	K80	K85	L80	Wall of O45.1 N-S	st
7979		K80	L80	M80	Wall (E-W) abutting 7978	st
7980		K85			Cut	c
7981		K80			Deposit	ud
7982		K80			Deposit	ud
7983		K80			Deposit	ud
7984		L80			Deposit	ud
7985		K80			Mud trample	ud
7986	7962	L80			Deposit	ud
7987		K80			Cut	c
7988		K80			Mud trample	ud
7989		L85			Deposit	ud
7990		K80			Natural	n
7991		K80			Mud trample	ud
7992		K80			Deposit	ud
7993		K80			Cut	c
7994	8073	K80			N-S wall	st
7995		K80			E-W wall/floor	st
7996	9475	K80			Wall	st
7997		K80			Mud trample	ud
7998		K80			Lime surface/"floor"	ud
7999		K80			Deposit	ud
8024		L80			Cut	c
8025		K80			Deposit	ud
8026		L85			Deposit	ud
8027		K80			Deposit	ud
8028		K80			Mud floor	st
8029		K85			Deposit	ud
8030		K85			Cut (burrow)	c

8031		L80			Floor	st
8032		K80			Deposit	ud
8033		K80			Deposit	ud
8034		K85			Deposit	ud
8035		K85			Kiln 1 structure	st
8036		K85			Deposit	ud
8037		K80	K85		Fired brick floor	st
8038		K85	L85		E-W wall of O45.1	st
8039		L80			Floor	st
8065		L80			Deposit	ud
8066		L80			Deposit	ud
8067		L80			Brick collapse	ud
8068		L80			Slag layer in Kiln 3	st
8069		L80			Deposit	ud
8070		L85			Deposit	ud
8071		L80			Deposit	ud
8072		K80			Cut	c
8073	7994	K80			Wall	st
8074		L80			Kiln 3 structure	st
8075		L80			Kiln 2 structure	st
8076	10232	L85			Skeleton	ud
8077		L85			Deposit	ud
8078		K85	(K90)		Deposit	ud
8976		M75			Top soil	sf
8977		L80			Backfill of Kiln 3	
8978		L80			Backfill of Kiln 2	
8979		L75	M75		Deposit	ud
8980		L75			Deposit	ud
8981		M75			Deposit	ud
8982	9030	M75			Wall	st
8983		M75			Cut	c
8984		L80			N-S wall	st
8985		L80			Deposit	ud
8986		L80			Deposit	ud
8987		M80			Deposit	ud
8988		M75			Deposit	ud
8989		L80			Deposit	ud
8990		L80			Deposit	ud
8991		M80			Deposit	ud
8992		M80			Deposit	ud
8993		M80			Deposit	ud
8994		M80	L80		Deposit	ud
8995		M80			Deposit	ud
8996		L75			Deposit	ud
8997		L75			Cut	c
8998		L75			Deposit	ud
8999		M80			Deposit	ud
9000		M80			Cut	c
9001		L75			Deposit	ud
9002		L75			Deposit	ud
9003		L75			Deposit	ud
9004		M75			Deposit	ud
9005		M75			Deposit	ud
9006		M80			Deposit	ud
9007		M80			Cut	c
9008		M75			Cut	c
9009		M75			Donkey burial	ud
9010		L75			Deposit	ud
9011		L75			Deposit	ud
9012		M80			Deposit	ud

9013		M75			Deposit	ud
9014		M75			Deposit	ud
9015		M75			Deposit	ud
9016		M75			Deposit	ud
9017		M75			Cut	c
9018		M75			Natural	n
9019		L75			Deposit	ud
9020		L75			Deposit	ud
9021		L75			Deposit	ud
9022		M80			Deposit	ud
9023		M80			Deposit	ud
9024		M80			Cut	c
9025		M80			Deposit	ud
9026		L75			Deposit	ud
9027		M80			Cut	c
9028		L75			Wall	st
9029		M75			Wall	st
9030	8982	M75			N-S wall of well	st
9031		K75	L75	M75	Wall	st
9032	10217	M80			Wall	st
9033		M80			Deposit	ud
9034		M80			Kiln 5	st
9035		L75			Deposit	ud
9036		L75			Deposit	ud
9037		L80			Skull in Kiln 2	ud
9038	10243	K85			Cut	c
9039		K85	K90		Cut	c
9041		M80			Wall	st
9042		M80			Mudbrick floor	st
9043		M80			Mudbrick floor	st
9044	8038	K85	L85		Wall	st
9045		K85			Wall	st
9431		All			Topsoil	sf
9432		J85			Deposit	ud
9433		J85			Deposit	ud
9434		J85			Deposit	ud
9435		J85			Deposit	ud
9436		J85			Floor	st
9437		J85			Floor	st
9438		J85	J80		Deposit	ud
9439		J85			Deposit	ud
9440		J80			Deposit	ud
9441		J85			Deposit	ud
9442		J85			Deposit	ud
9443		J85			Deposit	ud
9444		J85			Deposit	ud
9445		J80	J85		Deposit	ud
9446		J80			Deposit	ud
9447		J80			Deposit	ud
9448		J80			Deposit	ud
9449		J85			Deposit	ud
9450		K75			Deposit	ud
9451		K75			Deposit	ud
9452		K75			Deposit	ud
9453		J85			Deposit	ud
9454		J85			Deposit	ud
9455		J80			Deposit	ud
9456		J80			Deposit	ud
9457		J80			Deposit	ud
9458		J80			Cut	c

9459		J80			Deposit	ud
9460		J80			Cut	c
9461		J80			Deposit	ud
9462	9461	J80			Deposit	ud
9463		J80			Deposit	ud
9464		J80			Deposit	ud
9465		J85			Cut	c
9466		J85			Deposit	ud
9467		J85			Cut	c
9468		J85			Cut	c
9469		J85			Cut	c
9470		J80			Deposit	ud
9471		J80			Deposit	ud
9472		J80			Skeleton	ud
9473		J80			Cut	c
9474		J80			Floor	st
9475	7996	J80			Marl brick wall	st
9476		J85			Cut	c
9477		K75			Deposit	ud
9478		J80	J85		Deposit	ud
9479		K75			Deposit	ud
9480		K80			Deposit	ud
9481		K75			Deposit	ud
9482		J80	J85		Puddling pit clay lining	fd
9483		J80	J85		Unfired sherds and clay	ud
9484		K75			Deposit	ud
9485		K75			Kiln 6	st
9486	7978	K75			N-S Wall of O45.1	st
9487		K75			Wall	st
9488		K75			Deposit	ud
9489		K75			Deposit	ud
9490		K75			Deposit	ud
9491		J80	J85		Deposit	ud
9492		J80			Cut	c
9493		K75			Deposit	ud
9494		J85			Deposit	ud
9495		K75			Deposit	ud
9496		K75			Wall (in section)	st
9497		K75			Cut	c
9498		K75			Deposit	ud
9499		K75			Cut	c
9500		J80			Fill if Zir	ud
9501		J80			Zir	fn
9502		J85			Deposit	ud
9503		J85			Cut	c
9504		J85			Deposit	ud
9505		J85			Cut	c
9506		J80			Cut	c
9507		K75			Deposit	ud
10171		All			Backfill	ud
10172		K80			Deposit	ud
10172		K80			Natural	n
10173		K100			Topsoil	sf
10174		M85			Deposit	ud
10175		M85			Deposit	ud
10176	10179	M85			Deposit	ud
10177		K100			Deposit	ud
10178		K100			Deposit	ud
10179	10176	M85			Deposit	ud
10180		J85			Deposit	ud

10181		J75			Deposit	ud
10182		K75	K80		Deposit	ud
10183		K100			Deposit	ud
10184		K90			Topsoil	sf
10185		K90	K95		Deposit	ud
10186		K90	K95		Deposit	ud
10187		M75			Trench clean	
10188		K100			Deposit	ud
10189		M85			Deposit	ud
10190		K95			Topsoil	ud
10191		K80/85	L80/85	M80/85	Deposit	ud
10192		L85			Deposit	ud
10193		L85			Mudbrick wall/collapse	ud/st
10194		L85			Deposit	ud
10195		L85			Wall	st
10196		M85			Deposit	ud
10197		M85			Brick structure	st
10198		L85			Trench clean	
10199		L85			Deposit	ud
10200		K85			Deposit	ud
10201		M85			Deposit	ud
10202		L85	M85		Deposit	ud
10203		M85			Deposit	ud
10204		L85	M85		Deposit	ud
10205		K90			Deposit	ud
10206		M85			Cut	c
10207		K115			Deposit	d
10208		K90			Deposit	ud
10209		K90	K95		Deposit	ud
10210		K85			Deposit	ud
10211		L85			Deposit	ud
10212		L85			Deposit	sf
10213		L85			Deposit	ud
10214		L85	M85		Natural	n
10215		L85	M85		Deposit	ud
10216		L85			Deposit	ud
10217	9032	M85			Wall	st
10218		L85			Deposit	ud
10219		L85			Deposit	ud
10220		L85			Mudbrick structure	st
10221		M85			Deposit	ud
10222		L85			Laid mudbrick	st
10223		M85			Deposit	ud
10224		M85			Deposit	ud
10225		K85			Deposit	ud
10226		M85			Deposit	ud
10227		L85			Deposit	ud
10228		L85			Cut	c
10229		K85			Deposit	ud
10230		L80	L85		Deposit	ud
10231		M85			Topsoil	sf
10232	8076	L85			Skeleton	ud
10233		M85			Deposit	ud
10234		L85			Deposit	ud
10235		M85			Deposit	ud
10236		L85			Deposit	ud
10237		L80	M80		Cut	c
10238		L80	M80		Deposit	ud
10239		L75			Kiln 4	st
10240		M85			Cut	c

10241		L85	M85		Cut	c
10242		L80	L85		"Box" impression into *gebel*	
10243		K85			Cut	c
10244		K80			Wall	st
10245		K80			Mudbrick floor?	st
10246		J85	K85		Marl brick wall	st
10247		L80			Wall	st
10248		L80			Wall	st
10249		L80			Wall	st
10250		L80			Wall	st
10251		L80			Deposit	ud
10252		L85			Fill of pot	ud
10253		L85			Pot infill 10236	fn
10254		K80			Deposit	ud
10255		K85			Wall	st
10256		M75			Wall	st

Chapter 3

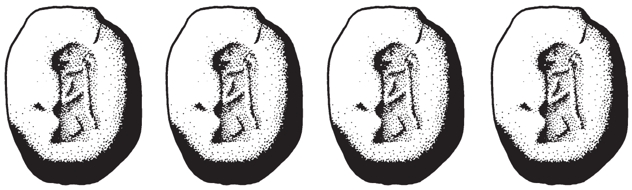
Endnotes

1. A local type of mattock.
2. At Amarna undiagnostic pottery refers to those pieces which are not rims, handles, bases or decorated sherds.
3. We are aware that slag is the result of a metallurgical process, but in appearance and texture this material, known to the local people as *khorfush* is so closely similar to slag as to justify this short-hand term. Professor M.S. Tite examined it for metallurgical traces and none were found.
4. I am grateful to Mr. Samir Anis and his colleagues at the Minya inspectorate for allowing us to inspect this area, and for their timely intervention in preventing the construction of the proposed building at the site.
5. Some evidence of faience making was recovered from spoil at the western end of the enclosure bordering the cultivated land, suggesting that some of the surface of the site had been stripped and dumped there.
6. When originally observed the east-west wall which defines O45.1 was labelled [8038]. It was subsequently recognised that it had two phases, the narrowest phase being where it met the north-south part of wall [7978]. This narrow part was subsequently numbered [9044]. For general purposes [9044] may be regarded as the equivalent of [8038].
7. The deposits within the northern half of Kiln 1 were not themselves excavated, a decision having been made to leave these *in situ*.
8. Also below the decayed mudbricks [9452] is a small fragment of a wall [9496] which comprises of two silt bricks running perpendicular to wall [9487] these were revealed as a result of over-digging the southern border of the square and are not shown on the plan.

Chapter 4

The Furnace Experiment

Paul T. Nicholson and Caroline M. Jackson



Introduction

Following the discovery and excavation of Kilns 2 and 3 at site O45.1 it was necessary to try to determine their possible function. One of the ways in which this was attempted was to build a full scale replica of one of the kilns and to attempt to make glass in it.

The experiment to replicate and fire a furnace based on Kiln 3 at site O45.1 took place between September 1st and 13th, 1996 and was carried out by the authors. The experiment had several objectives:

1. To determine whether a furnace on the scale of Kiln 3 could reach a sufficiently high temperature to make glass from its raw materials.
2. To determine whether forced draught was necessary in order to achieve temperatures high enough to produce glass.
3. To determine whether glass could be made from raw materials, similar in composition to those which are likely to have been available at Amarna.
4. To determine whether it was necessary to add lime to the glass mixture in order to successfully produce glass.

So far as possible all the materials used in the furnace construction and in the glassmaking were authentic (see Jackson *et al*. 1998). Where substitutions were made they are outlined below.

At the time the experiment took place there was considerable scepticism as to whether a structure of the size of Kiln 3 could be used to produce glass. It was widely believed that glass furnaces would be of very small size. This scepticism was expressed at the A.I.H.V. Congress in Amsterdam in 1995, where at least one delegate stated the opinion that a structure of the size excavated could not possibly reach a temperature suitable for glassmaking. Such scepticism was well placed; it is not sufficient to hypothesise on the function of a hitherto unknown structure without attempting to determine whether it could be used as suggested. No pharaonic glass furnaces had been found in Egypt, and other high temperature furnaces known from Egypt, such as smelting furnaces for metal, were generally much smaller.

It was clear from comments made at the Amsterdam meeting that many expected that glass could not be made using temperatures below 1250°C and that this could be achieved only by the use of some kind of forced draught. It was thus important that the experiment recorded the temperature achieved by the furnace in some detail.

It was also unknown whether sand from Amarna might have been used in the glassmaking process, or whether it would have been necessary to prepare silica from crushed quartz pebbles. Turner (1956:281T), presents a number of analyses of sands assuming Egyptian glass was produced from sand and a halophytic plant ash. However many recent publications suggest crushed quartz pebbles are the most likely source of silica (e.g. Lilyquist *et al*. 1993:41), although Tite and Shortland (2003:299) suggest that the use of a quartz sand may be possible.

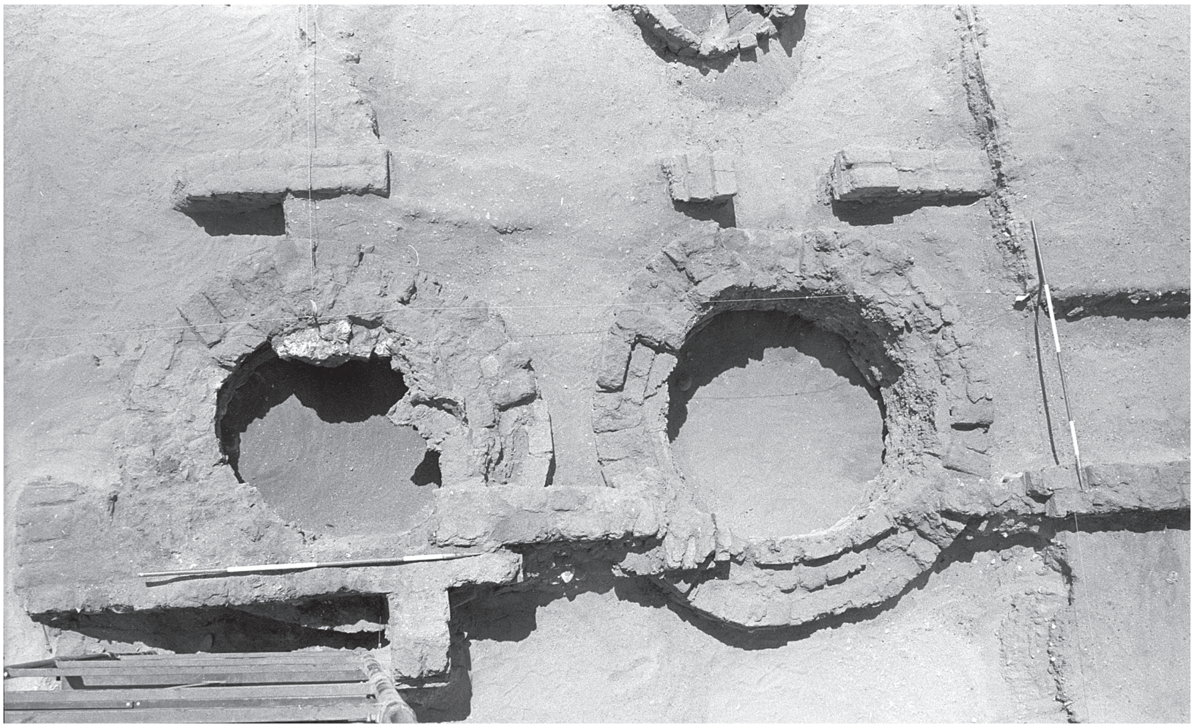


Plate 4.1. Kilns 2 (right) and 3 (left) as excavated in 1994. North is at the bottom of the picture. Kiln 3 was felt to offer better evidence for reconstruction purposes. (Photograph: Caroline Jackson, E.E.S.).

In summary, the form of an ancient Egyptian glass furnace was unknown. The temperature needed to make glass from its raw ingredients in such a furnace was unknown, and it was unclear whether such temperatures could be achieved without forced draught. Finally, the suitability of raw materials from Amarna was also unknown. The experiment conducted could never hope to *prove* that glass *was* made in the way suggested. However, it could show whether or not glass *could* have been made in that way. If successful it would add weight to arguments suggesting the function and use of the excavated structures.

In recent years the experiment has been criticised for using seaweed ash rather than the ash of *Salsola kali* or a similar desert species. Whilst it would have been more satisfactory to use such a plant, the purpose of the experiment was not to test the alkali but to examine the function of the furnace and the local sand. In our view the seaweed ash represented an acceptable, substitute for local plants, having a very similar composition to *Salsola kali*. It could therefore be expected to produce a glass with a similar composition and melting characteristics.

The Furnace

The first stage in the experiment was to decide on which of the two large furnaces at O45.1 the replica should be based. Kiln 3 was chosen since this was the better preserved, and there was some suggestion that at least some of the vitrified material adhering to the walls might be melted brickwork representing a shelf (Plates 4.1 and 3.8). There was also some evidence for a domed roof (Plates 3.8 and 3.10).

The site chosen for the replication experiment was behind the Egypt Exploration Society's excavation house at Amarna. Here a pit was dug about 2.5m in diameter and about 0.75m deep. This large diameter was necessary to accommodate the thickness of the wall which is approximately 0.5m. This has the effect of reducing the space in the furnace to approximately 1.5m diameter.

One of the reasons why colleagues had assumed the furnaces were "too large" was that in plan-view the excavated structures look enormous. However, this impression of size is illusory because in plan one sees the whole diameter of the structure, including the wall thickness. The internal diameter is relatively small. The thickness of the walls is, of course, significant—insulation was clearly important to the builders.

The fabric of the structure is mudbrick, which became fired *in situ*. The replica mudbricks were made by one of the villagers from el-Hagg Qandil using Nile mud and some chopped straw. They measure approximately 32cm x 16cm x 8cm and were sun dried for a minimum of 3 days before use.

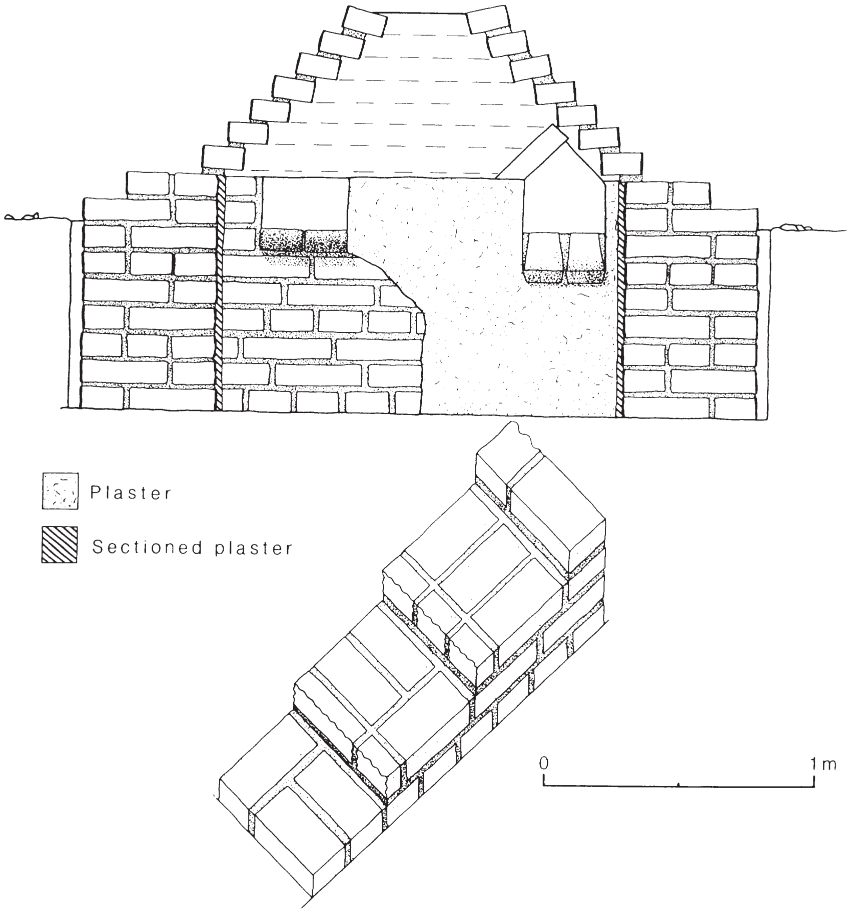


Figure 4.1. Reconstruction drawing of Kiln 3 as built for the experimental firing, and showing the complicated brickwork pattern used in its construction. (Drawing by Ian Dennis).

The brickwork pattern was copied from the excavated furnace. The brickwork here is clearly designed for maximum strength and insulation (Fig. 4.1 and Plate 4.2). Described from the inside to outside of the walls the pattern is two headers behind which is a stretcher, in the next row this is reversed so that a stretcher is backed by two headers, whilst the next row comprises three stretchers. The fourth course repeats the first and so on. The bricks are mortared together using the same mud that was used to produce them, though without the addition of any straw.

The lowermost 7 courses of brickwork are a simple circle, but higher up it was necessary to introduce a stoke hole and ports into the structure. The nature and position of these features required some consideration in order to make the structure as authentic as possible. On the excavated furnace a later brick wall [7979] runs over the northernmost edge of the structure. On the inside of the furnace at this point the wall has been "patched" using bricks stuck on edge (Plate 3.13). It is believed that these bricks have been inserted to support the later wall and that they are blocking the sloping part of the stoke hole. The exterior of the kiln has also been excavated but shows no such "patching". This suggests either that there was no stoke hole at this point and that the bricks are fortuitously placed or—in our view—that they are placed to eliminate the chute area of the stoke hole. Accordingly the stoke hole in the replica furnace was placed facing due north. There is no evidence for its height, but approximately 4 courses of brick were allowed in the reconstruction. The general form of the chute is based on a pottery kiln excavated at Amarna site Q48.4 in 1987 (Nicholson 1989a).

The means by which the crucibles believed to have been used for glass melting were supported was more problematic. In a conventional updraught kiln used for pottery manufacture one expects to see a perforated floor (or "chequer") dividing the fire chamber from the vessel stack. Although this is not always obvious in excavated kilns there is usually some trace of it, whereas in Kiln 3 it was conspicuously absent. However, a thick layer of slag on the western side of the structure, alongside what appeared to be an embayment where there may have been a gap in the dome, suggested that there may have been a small mudbrick shelf at

Plate 4.2. The kiln reconstruction after two courses. Note the brickwork pattern.

this point (Plate 3.8). It is possible that there would have been a continuous shelf (= siege) running around the furnace, but since there was no clear evidence for this it was decided that only three shelves (or sieges) would be used (since it is unlikely that there would only have been one on a structure of this size). These were placed east, south and west of the stoke hole, the southernmost shelf being visible through the stoke hole itself.

The shelves each consisted of two bricks placed side-by-side and protruding for half their length (c.16cm) from the wall, with the other half set into the wall to support them (Plate 4.3).

The inside of the furnace was given a coating of mud plaster up to two courses above the shelves, that is to the point at which the dome started to curve in strongly (Plate 4.4). The mud was mixed with straw. This plaster layer is clearly attested on the excavated furnace, where it can be seen clearly preserved on the eastern side, and gradually fuses to vitrified slag (the material known locally as *khorfush*) on the western side. The plaster would have served as a "sacrificial render" which could be broken away, complete with slag after a number of firings and the furnace re-lined without the need to completely rebuild it. This process seems to have been underway in the excavated Kiln 2, where the lining has gone.

Since the excavated kilns are only preserved up to ground level the superstructure must, to some extent, be conjectural. However, there is good evidence to support the view that it was a dome. First, on the east side of Kiln 3, the brickwork can be seen curving in, whilst on the west side, next to the embayment there is a sloped brick, presumably the start of the dome (Plates 3.9 and 3.10). Similarly, amongst the finds is a loose brick (from M80 [8991]) which has a curtain of slag hanging at an angle from its surface (Plate 3.12). Clearly the slag dripped downwards, indicating that the brick must have been sloping, and therefore presumably part of the dome.

The replica dome was built by corbelling, laying the bricks on their widest face and overlapping them each by about half of their width. They were also laid on a slight slope so that they wedged together more tightly. The dome itself is seven courses high beginning from the ninth course of horizontal brickwork. The experiment showed that it could have been given additional courses to make the hole in the centre smaller, since a large diameter (c.30cm) hole is unnecessary to allow smoke to escape efficiently (Plate 4.5).

It was not possible to plaster the inside of the dome, and we have no doubt that it would have been similarly difficult for the ancient workers. Although the stoke hole is large enough for a small person to gain access, plastering would have been very difficult.

Plate 4.3. The kiln reconstruction with the chute-like stoke hole and three shelves (sieges) in place. Note that the brickwork at this level is the reverse of that in Plate 4.2.

Plate 4.4. The plaster, or "sacrificial render", lining the reconstruction.

Plate 4.5. The completed corbelled dome of the replica furnace.

It is also assumed that the interior of the dome may not have been plastered in antiquity as this part of the furnace would have been removed, either wholly or in part, after the melt, to remove the glass. As a result a plaster coating was applied only to the outside of the dome. It was hoped that this would assist in insulation and also help to strengthen the structure (Plate 4.6). Those courses of horizontal brickwork showing above the ground were also buried in sand to add to the insulation of the structure. The furnace was completed and these lowest courses of brickwork covered in sand on September 8th.

The experimenters were concerned that the weight of the bricks and the stresses of heating and cooling might cause the dome to collapse. However, not only did it stand during firing, but when last seen in March 2005 was still standing. It may be that the dome on Kiln 3 was dismantled after the final glass melt, or alternatively was only demolished when the site was redeveloped and the wall [7979] was built over it.

It should be noted that the corbelling technique is much simpler, and more authentic, than an earlier experiment in which bricks were placed on edge and bevelled to fit, rather as the blocks of an ice igloo, was attempted. This technique would give a smooth dome, but one which was quite thin. It was found to put a great deal of stress on the mortar joints, and since there was no evidence for its use in pharaonic Egypt it was abandoned in favour of corbelling.

The whole structure was allowed to dry for some days before firing. Ideally the structure would have been fired empty to harden the bricks and fire the plaster lining before it was used, but time and a delay in obtaining fuel prevented this.

The Batch Materials

The components of New Kingdom glass, as of much of the glass of antiquity, are soda, lime and silica.

Soda

At the time of the experiment it was generally believed that the source of soda in glass of the New Kingdom was probably plant ash, the ashes of *Salsola kali* being thought to be especially useful in this respect (Brill 1970:110). This then would be a high magnesia source. The authors had discussed the possibility that the alkali might in fact be a mixture of plant ash and natron, but decided to use only plant ash since evidence of a mixture was lacking. Shortland (2000:45–46) has recently suggested that there may indeed be a mixture of alkalis used for cobalt blue glass production, although Rehren believes that any differences in composition arise from the use of plant ashes harvested from differing locations (Rehren 2001). The purpose of the alkali is to serve as a flux, facilitating the melting of

Plate 4.6. Dr. Jackson beside the reconstucted furnace with its plastered dome. The illusion of size is much diminished when the reconstruction is compared to the plan.

the batch at reduced temperatures.

Because salt tolerant plants (halophytes) are no longer abundant in the area around Amarna, the experimenters decided to use a substitute. This consisted of seaweed collected at Penarth in South Wales (Plate 4.7). This was dried for several days before being ashed in a domestic garden incinerator. The resulting ash was coarse and contained many small stones and impurities. Some of it was slightly vitrified. It was in this condition that it was transported to Egypt.

On arrival at Amarna the ash was crushed using a mortar and pestle (Plate 4.8) and then sieved to remove any particles larger than 2mm across. This process would have been one which was well within the technical competence of the ancient Egyptians.

Lime

The presence of lime in Egyptian glasses has been the subject of some uncertainty. The lime acts as a stabiliser and prevents the glass from degrading. However, such ancient Near Eastern glassmaking texts as exist[1] do not specifically mention the addition of lime to the batch, and it may be that it was added as an impurity in the sand, or from the plant ash (see Oppenheim *et al.* 1970). Newton (1980:175) is clear that despite earlier mistranslations (Gadd and Thompson 1936) "there was no deliberate addition of lime". The ancient workers were probably aware that some sands were more suitable for glass manufacture than others, but may not have known why.

For the purposes of the experiment it was decided that no lime other than that present in the local sand, and ash, would be used. The high percentage of lime (CaO) in the Amarna sands had already been recorded by Turner (1956:281T) who found 18.86% was present in one sample. Similar high percentages (10.73%) were also recorded by him on the West Bank at Luxor.

Silica

The source of the silica used in ancient Egyptian glass has itself been controversial. Petrie (1894:26) believed that the white quartz pebbles which he thought made up the floors of the furnaces were later crushed for use in the "frits". This would certainly be a plausible use for them. Recent chemical examination of Egyptian glasses (Shortland 2000:44) has also tended toward the view that such pebbles provided the silica source. However, as Hatton (2005:51) has noted, many desert sands are not significantly less clean than pure quartz pebbles. In other words the source of silica in Egyptian glass is not yet certain.

The experiment was undertaken at a time when the furnaces had been revealed, but when (as now) there were not significant quantities of quartz pebbles from

Plate 4.7. Collecting seaweed from the tide line at Penarth, South Wales. Seaweed ash has the same properties as the ash of halophytic desert plants such as Salsola kali. *(Photograph: Caroline Jackson).*

Plate 4.8. The seaweed ash during crushing with a mortar and pestle.

the O45.1 site. Indeed the quantity found by Petrie is questionable and simply recorded as "many" (1894:26). As a result it was felt that local sand should be used to see whether this would yield a suitable glass. In any case, without the local sand, the lime would either have had to come in with the plant ash, or have been added separately.

The sand was collected from the area surrounding an ancient well beside building Q48.2. This sand, coming as it did from beside a well unearthed in excavation (see Galal 1989), was not contaminated by high quantities of mudbrick dust from the decay of buildings around the ancient city. Like the ash, the sand was also sieved to remove any material above 2.0mm in size.

The Mixture

The batch ingredients were mixed in the ratio two parts ash to one part (lime bearing) sand by weight. This ratio was chosen first, as a result of work carried out by Jackson and Smedley (Smedley *et al.* 1998) itself based on a recipe from Theophilus's *On Divers Arts* (c.1100 A.D.) (see Hawthorne and Smith 1979), and second, because the relative concentrations of silica and alkali in Egyptian glasses would suggest this ratio.

This mixture, if successful, would yield a greenish or brownish glass. Since most Egyptian body glass of the period is a dark cobalt blue a pinch of powdered cobalt from a laboratory supplier was added to the mixture to yield the desired colour.

The Reaction Vessel

The cylindrical vessels identified by Petrie (1894:26 and Pl. xiii: 62) as stands seem the most likely candidates for the reaction of the glass batch. Although Petrie did not find any which contained glass, these have subsequently been identified at Amarna from the Palace Dumps (Nicholson 1993:51) (Plate 4.9).

Rehren and Pusch (2005) have recently suggested that the reaction of glass batch materials at Qantir took place in reused beer jars coated on the inside with the same calcareous slip as found in the cylindrical vessels. This does appear to be the case, but it is also true that the same authors (2005:1757) have their best evidence of batch materials which have not been fully fused from a cylindrical vessel.[2] This suggests that at least

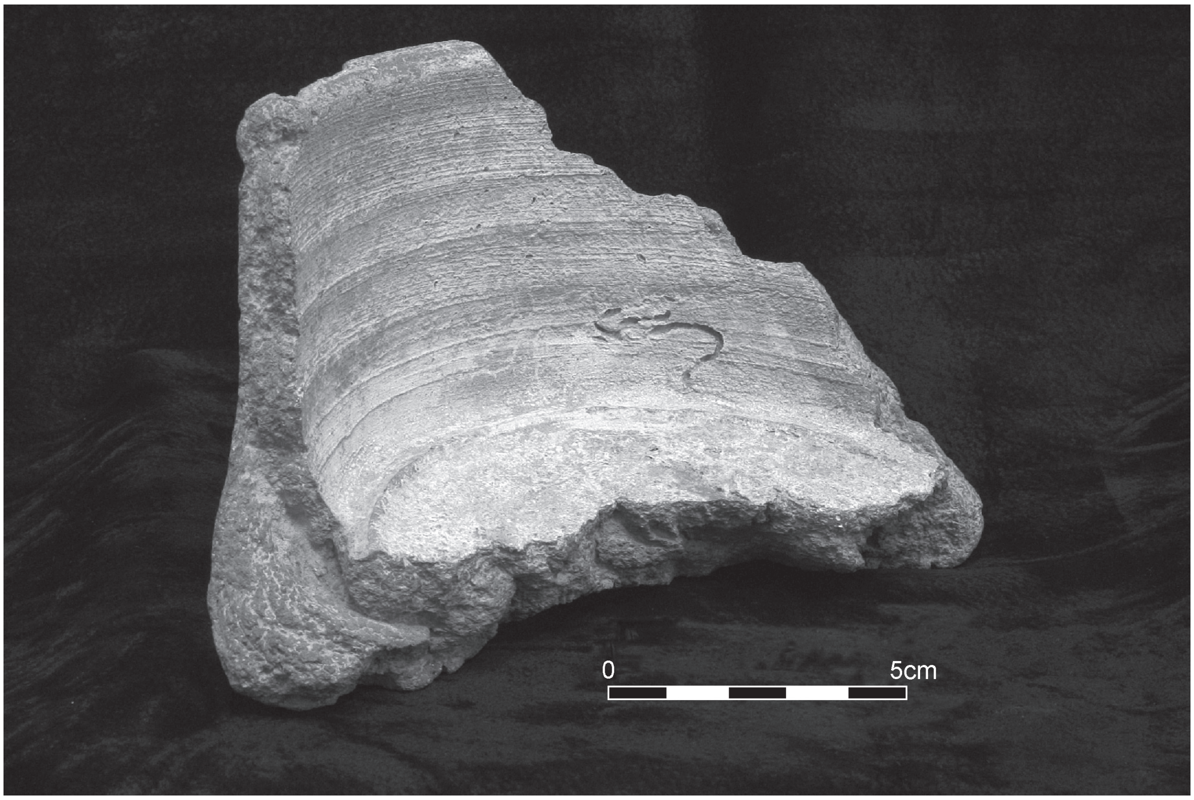


Plate 4.9. A typical cylindrical vessel as believed to be used as crucibles in glassmaking. This one is a surface find from the Palace Dumps.

some of these vessels were used to fuse the glass, and that they were not, as Rehren and Pusch (2005) argue, only for the re-melting and colouring of the glass. The question of whether this was a one stage or two stage process for cobalt blue glass production at Amarna as Petrie originally suggested, and Rehren and Pusch (2005) indicate for the complex procedure necessary to produce a red glass, is difficult to demonstrate.

That such vessels were used for containing molten glass is beyond question, as examination of the ingots from Uluburun has shown (Nicholson, *et al*. 1997). It therefore seemed reasonable to assume that the vessels in which glass was reacted at Amarna were the cylindrical ones. The high calcium lining to each of these vessels would further reinforce this suggestion. Turner (1954:440T) indicates that this film would help protect against corrosion of the ceramic wall upon prolonged and intense heating.

For the experiment it proved impossible to have vessels of sufficient quality made of Egyptian Nile clay at the right size. However, mullite crucibles of 18.5cm diameter and 5.5cm height were available from the Department of Engineering Materials at Sheffield University. This size is within the range of variation of the ancient cylindrical vessels, and may say something about the suitability of this shape and size for glass production. 700cm^3 of batch material was placed in this type of crucible. A second type of mullite crucible was also used, measuring 7.5cm in diameter and 9.0cm high and was used to contain 160cm^3 of batch. No ancient equivalent of this size is known, and its use was entirely experimental.

An attempt was made to cover both types in Nile clay to give them a wall thickness more comparable to the originals, and to make them more robust. It was expected that this coating would crack and break away during firing, and this happened to some extent with each of the vessels.

So-called "Nile silt clay"[3] has a melting point of around 1100–1150°C. As a result the ancient craftsmen would have been able to see, via the furnace stoke hole, the state of their reaction vessels. As they glowed hot, and started to look shiny, it would be apparent that they were in the correct range,[4] and an attempt to maintain that temperature could be made. It was hoped that the coating of Nile clay would at least help the experimenters to judge that point, independent of the thermocouples (below).

Fuel

At the time the experiment took place no analyses of the charcoal from the excavated Kiln 3 had been

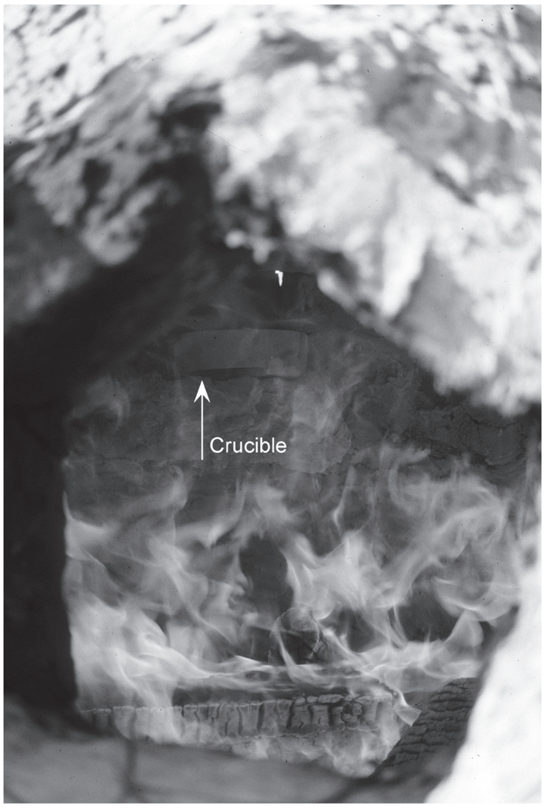


Plate 4.10. One of the cylindrical crucibles on the southernmost shelf of the reconstructed furnace. It was expected that this would provide the best visual record of the process since it could be monitored through the stoke hole.

carried out. Dr. Mary Anne Murray of the Institute of Archaeology subsequently identified a sample as being *Ficus sycomorus* and Dr. Rainer Gerisch has identified further samples of the same species and of *Acacia* in his examination of all of the charcoal from the site (Appendix 3).

The discovery by Petrie (1894:26 and Pl. xlii, here Fig. 2.2) of what he believed was a furnace for charcoal making is of little help in this context, since he fails to give its precise location, and the type of charcoal was not identified. It does however, raise the possibility that charcoal was deliberately produced for high temperature industries, although it is unlikely this was glass production as wood is a more suitable fuel for melting glass, and is specifically mentioned in the Cuneiform texts (Oppenheim 1970:58). Nonetheless, if charcoal were used in this way it would be contrary to recent Egyptian practice, and unlike the process carried out in Britain until recent times (see Chapter 2). Furthermore, Dr. Caroline Vermeeren (pers. comm.) informs us that long lengths of carbonised wood, such as those found in Kiln 3 are unlikely to result from the charcoal making process.[5]

The experimenters also had doubts about the use of deliberately produced charcoal for the furnace and so used dry wood as fuel. A mixture of woods was used. This mixture comprised palm ribs (*jereed*) which was plentiful locally, and would have been readily available in ancient times, and also pine from well dried planks. Billets of two types of wood were also obtained from a local saw mill. These were subsequently examined at Kew Gardens and identified as *Eucalyptus sp.* and *Morus sp.* (Mulberry). Neither of these is indigenous to Egypt, and were the experiment to be repeated only locally available fuels would have been used. However, it should be recognised that obtaining sufficient quantities of *Sycomorus* or *Acacia* locally would nowadays present difficulties.

The different types of fuel were put into separate piles, and the weight of each type used was recorded during the firing.

The Firing

Firing took place on September 12th, 1996. On the western shelf were placed two tall crucibles, one containing the 2:1 by weight ash:sand mixture, the other green cullet from broken soda-glass beer bottles.[6] This was included so that should it prove impossible to reach a temperature sufficient to fuse the batch materials it would be known that the furnace was nonetheless capable of reaching temperatures sufficient to melt cullet. Such a discovery might make it more likely that the furnaces were for glassworking rather than glassmaking. A k-type thermocouple was located beside this shelf.

Each of the other two shelves (south and south-east) was provided with one of the wide cylindrical vessels. The southernmost emplacement was visible through the furnace stoke hole and was expected to provide visual confirmation of the firing stages (Plate 4.10). A thermocouple was located at this point. The embayments themselves were blocked using mudbricks. Whilst these provided good insulation, they were difficult to remove and replace when required. Were the experiment to be repeated then purpose made clay tiles would be used for the purpose.

Once the fire was lit the temperature increased rapidly during the first two hours to about 1000°C, which is generally regarded as the upper limit of a conventional updraught kiln. It was found that burning *jereed* helped to raise the temperature quickly, whereupon the timber off-cuts could be used to maintain it. The pine fuel served an intermediary role—burning more rapidly than the timber off-cuts, but more slowly than the *jereed.*

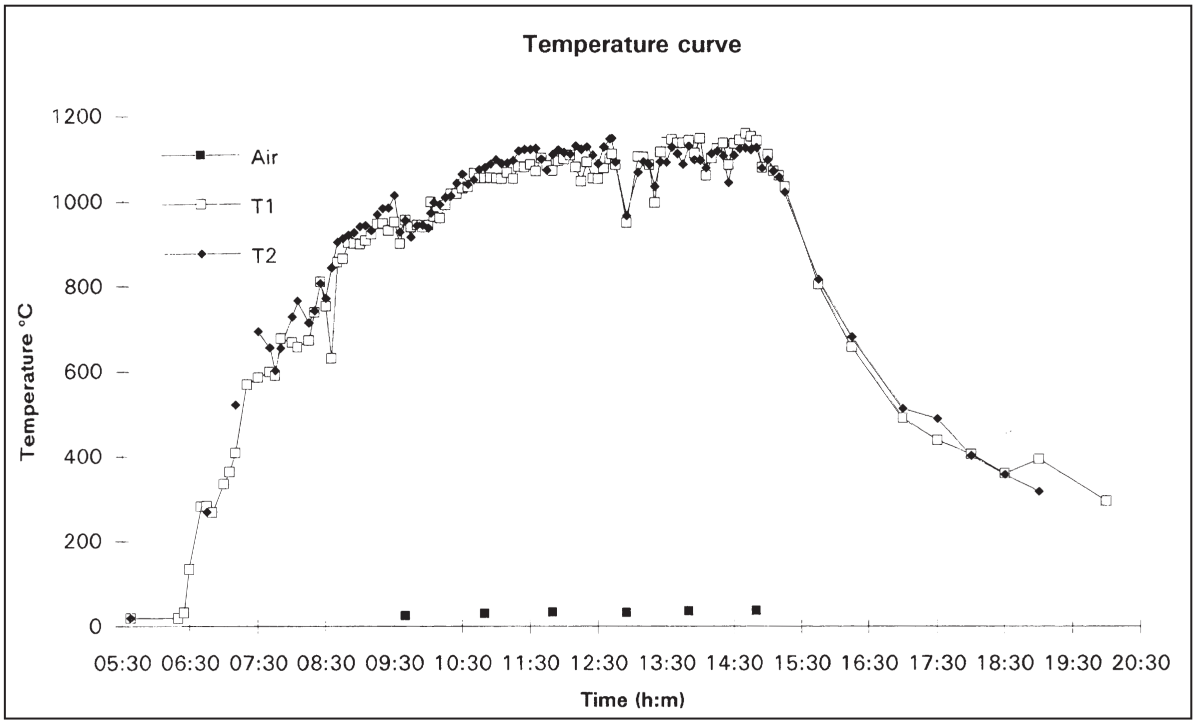


Figure 4.2. Graph showing the progress of the experimental firing on September 12th, 1996.

Plate 4.11. Firing in progress on September 12th, 1996. A wall of uncemented bricks has been added to the east side of the stoke hole to help funnel the breeze. The opening in the top of the dome has also been constricted to help retain heat.

Since the prevailing wind at Amarna comes from the north, it blew straight into the furnace stoke hole. It was very quickly apparent that no artificial forced draught would be necessary for the experiment. This discovery tends to support our view that the brick blocking on the north side of Kiln 3 was indeed infill for the stoke hole once the furnace had gone out of use. It was also found that by adding a low wall of uncemented bricks on the east side of the stoke hole and at a slight angle to it, the wind could be better channelled into the furnace (Plate 4.11). This was gradually enlarged during the firing. There is no archaeological evidence for such a device being used at O45.1, but given that the superstructure of the furnace would be demolished in order to re-line it, any trace of such an ephemeral wall would be destroyed with it.

It was also obvious that the opening in the top of the dome was much larger than necessary, and further bricks were put around this to reduce its diameter, so retaining more of the heat. The reduction of the opening in the dome, and the use of the temporary wall to channel the wind into the furnace should not be taken to imply that it was difficult to maintain or develop a high temperature in the furnace. It had been expected that temperatures over about 900°C might be difficult to achieve, but this did not prove to be the case. Stoking of the furnace was relatively simple, with billets of wood thrown in systematically so that the fire was maintained all around the circumference of the furnace. The stoke hole was sufficiently large to allow the fuel to be thrown in with some accuracy so that it landed where most necessary, often at an angle to the wall such that air was able to circulate all around the fuel, burning it completely and effectively. The fuelling method used was based on trial and error, but is similar to that described by Cable (1998).

If large quantities of fuel were thrown in quick succession temperature was initially reduced, sometimes by more than 50°C, but then quickly recovered to reach a higher temperature than previously. As might be expected, if large amounts of fuel were thrown in, combustion was not immediate and there was a period of smokey, reducing fire before a clean fire was resumed.

One of the discoveries of the experiment was the difficulty of raking or poking the fire using only a wooden poker. A long piece of *jereed*, in fact a whole branch trimmed of leaves and spikes, was used, the end being continually quenched in water. This poker had to be replaced at regular intervals.

After five hours a temperature of 1100°C was reached, with a maximum temperature of 1150°C achieved after 6 hours and 20 minutes (Fig. 4.2). Shortly after this maximum temperature was reached the shelf on the south side of the furnace, opposite the stoke hole, collapsed. As a result the crucible and batch on that shelf was lost, which also meant that there was now no visible crucible by which to judge the firing effects. The collapse of the shelf does not seem to be related to the fact that at around 1150°C the Nile silt clay becomes molten and fails, the other shelves showed no signs of failure, nor did any other parts of the structure, though they may well have done had this temperature been maintained for a long period of time. The reason for the collapse was probably a larger than average stone accidentally incorporated into one of the bricks (as only one of the two shelf bricks failed), or a small crack caused when setting the bricks.

However, at the time of this failure the cause was unknown and it was thought prudent to open the western embayment of the furnace and examine the contents of the two tall crucibles. Predictably, the green glass cullet had melted to give a good quality, bubble free glass. The batch materials in the other crucible had become a crystalline mass of green-blue material, closely resembling the frit material found by Petrie at Amarna. After photographing the material the crucible was returned to the furnace, which showed no further sign of structural failure, and the firing was continued.

The total duration of firing was 8 hours and 50 minutes, with temperatures above 1100°C maintained for about 4 hours.

Type of Fuel	Weight – Kilograms
Palm rib (*jereed)*	68.00
Pine	85.00
Eucalyptus sp. and *Morus sp.*	227.00
Total Weight	**380.00**

Table 4.1. Fuel weights by type.

The total quantities of fuel used are given in table 4.1. The large amount of timber off-cuts used (*Eucalyptus sp.* and *Morus sp.*) reflect the desire to maintain the temperature reached. However, the figure also reflects the fact that this was the most plentiful fuel, and there is no doubt that the temperature could have been maintained by using a correspondingly large quantity of pine or similar timber. Although the amount of fuel used is considerably less than the experimenters had predicted, it is still likely to be more than would have been used anciently, since the Amarna glass makers would have had a good deal more experience than their modern apprentices.

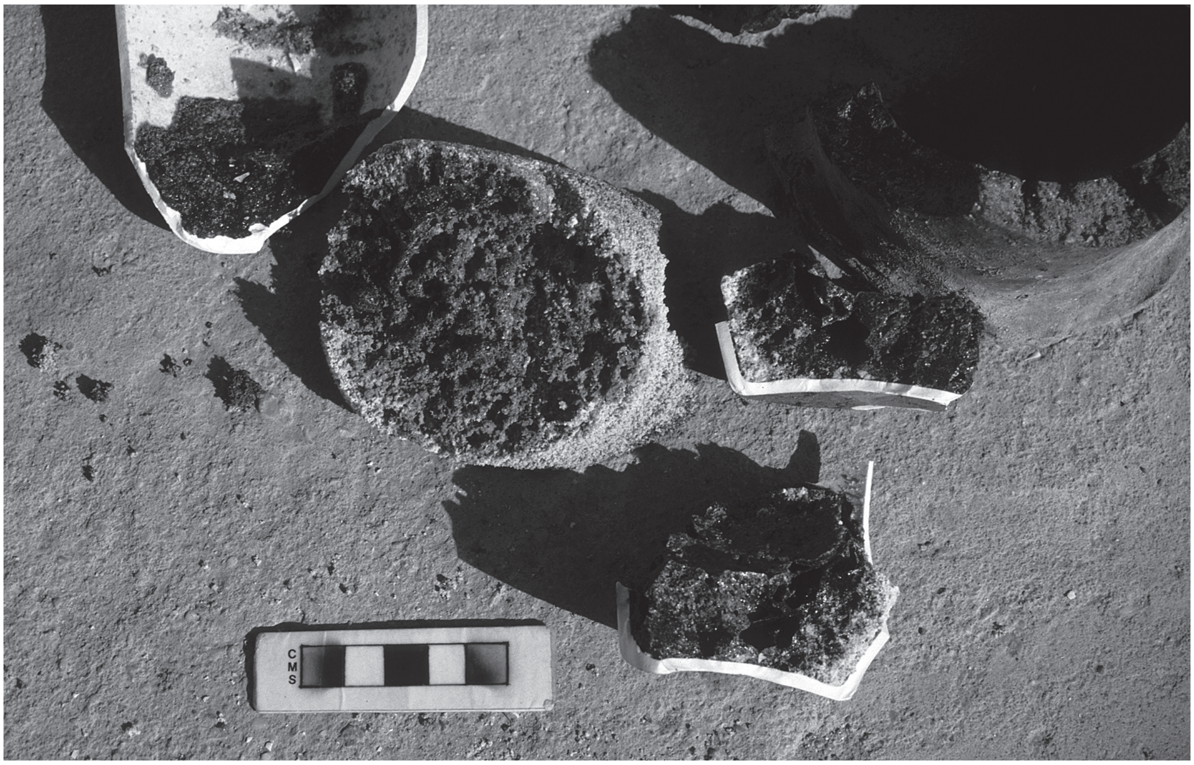


Plate 4.12. The crucible from the western siege after firing. It has been broken open to show the product—blue frit. At the bottom of the vessel the material is becoming vitreous.

We are aware, of course, that different timbers have different calorific values. However, it was obvious from observation of the pyrometer that the result achieved did not depend upon the timber off-cuts, and that high temperatures could be maintained using pine. Presumably a similar situation would have occurred if other woods had been available for use.

At the end of firing the tall crucible in the west embayment, containing the frit material, was removed and the opening re-closed. The stoke hole was blocked and the furnace left to cool overnight.

The Products

The tall crucible, which had been observed to contain frit when it was examined after 6 hours and 20 minutes, and then returned to the furnace, was broken open at the end of the firing (Plate 4.12). The upper surface had remained as frit, it had a distinct blue colour with specks of un-reacted silica. The lowermost part of the charge had fused to a dark grey-green with numerous vesicles. The glass has little resemblance to that found from excavation at O45.1, or from Petrie's work, though the upper part is very similar to frit (Plate 4.13). However, the composition of the experimental frit is different from the excavated frit, since the former had been produced from glassmaking raw materials.

Petrie had believed that the frit was the first stage in glassmaking, but Shortland and Tite (1998) showed that the frit has a lime content lower than that of the glass. However, their view has recently changed (Tite and Shortland 2003:285, 305–6) and they now suggest that the frit was indeed used in glass colouring. Whatever the true picture, it can be said that the experiment successfully produced frit.

It will be recalled that one of the two wide crucibles, most closely similar to the ancient examples, was lost when the southern shelf collapsed. The other one was left in the furnace overnight, and had not been checked during the experiment. This remaining crucible was removed at 06.30 on the morning of September 13th and found to contain a thin ingot of deep cobalt blue glass. The glass was of good quality, with very few bubbles or pieces of un-reacted silica (Plate 4.14).

It is likely that glass formed in this easternmost crucible for two reasons. First, the wide and shallow crucible shape allows a greater surface area to be exposed to heat than does the taller vessel form, as present on the west. Second, the crucible was undisturbed throughout the firing and was left in the furnace overnight. Unfortunately there was no thermocouple next to the eastern shelf where this last crucible was situated, and the temperatures can only be suggested from the other two thermocouples. It may be that this eastern part of the furnace was slightly hotter than elsewhere,

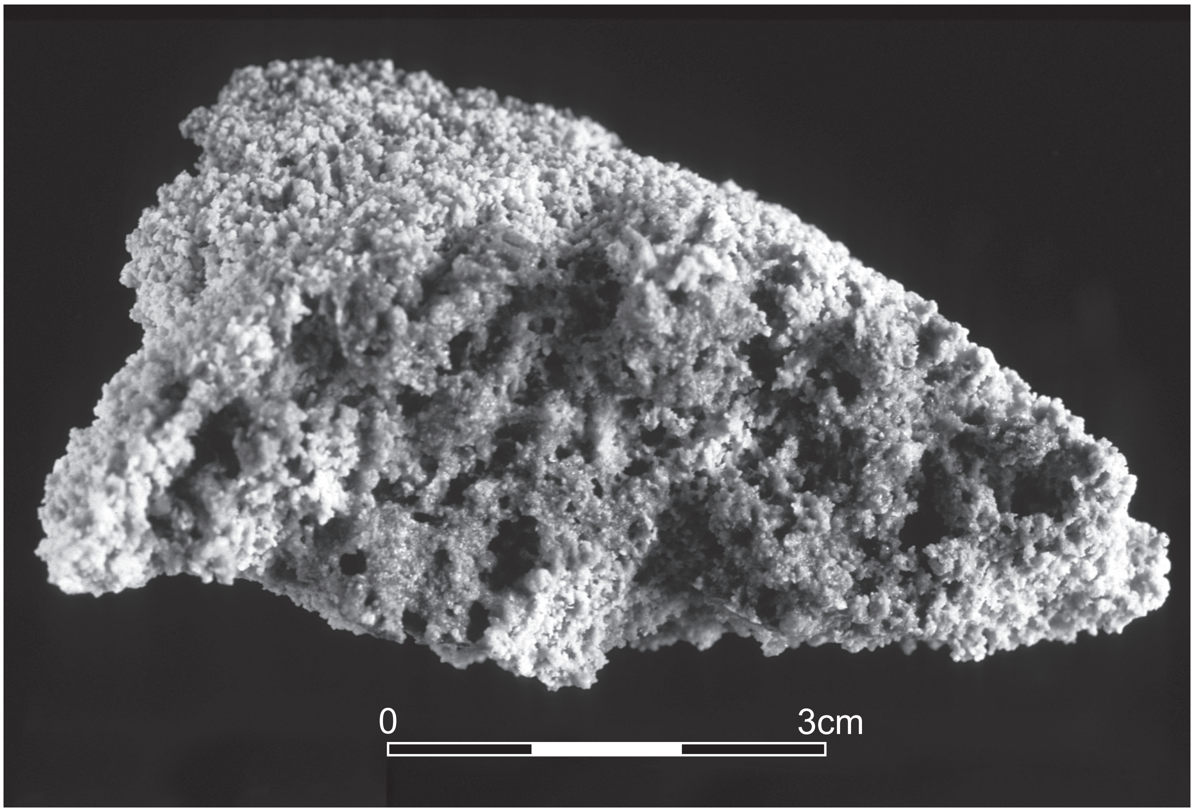


Plate 4.13. Detail of the experimentally produced blue frit from the western siege. (Photo: John Morgan).

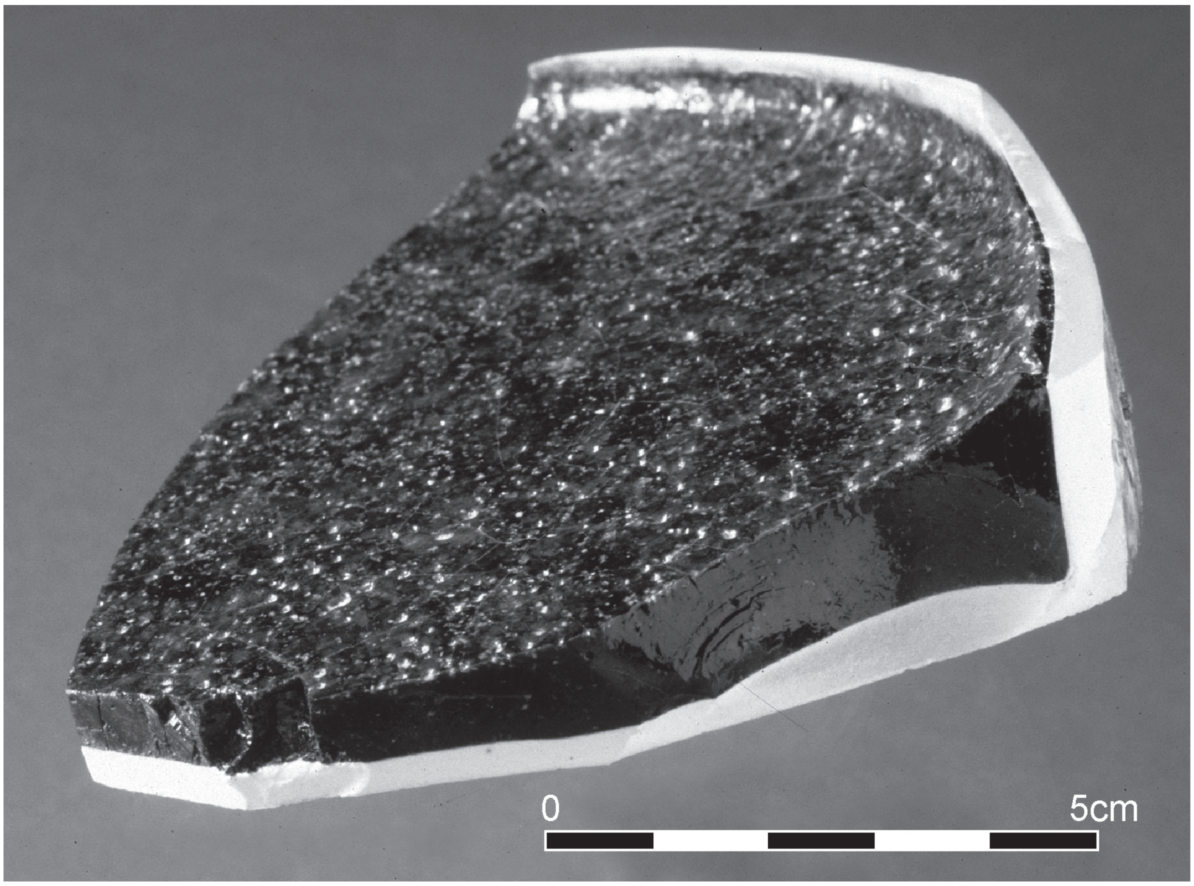


Plate 4.14. Experimentally produced blue glass ingot. (Photo: John Morgan).

but it is unlikely that it was as high as 1150°C for any significant length of time; there is no indication that any part of the furnace maintained such high temperatures for long periods. It therefore seems reasonable to suggest that the glass formed at around 1100°C and may already have been formed by the time the stoke hole was blocked. The subsequent slow cooling of the furnace probably served only to anneal the ingot.

The experiment therefore suggests that Egyptian glass *could* have been made in a single stage operation without the necessity of fritting. This does not, of course, mean that the glass *was* made in this way. The ingot was thin because no attempt was made to top-up the batch materials as they melted. The recent study by Rehren and Pusch (2005) lends weight to the idea that the cylindrical crucibles could be topped up, either with batch materials, or with powdered glass as they suggest. Obviously, the more often one opens the embayments the longer firing would take because of the decrease in temperature caused by such actions. However, with practice this could be minimised. The glass from the ingot remains stable and undeteriorated at the time of writing (2006).

Composition of the Glass

The experimentally produced ingot has been examined at the Department of Earth Sciences, Cardiff University, using a scanning electron microscope equipped with an energy dispersive spectrometer. The results are given in table 4.2.

Components (wt %)	Experimental glass	Cobalt glass from Amarna (Lilyquist *et al.* 1993:41) Brill 1999b:27 sample 3357)	Uluburun ingot (Brill 1999b:53, sample 5954)
Silica (SiO_2)	60	67	67
Soda (Na_2O)	10	18	17
Potash (K_2O)	6	1	1
Lime (CaO)	10	8	7
Iron oxide (Fe_2O_3)	unknown	0.5	0.5

Table 4.2. Comparison of ancient and experimental glass compositions.

At 16%, the total alkali content of the glass (Na_2O plus K_2O) compares favourable with the total sodium and potassium content (c.19%) of a typical Amarna cobalt glass as analysed by Brill (1999b:27, sample 3357). The slightly lower total alkali content and higher proportion of potash to soda in the experimental glasses, is outweighed by the higher concentration of silica in both the typical Egyptian glass and the Uluburun ingot, indicating the melting temperatures would be of a similar order. Slight differences in composition are to be expected because of the substitution of seaweed for a more authentic (but as yet unknown) plant ash source, and because of the inherent variability in plant ashes even of the same species.

By-Products

One of the benefits of an experiment of this kind is the opportunity to examine by-products of the process. When the crucible was removed on September 13th, it had stuck to its outside the remains of the clay which had been applied to it. This clay had fused to become *khorfush*. This might be taken to show that the crucibles would not have withstood the heat treatment they were given. However, it will be recalled that the clay was not fired before the firing began, nor was it a complete coating since large chunks flaked off during the firing. As a result the broken edges of the clay coating were exposed to a great deal of heat, and are likely to have melted more easily than a complete vessel would have done.

Some support for this view is found from examination of the furnace lining itself. This did not melt to *khorfush*. The result was not an unexpected finding, since it is believed that it would take several firings for this to happen.

Examination of the underside of the crucible showed that some of the plaster lining of the furnace had, however, become stuck to it—but by no means fully fused. What was found adhering was a coarse yellowish plaster, of the kind found in large quantities in the excavation. This might suggest that such plaster came from the sieges in the furnace, and perhaps from other parts of it. It appears to form most readily close to the openings in the furnace, and especially where there is contact between the crucible and the shelf.

Conclusions And Further Work

The glassmaking experiment proved valuable in determining that the excavated structures (Kilns 2 and 3) at site O45.1 were not too large to have served as glass furnaces. Furthermore, it proved that temperatures sufficient for the making of glass from its raw materials could be achieved without the use of artificial forced draft, and that these temperatures were around 1100°C.

It was also demonstrated that the glass could be produced from local sands without the deliberate addition of lime. Only the alkali source was a substitution for a local plant ash source. Despite this the composition of the glass produced was similar to that of excavated glasses from Amarna. The experiment was therefore successful in providing answers to all of the questions posed for it (above). In addition, it gave a valuable insight into the construction and possible manner of operation of such a furnace.

It must be recalled that this was the first attempt by the experimenters at building and firing such a furnace, and their first attempt to produce glass in the field. It can safely be assumed that the amount of fuel used would be substantially reduced given more experience, and that the quantity of glass produced could be greatly increased, both by "topping up" the crucibles and by including more crucibles in each firing. The number of embayments was kept to a minimum for the reconstruction, but more would allow easy access to a greater number of crucibles.

Subsequent to the 1996 experiment the Egyptian Security Services required the building of a high stone wall immediately north of the furnace, effectively cutting it off from the north wind and making follow-up experiments impossible. However, should it be possible to resume these in the future the following would be desirable:

1. Use of a potentially more authentic plant ash alkali, if one can be identified which would produce a glass of a "typical Egyptian composition".
2. Use of natron alkali source.
3. Use of mixed alkali sources.
4. Use of authentic Nile silt crucibles.
5. Use of *Acacia* and *Sycomorus* timber if available, or of other anciently available fuel woods.
6. Determination of the minimum time, temperature and fuel required to successfully produce glass in a single stage.

To the question "Did the ancient Egyptians make glass in this way?" the answer can only be that we do not know, but that they *might* have done. Experimental archaeology cannot *prove* beyond doubt that they did. The experiment depends upon a number of assumptions, not least that the furnaces are for the production of glass. The evidence for this is discussed elsewhere in this volume.

Chapter 4

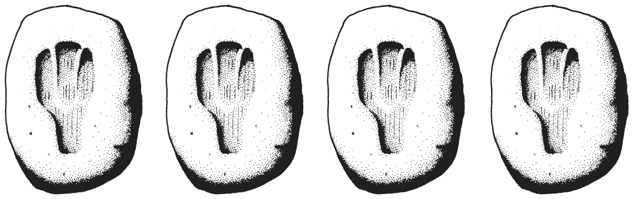
Endnotes

1. For example BM 120960 from Assyria. No Egyptian accounts are known.
2. Excavation number 00/0344.
3. Geologically speaking this is a contradiction in terms, but the term has become established in Egyptian ceramic studies.
4. c.1100°C.
5. It must be stressed that Dr. Vermeeren has not herself seen the material but has based her opinion on descriptions provided by Nicholson.
6. Confirmed as soda-lime-silicate glass by analysis.

Chapter 5

Compositional Analysis of the Vitreous Materials Found at Amarna

Caroline M. Jackson and Paul T. Nicholson



Introduction

In the past few years there has been a renewed interest in Egyptian glasses, and a number of scientific papers have appeared which have sought to locate the provenance of the glasses and their raw materials, and develop an understanding of the technology which was applied in their manufacture. Many of these papers have centred upon analyses of glasses from Amarna and so will be drawn upon in the discussion below (Lilyquist *et al*. 1993, Jackson *et al.* 1998, Rehren 2000b, Shortland 2000, Shortland and Tite 2000, Tite and Shortland 2003 see also Tite, Shortland and Hatton, this volume). The analyses here will both complement and build upon these publications.

This chapter examines the analytical data generated from the analysis of vitreous debris from the glassmaking process found at Amarna and fully finished glasses. The samples were collected from the current excavation of O45.1 and are supplemented by samples donated by Petrie to Manchester Museum and the Petrie Museum, University College London.[1] All except three samples from Gurob, derive from Amarna. The purpose of the analysis is to help us determine the nature of the vitreous industry at Amarna and to understand better the production of glass and the organisation of the glassmaking industry in Egypt during the 18th Dynasty. The compositional data presented below is that obtained from chemical analysis using electron probe microanalysis (EPMA)[2] and scanning electron microscopy with analytical capability (SEM-EDS)[3].

Methodology

Two types of instruments were used to produce the data presented in Appendix 5. The methodologies adopted were chosen because of the small size of samples which negated the use of wet chemical means such as ICP-AES[4] analysis or similar (laser ablation ICP-MS[5] was not readily available at the time of analysis). A suite of blue-coloured samples were analysed using the Manchester N.E.R.C. EPMA facility using a *Cameca SX100* electron probe microanalyser with wave dispersive analysis, housed in the department of Geology, University of Manchester. The data generated presents a good range of elements, many to minor and trace concentrations.

Unfortunately the EPMA facility was not available for the remainder of the analyses which were conducted at the school of Earth Sciences, University of Cardiff,[6] on a *Carl Zeiss SMT S360* scanning electron microscope with an *Oxford Instruments AN 10000* analyser. This allowed determination of the major elements but could not determine many of the minor or trace elements which would have helped interpretation of the data. Usefully, the SEM was fitted with photographic capabilities and this allowed examination of the microstructure of the samples being analysed.

For both techniques the samples were mounted in epoxy resin, polished to ¼ μm and carbon-coated before analysis. The results are discussed below.

Examination of the data

The accuracy of the data proved to be extremely good. For EPMA most major elements were accurate to below 3% and minor/trace elements below 10% (the majority below 5%). The SEM data were exceptionally good with nearly all elements showing accuracy below 5%, although only major/minor elements (Si, Na, Ca, K, Mg, Al, Fe, Cu, S and Cl) could be measured because detection limits were relatively high. Ti, Sb, Mn, Co, Sn and Pb were generally below detection in most samples and are only reported when they are above detection. In general, where the same sample has been analysed more than once, the EPMA results are presented because in this case this method can analyse for a greater number of elements.

The EPMA data presented for the blue glasses are the means[7] of between 4–6 analyses taken on each sample. The number of analyses depended upon the homogeneity of the sample, many showing a very variable composition over a small surface area, although this phenomenon is not easily observed by eye. It is more easily observed in the opaque glasses where crystals are present, such as the yellow samples, where visible changes in composition can be observed in the form of 'swirls'. These technological traits suggest incomplete mixing of the glass. As both methods used in this study rely on spot analysis at a micron level, differences in composition between different samples may be caused by inhomogeneity within the sample rather than real differences between samples. Therefore the data presented here is used to determine broad compositions, and groups are only defined when they are (a) quite different from each other and (b) can be demonstrated by a significant number of samples and a trend can be observed. The advantages of using these techniques, in addition to the minimal destruction required of the sample, are that these techniques can examine structure within the specimens, identify certain technological characteristics which may help our understanding of the manufacturing process.

A General Glass Composition for Egyptian glasses

Caley (1962) in his examination of the analyses of Egyptian glasses up to 1957 summaries the understanding of Egyptian glass compositions up to this time, and what this may suggest about the raw materials used to manufacture them. He concludes that a mixture of natron and plant ash was used to produce the typical soda-lime glasses found in Egypt. The use of natron would introduce high concentrations of soda, and the plant ash the elevated magnesium levels which could not be explained by the use of natron alone. He suggests that "the manufacture of glass in ancient Egypt from only two raw materials seems unlikely" (1962:82). Further work by a number of different authors suggests this statement may be incorrect and a two component mixture is likely (Turner 1956, Sayre and Smith 1967, Lilyquist *et al*. 1993). Nevertheless, although the picture of glass production in Egypt has been refined, it is not yet fully understood. Further analyses, since the 1950s has shown that the general composition of Egyptian glasses is consistently based upon a soda-lime glass with minor concentrations of potash and magnesia—something that Caley observed. It is now thought that this composition is typical of one which was produced using halophytic plant ashes, high in soda, as the alkali. The use of a plant ash alkali introduces a few weight percent of potash and magnesia into the glass, in contrast to mineral alkalis which have less than one percent of these components. Other impurities in the glass matrix, such as phosphorus and manganese, can also be explained by the use of a plant ash alkali. The low impurity pattern in these glasses which can be attributed to the silica, especially the low concentration of iron oxide at an average of 0.5 wt%, could argue for either the use of quartz pebbles or a "pure" silica sand as the main glass former, as Tite and Shortland (2003) suggest (see Chapter 6). The alumina (below ~1%) present in these glasses would derive from the silica source and/or possibly be introduced with the plant ash. This composition represents what we will term a "typical Egyptian glass composition" and is consistent, with very minor variation, for Egyptian glasses spanning many hundreds of years and over a wide geographical area.

The glasses analysed here exhibit this "typical Egyptian" composition. However this broad composition can now be divided into subgroups which are associated primarily with different colours of glass, but also with the primary raw materials used to form the glass itself. The following discussion introduces these sub-groups of glass and looks at their compositions in the light of the organisation of the Egyptian glass industry. The analysis of the industrial debris found at Amarna, associated with the glassmaking complex (Chapters 2 and 3), is then discussed in order to explore the technology of glass production in Bronze Age Egypt and to throw light upon how and where glasses may have been produced in Egypt and beyond.

The analysis of fully formed glasses

The discussion of the glass compositions below is structured around glass colour. Blue glasses form the largest group of analyses as these glasses were associated with the industrial debris collected from the most recent excavations at Amarna site O45.1. The

Colour	n	SiO2	Na2O	CaO	K2O	MgO	Al2O3	FeO
Cobalt	13	65.00	18.89	6.95	0.89	3.26	2.42	0.64
Copper	21	63.27	17.07	8.64	2.37	3.84	0.76	0.47
TiO2	**Sb2O3**	**MnO**	**CuO**	**CoO**	**SnO**	**PbO**	**SO2**	**Cl**
0.15	0.12	0.14	0.29	0.14	0.01	0.02	0.33	1.13
0.10	0.23	0.30	1.73	0.00	0.16	0.01	0.37	0.91

Table 5.1. Mean compositions of blue glasses analysed by EPMA (many elements shown here were not detected by SEM).

analyses of blue glasses represent samples collected from the present excavations at Amarna, the Petrie Collection and from Manchester Museum. The other glasses analysed are from the Petrie Collection and Manchester Museum only.

Blue glasses

Two compositional groups are present in the blue glasses (Table 5.1), in agreement with analyses of blue glasses reported from a number of sites in Egypt (e.g. Sayre and Smith 1967, Lilyquist *et al*. 1993, Shortland and Tite 2000). The differences in the glasses appear to be based primarily upon the colourants used to produce the blue hue, but there has also been some discussion relating to the primary raw materials used to manufacture these glasses. The majority of these samples were analysed by EPMA as this technique could determine the minor colouring elements, such as cobalt. A small set of samples were also analysed using SEM to determine major elements and these have been plotted where appropriate. It can be seen that there is no compositional difference between samples from the present excavation and those brought back by Petrie. This is to be expected as all samples were recovered from the same site which was occupied for less than 100 years. The samples analysed include some examples of glass thought to be related to "production debris", and finished vessels (See Appendix 5).

Early Egyptian blue vitreous materials, including glasses, were coloured using either copper or cobalt. Many of the samples analysed here contain varying concentrations of copper. The use of copper has produced a colour variation from green through turquoise to a deeper blue. The source of the copper is likely to be related to metallurgical practices as many contain concentrations of tin which would be consistent with the addition of a 5–10% tin bronze added as a colouring agent during glass manufacture.

The results also show that some of the deep blue samples are coloured with cobalt. The association of a singular suite of elements would suggest that these blue glasses can be linked elementally to the alums from the Dakhla and Kharga oases in Egypt, first identified as Egyptian glass colourants by Kaczmarcyzk (1986). These alums contain, in addition to the cobalt, aluminium, magnesium, manganese, iron, nickel and zinc which is then incorporated into the glass. This is illustrated in Figures 5.1 and 5.2 and Table 5.1. Figure 5.1 shows that in the cobalt blue glasses nickel and zinc are found at higher concentrations than in the copper-coloured glasses. The positive correlation of the two elements would suggest they had a common origin. Figure 5.2 shows the elevated levels of alumina in the cobalt blue glasses which may have been introduced with the alum. The tight correlation of alumina and titania in the copper glasses is likely to have derived from the sand and many indicate a common source.However, the contribution of the plant ash to the titania and alumina concentrations cannot be discounted.

Shortland and Tite (2000) argued that these cobalt blue glasses were *natron* based glasses, coloured with a purified cobalt alum, which if added in

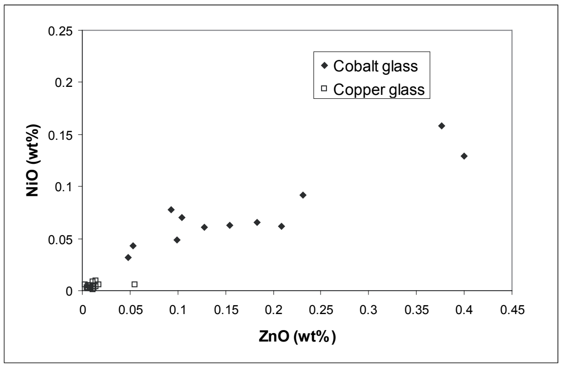


Figure 5.1. Nickel and zinc concentrations in blue glasses from Amarna.

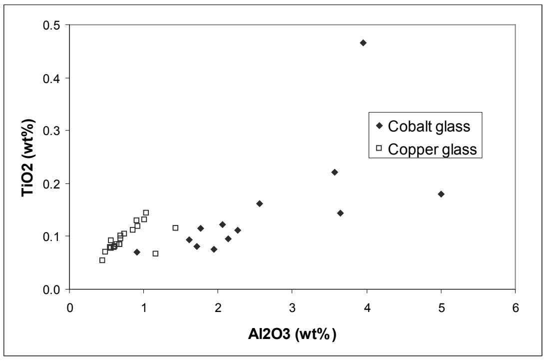


Figure 5.2. Alumina and titania concentrations in the blue glasses from Amarna.

the raw state would increase the concentrations of elements in the glass known to be present in the alums (e.g. Mg). However, the difficulties of relating the alum composition to the cobalt glasses, and so predicting the raw materials used to manufacture the glass, is extremely difficult. This is because cobalt alums are heterogeneous, and differences in partitioning between elements in processing the alum to concentrate the cobalt, would produce an unpredictable colourant composition (Noll 1981b, Rehren 2001, Tite and Shortland 2003). This can be seen in the wide distribution of aluminium, iron, magnesium, manganese, nickel and zinc concentrations in the glasses. This in turn makes it more difficult to ascertain what the base composition of the glasses might be. This was illustrated by experimental work undertaken by Tite and Shortland (2003) where they attempted to calculate the contribution of the alum to the magnesia and alumina levels in the cobalt glasses. Their experiments proved inconclusive, except that they inferred that it is likely that natron was not the sole source of alkali used in manufacture of these glasses, but that a plant ash, naturally lower in potash, was used. This hypothesis, whereby a purified concentrate of cobalt was added to the glass, was originally suggested by Noll (1981b) and it would account for the slightly increased concentrations of sodium in the glasses and would allow for a base glass manufactured using *plant ashes* and silica pebbles.

This assumption can further be supported by the correlation between potash and phosphorus oxide, both components typically found in plant ashes, but not present at appreciable levels in quartz pebbles and sand (Fig. 5.3). Although the concentrations of these oxides are lower in the cobalt-coloured glasses, they

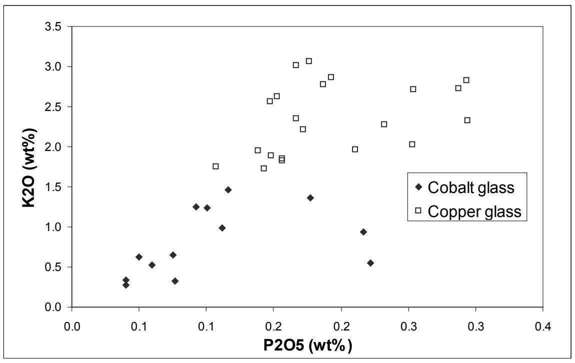


Figure 5.3. Distribution of potash and phosphorus pentoxide in blue glasses.

show a similar trend to those found in the copper-coloured glasses. This would support the view that the cobalt glasses were made using plant ashes, but ashes of a different composition to those used in copper blue glass manufacture. This working hypothesis does not rule out a dilution of plant ash with a pure evaporite source as Tite and Shortland suggest (2003), although in the case of the glasses here soda concentrations are similar in both groups of glasses with a mean of around 17–18%.

These divisions between cobalt and copper glasses are clearly not mutually exclusive. The most distinctive feature of the cobalt blue glasses is their high concentration of alumina, above 1.2 wt% and low concentrations of potash, below 2 wt%. However, Lilyquist *et al.* (1993) and Rehren (2001) had noted that glasses of colours other than "cobalt blue" can fall in this range (and this can be seen in Fig. 5.4, which shows a correspondence between the two data sets, and is noted in the discussion of other glasses below). Thus the data here suggests that cobalt blue glasses are low in potash, but not all low potash samples are cobalt blue. However, Smirniou and Rehren (2006) have recently reported at least one cobalt sample from Amarna (Petrie Museum collection) which shows elevated levels of potash, similar to those seen in glasses coloured by copper. However, the glass in question had 1.3 wt% copper colourant and 0.1 wt% cobalt, so their attribution of colour may be one which is open to dispute. Further analysis will either support this claim or discount this sample as an outlier.

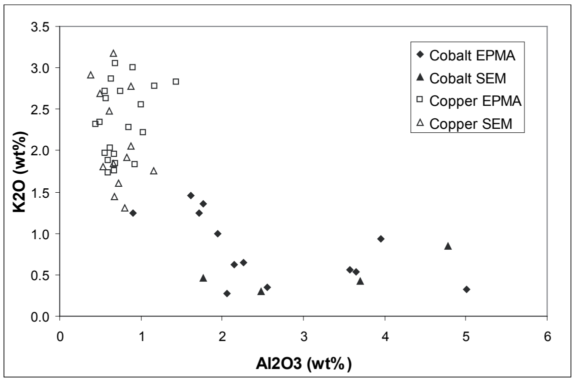


Figure 5.4. Distribution of alumina and potash in all blue glass samples analysed

This begs the question "when do we call a glass "copper blue" and when do call it "cobalt blue"?", as many glasses contain both colourants. Tite and Shortland (2003) suggest that as cobalt is present in nearly all the glasses to some degree, then a copper blue glass is one which has less than 0.05 wt% CoO and a cobalt one which has more than 0.05 wt%. If we take these concentrations for the glasses analysed in this study, then cobalt-coloured glasses have cobalt oxide from 0.06–0.31 wt% and 0.02–1.3 wt% copper oxide, and copper-coloured glasses have cobalt oxide all at less than 0.01 wt%, and between 0.08–3.7 wt% copper oxide. In these samples the copper-coloured glasses contain only traces of cobalt oxide, whilst the cobalt -coloured glasses contain varying levels of copper oxide too. These patterns are clearly intentional and, in the case of the copper-coloured glasses, indicates a very clear use of copper to produce blue.

However, visually the glasses do not fall into these simple compositional groups. Some of the glasses which are clearly a more turquoise-blue colour which might be indicative of a copper colourant (UC6524 and UC22910b), are placed in the cobalt glass group because they have cobalt at a concentration above 0.1 wt% and a copper concentration below 0.1 wt%. Likewise some dark blue samples which may indicate cobalt colourant have been placed with the copper-coloured glasses. Thus visual characteristics cannot be used to determine the colouring elements used.[8] Therefore the differentiation into two groups here is purely a chemical one, as the influence of the different colourants will depend upon the base glass composition in addition to the interplay between the differing colouring elements. As has been noted before, glass colour is difficult to determine because of glass thickness and different lighting conditions which will affect the perceived colour.

Thus the general composition of the blue glasses from Amarna suggest that plant ashes of slightly different compositions were used in their manufacture. The source of the silica is even less straightforward to determine. Tite and Shortland (2003) suggest the most likely source would be quartz pebbles because these are relatively pure and contribute few impurities to the glass (see analysis by Brill 1999b:474 of a pebble collected by Petrie from a kiln at Amarna). The use of pure sands would have a similar effect, but may have the added bonus of introducing calcium into the glass which acts to make the glass durable. Turner analysed sands from Amarna and found they would contain sufficient calcium to produce a stable glass (Turner 1956:281T). However, most plant ashes contain calcium, and many halophytic plants at a concentration sufficient to provide enough calcium in the glass (e.g. Brill 1999b:482–86), and so either sand or quartz could have been used in glass production, in a two component recipe.

The presence of antimony in some of the blue glasses is due to the contribution of calcium antimonate in the glasses which renders the glass semi-opaque, a common feature of Bronze Age Egyptian glasses. Opaque blue glasses reported by Mass *et al.* (2002:75) contain similar concentrations of antimony in their bodies, which they attribute to the mixing of blue glass and white calcium antimonate glasses to produce an opaque blue glass.

The origins of the blue glass.

Many authors have postulated about the origin of blue glasses found in Egypt (see Chapter 1). Whilst a specific and definite manufacturing location of these glasses is difficult to confirm at present by compositional analysis alone, there are two strands of evidence which may indicate an Egyptian origin for these blue glasses, and that some blue glasses were probably made at Amarna.

Shortland (2005) has suggested that the iron and titanium ratios can be used to distinguish glasses produced in Egypt from those produced in Mesopotamia (Tell Brak). The ratio of Fe:Ti is approximately 6:1 in Egyptian glasses and 10:1 for glasses from Tell Brak (2005:3). This he relates to contamination of the ash alkali through burning of the plants on a clay substrate, the cultivation of plants on clay-based soils or contamination from the crucible wall upon melting (although iron and titanium are present and correlated in many glassmaking sands (Jackson *et al.* 1990). The iron:titania ratio of the blue glasses analysed in this study gives a ratio which is always below 10:1 and is generally lower than 6:1. This evidence suggests an Egyptian origin for the blue glasses, but it does not clarify the place within Egypt where this glass may have been manufactured.

The second string of evidence is related to glass found on what is thought to be debris associated with glass manufacture. At least two blue glass samples analysed have been recovered from fragments of the cylindrical vessels, believed to have been used to form ingots (see Chapter 6); one of cobalt (UC22922a) and one of copper (TA143) suggesting that both glasses may have been produced on site, as it is unlikely ingots would have been transported in their moulds for reworking elsewhere. These glasses fall convincingly into the compositional groups formed by the other blue glasses analysed from Amarna.

Other Colours of Glass

Red, white, colourless, yellow, purple and brown glasses were sampled from Manchester Museum and the Petrie Museum, University College London. These samples were donated by Petrie from his expeditions to Amarna, and it is not known from where on the site they were collected. They mainly comprise rods and canes of glass which presumably would have been used for decoration in vessel, inlay or bead production. It may be that these operations took place in workshops away from O45.1, or indeed outside Amarna altogether.

Colourless and white glasses

Colourless glass is relatively rare in Egypt at this time. This is probably because the natural colour of glass would be a blue or, more likely, green hue, resulting from iron impurities present in the plant alkali and possibly the sand, if this was used. The analyses presented show all the glasses contain iron, generally around 0.5 wt% (Appendix 5). The composition of the single colourless sample (UC22919bB) falls well within the composition of Egyptian glass discussed above, and has an iron oxide concentration of 0.43%. Although the concentration of alumina falls below the 2 wt% threshold often attributed to the low potash glasses characterised by cobalt blue glasses, it also falls within the lower range of the typical plant ash glasses seen in most other colours, with a relatively high concentration of magnesia at around 5.0 wt%. The reason for the transparent colourless nature of the glass is not readily apparent from the analytical results; manganese or antimony are below the detection levels of the SEM, so it must be deduced that this glass was decolourised by careful control of the furnace atmospheres. This is further reinforced by the one early colourless transparent example of a bead from Hatshepsut published by Brill (in Lilyquist *et al*. 1993) which is compositionally similar to the piece seen here, also with relatively high magnesia, but which also contains no traces of decolourisers (Lilyquist *et al*. 1993: 36). The sample is a colourless rod which may have been used as a decorative element in jewellery.

Two samples of opaque white glass, one found in a "slaggy" mixture, are of a very similar base composition to the clear colourless glass. Both have been opacified using calcium antimonate. Although the calcium concentrations are not higher in this glass than other Egyptian examples, the presence of antimony at high concentrations (0.73 and 1.01 wt% respectively) would form the insoluble calcium antimonate crystal, commonly used to produce an opaque white colour. Mass *et al.* (2002:78) suggest that the antimony concentration in these glasses is lower than that seen in later Roman glasses, and attributes this to the mixing of opaque white imported glass ingots with colourless glass. While this is a reasonable hypothesis, the presence of truly colourless glass in Egypt is quite rare and it is unlikely this was produced solely to mix with imported glasses. It is more likely that antimony was added directly during manufacture to produce the opacity. Sample MAN2614 has relatively high concentrations of alumina (1.87 wt%), and SEM analysis showed areas which were rich in iron and titanium which may indicate un-reacted minerals within the glass (ilmenite?). Analyses of opaque white glasses from vessels with very similar compositions can be found in Lilyquist *et al*. (1993:37) from the reign of Amenhotep II, and from Amarna (Henderson 2000a: 215; Brill 1999b:29).

Translucent and opaque yellow glasses

The yellow glasses are opacified with lead antimonate, which is present as crystals in the matrix. Unfortunately antimony was below detection in the glass matrix, therefore the analyses seen in Appendix 5 show appreciable concentrations of lead, up to 10 wt% in some phases, but antimony below detection. Rehren (2000a:8) also noted a low concentration of antimony in yellow glasses analysed by others (Sayre and Smith 1967, Lilyquist *et al*. 1993) but offers no explanation. Mass *et al.* (2002:79) suggest the lead antimonate derived from cupellation lithage, a bi-product of silver refining, although Rehren (2003) refutes this and suggests the lead and antimony were introduced from mineral sources. Lead isotope analysis by Lilyquist *et al*. (1993:61) of opaque yellow glasses from Wadi Qirud suggested the lead had a Mesopotamian source. Analysis by Shortland (2000:51) of yellow faience and glasses suggests some had an Egyptian source (Chapter 6). The samples here have not been analysed for lead isotopes and so an assignation of the source of the lead cannot be made. In two samples (MAN2664, UC22916b) copper was also detected up to 1 wt%, which has not appreciably affected the yellow colouration; the addition of copper to a yellow glass base might produce a green hue. The base composition of these glasses is typical of a plant ash glass, similar to the plant ashes used to produce the turquoise blue glass; potash concentrations range between 2.7–3.5 wt% with magnesia concentrations around 3.7–4 wt%. These analyses all derive from trails or thin rods which may have been used as decorative elements in vessel manufacture.

The opaque yellow glasses exhibit a high degree of heterogeneity in the glassy matrix. The incomplete mixing of the crystalline components gives some indication of the method of manufacture, especially of the rods. This is particularly evident in an opaque yellow glass cane MAN2647 (Plate 5.1), but is also seen in other canes which display a central "swirl" of glass, shown in backscattered electron beam as an area of slightly different composition (with fewer opacifying crystals). An examination of the outer surface of the rods shows linear striations as though the glass has been pulled or marvered. It is possible that these artefacts were manufactured in a similar way to that used in producing "seaside rock" confectionery, with the hot glass being folded, marvered, reheated and then pulled to produce a thin rod of glass to be used for decoration. This analogy fits well with Petrie's discussion of the production of "clear" glass (Chapter 2). He suggested that lumps of glass were heated and worked on a flat surface to produce a "roll". This colour patterning could be achieved by mixing of different coloured glasses in the same way modern glassmakers produce multi-coloured glasses, by dipping the hot surface of the glass in powdered coloured glasses to get an opaque decorative effect on the outer surface. In this case the opacifier/colourant is clearly folded into a glass of a slightly different composition. This process

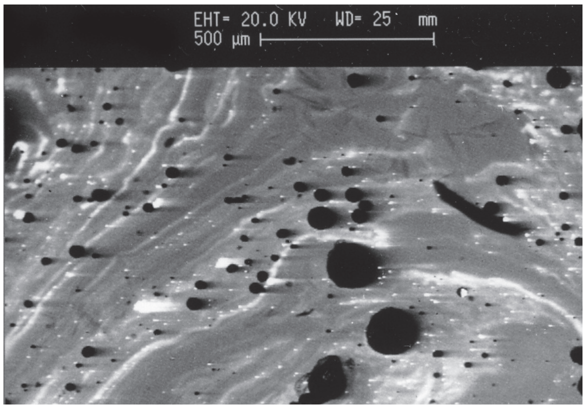


Plate 5.1. The opaque yellow glass (MAN2647) illustrating incomplete mixing of the crystalline components. This is evident from the central "swirl" of glass, shown in the backscattered electron beam image as an area of slightly different composition (with fewer opacifying crystals). (Photo: Caroline Jackson/Paul T. Nicholson).

may have been necessary because heating the glass too much would cause the opaque crystals to dissolve into the matrix. Alternatively two different "base glasses" may have been mixed to produce an opaque yellow, an idea propounded by Mass *et al.* (2002) for green glasses from Malkata and for the opaque yellow glasses where lead-rich phases are observed. They attribute this to the remelting and mixing of glass from different factories. It is impossible to suggest if this was done at the site of glass manufacture.

Opaque Red

Three samples of opaque red glass were analysed. One sample (MAN1521A) came from Gurob, which may be of a similar date to Amarna (see Chapter 2). The high concentrations of copper in these samples are indicative of red glasses coloured by the cuprous (Cu^+) ion which produces a rather brownish-red colour (Freestone 1987); copper is present at around 5 wt%. The colour is produced by small cuprite crystals which produce a "liverish" red colour, rather than the sealing wax red colour noted when the colour is produced by dendritic crystals of copper in the presence of lead. Lead is not detected in these analyses. The tin is below the limit of detection, therefore it is not possible to determine if the copper was added in mineral form, as a pure metal or as a tin-bronze alloy. It is intriguing to see in samples recovered from different sites that the base composition is one which follows the low potash type, typically observed in the cobalt blue glasses, with potash concentrations ranging between 0.93–1.62 wt%). The inference is that these glasses were produced using a plant ash which was lower in potash than most of the other glasses found in this period.

These glasses compare well with two samples of red glass from Qantir dated to the Ramesside period, with potash below 2 wt%, soda around 17 wt% and a high concentration of copper oxide (Rehren 1997:362), and are almost indistinguishable from other red glasses from Amarna analysed by Freestone (1987:176).

Brown and purple glasses

In colour these may be related to the red glasses described above, but their colour is produced in a completely different way. Their base composition is unremarkable when compared to the other samples analysed and they clearly fall within the same manufacturing technology, using similar plant ash raw materials to the "standard Egyptian composition" observed in the majority of copper-coloured glasses. Sample MAN1967E derives its brown colour from high concentrations of iron which at 1.47 wt% was presumably added to colour the glass. In the other examples, as far as it is possible to tell from the major element analyses, the colour is derived from control of furnace atmospheres rather than the addition of distinctive colouring elements. One sample of purple glass (UC22914B) owes its colour to the use of manganese which is present at almost 1 wt% (MnO) in the matrix. A black sample (UC22920B) is placed in this group because it contains manganese oxide at 2.46 wt%, in addition to copper at 1.32 wt% and cobalt above the detection levels for the SEM at 0.23 wt%. Clearly a piece with an identity crisis.

Green glasses

The visual separation between blue, green and turquoise glasses is one which is open to interpretation. Similarly, the production of green glasses may arguably not have been deliberate, as copper or iron compounds can produce anything from blue to green depending upon their redox[9] state. However, the green samples are an interesting subset as they all contain copper as part of the colourant (see below), but not all display the typical base glass composition observed in the copper-*blue* glasses analysed here and reported by Brill (in Lilyquist *et al*. 1993), and later by Shortland and Tite (2000). Seven samples analysed have been assigned to this group; three samples have concentrations of potash at 2 wt% or above, three have concentrations of 1.8 wt% potash or below and one has a mean concentration which may be considered borderline at 1.98 wt%. Cobalt falls below detection in all the analyses of these samples, but concentrations of alumina are not elevated in any of these glasses suggesting cobalt alum did not play any part in their colouration. Therefore, although they are not coloured by cobalt alum, some of these glasses appear to have been manufactured using similar alkali raw materials as the cobalt blue glasses. This phenomenon was also observed in the red glasses.

The production of the green colour (often opaque) is of particular interest. All contain copper at concentrations of 0.8 wt% to 2.17 wt% which will produce a blue colour. They also contain varying concentrations of lead (from 0.4–2.7 wt%) which may turn the blue colour of the copper to green. Examination of the structure of these samples by SEM showed that they contained lead antimonate crystals. The copper blue of the glass insterspersed with yellow lead antimonate crystals (more commonly seen in yellow glasses above) is responsible for the overall green hue. This particular combination has also been observed by Mass *et al.* (2002:79), which they attribute to the use of lithage, but which has been discounted by Rehren (see discussion on opaque yellow glasses).

Overview of the glasses

The glasses discussed above attest to a technologically sophisticated industry, with the ability to control temperatures (opaque glasses) and furnace atmospheres (colourless and copper-coloured glasses). It also illustrates the wide trading networks either in raw materials (antimonates) or in finished glasses if indeed any of these glasses were manufactured outside Egypt.

The difficulties of data interpretation arise when trying to determine *where* these glasses were produced. We have a relatively new archaeological base covering the discovery of new glassmaking sites in Egypt with which to address these issues (see Chapters 2 and 6), but the compositional analysis of glasses is at this stage only giving a tantalising glimpse of a possible number of different interpretations. This is most easily observed in the two compositional groups of blue glasses. It was first thought that these two glasses formed exclusive populations based upon plant ashes which were either higher or lower in potash, and hence these two populations were manufactured in different locations. However, as Rehren suggests "all cobalt-blue glasses have a low potash content, but not all low-potash glasses are cobalt blue" (2001:487). This is upheld here with most of the turquoise glasses, some of the green glasses and the red glasses falling into this category. Other glasses reported by Lilyquist *et al*. (1993:36–39) and Brill (1999a:27–33) from Amarna, Malkata and Lisht show examples of low potash glasses in purple, light green, red, opaque white and opaque yellow.

These patterns in the data hint at different methods of production for different colours of glass and a more complex system of production than has been explored previously. However, if we are to accept an Egyptian manufacturing location for the blue glasses based on the iron:titanium ratios suggested by Shortland (2005) we must be looking internally, within Egypt, for manufacturing locations. Unfortunately titania could not be measured by SEM for the other colours of glasses discussed here so this hypothesis could not be tested more widely. An in-depth discussion exploring these ideas and their implications for the organisation of the glass industry is presented at the end of this chapter.

Industrial debris associated with glassmaking

In addition to the glasses themselves, there are a number of other categories of material which appear to be related to the production of vitreous materials (see Chapter 6). These include sandstone (often banded) with glassy surfaces or glass incorporated in the matrix whose function is not clear. Other more identifiable pieces include glasses adhering to ceramic (some of these ceramic forms are cylindrical vessels), a selection of semi-fused glasses and "frits", and some blue vitrified material adhering to yellow plaster. A few pieces of faience were also analysed and a sample of Egyptian blue.

Vitreous deposits on "banded sandstone"

These sandstone fragments may be the remains of industrial stone vessels but are more likely to be related to the furnace structure. Whilst the furnace walls are mudbrick it may be that some furnace furniture was made of stone which could withstand the high temperatures reached within the furnace. Although the exact purpose of these fragments could not be determined, they appear to be associated with glass production and so their glassy residues were analysed. The glassy residues sampled are all tinted blue or green.

The analyses of four samples of glaze on the sandstone can only be taken as a rough guide to their compositions as the thin surface layer of glass overlying the sandstone will have become contaminated with the underlying rock matrix. The rock itself was not analysed. Upon initial examination it might be suggested that the glaze found on these pieces was caused by its inclusion in a high temperature environment. The surface of the sandstone, being high in silica, had become vitrified from contact with the fire and fuel ash and acquired a surface "glaze". These types of "glaze" can vary in colour from whites, blacks and even blues which is often apparent in thin glazes. This blue may be caused by iron present in the original sandstone. However, the compositional analyses suggests the glaze was not formed by contamination of the sample with fuel ash, as three contain varying concentrations of copper which is responsible for their blue colour. One sample contains in excess of 10 wt% CuO, although this may be a copper-rich pocket. It is unlikely to be Egyptian blue which is high in copper ($CaCuSi_4O_{10}$) because this sample contains alkalis at around 10% (Brill 1999b:470). The remaining sample may contain cobalt but this is around the level of detection by SEM. The vitreous layer and the detection of copper colouring indicates these samples were heated to relatively high temperatures and *may* suggest they were associated with glass production rather than the production of other vitreous materials. Sample MCR1967A has been subjected to temperatures which have caused the material to melt and form a type of vitreous "slag". This slag may be caused by the high concentrations of soda in this sample, similar in concentration to the glasses analysed. The other samples do not exhibit a typical glass composition, containing a low total alkali content (around 10%) and in one case showing higher concentrations of potash rather than soda. These are therefore thought to be samples which reflect the production of vitreous materials, but cannot be linked with certainty from these analyses to any specific process.

Analysis of semi-fused glasses and frits

There are a few samples which may be indicative of various stages in glass fusion, from semi-fused glassy mixtures peppered with quartz to more fully formed glasses with some vestiges of quartz remaining in the matrix. It is debatable whether all of these are actually semi-fused glasses, but certainly all fall within the category of vitreous materials and all are heat treated in some way. Shortland and Tite (1998) discussed a number of frits from Amarna, and because of their dissimilarity to finished glasses, suggested that these were associated with the production of cobalt-blue vitreous faience. In the cases they examined the glassy matrix contained much lower concentrations of soda and lime, in some cases approximately half what may be expected in the finished glass. They suggested that if these were associated with glass production, more lime and soda would need to be added. Further analysis by the same authors suggested that indeed these frits may have been used in glass production in a two step process, whereby more low-potash alkali and silica were added to the fully formed frits and then the mixture remelted (Tite and Shortland 2003). Certainly two of the "frits" analysed here have a similar composition (TA125, TA20). They are composed of copper-coloured blue glassy matrices with rounded silica inclusions, suggesting that they had been heated to temperatures sufficient to start to melt the silica, although TA125 (Plate 5.2) does show some angularity of the silica crystals which may be indicative of the use of crushed quartz rather than sand (although the evidence from one sample cannot be taken as indicative of the whole population) (Hatton 2005, see Chapter 6). These two examples have soda within the glassy matrix at the low concentrations observed by Shortland and Tite, although only one

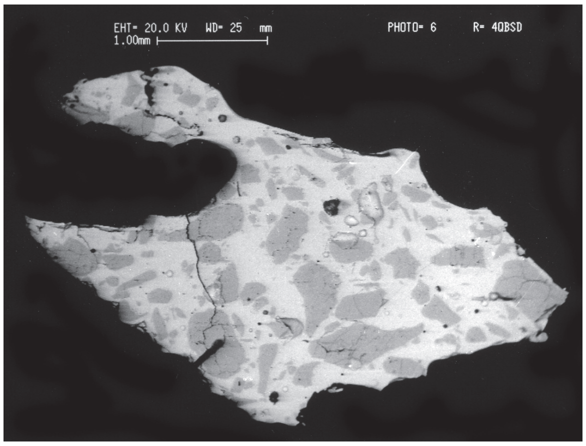


Plate 5.2. Backscattered SEM image of sample TA125 showing some of the angular silica crystals possibly indicative of crushed quartz as a raw material. (Photo: Caroline Jackson/Paul T. Nicholson).

has a low concentration of lime (TA20). Both of these samples are taken from glassy fragments adhering to ceramic vessels and it is clear that their composition reflects some dissolution of the ceramic into the glass, with high concentrations of iron and alumina. TA125 has laths which are silica-calcium-magnesium-iron rich (amphibole), which may in fact be decay artefacts or particles which have not dissolved into the melt, but which may account for the anomalous composition observed. As has been commented upon widely (e.g. Jackson *et al.* 2003), the glass remaining on crucible walls cannot be taken as a true reflection of the glass composition produced (if glass was indeed the final product of these frits), and it is clear to say here that with the dissolution of the ceramic alongside the semi-fused nature of this vitreous material these samples can only hint at what was being produced. Whether these samples can be seen as evidence for a rather complex glassmaking technology proposed by Tite and Shortland (2003) cannot be determined.

Sample TA22 (Plate 5.3) however, while appearing similar to the two samples described above, is a more vitreous piece which has clearly been taken to a higher temperature; the ceramic it adheres to is quite vitreous and there is much less residual silica within the sample. In contrast to the two described above, this sample is coloured by cobalt. Its composition is indistinguishable to that of a cobalt-coloured glass from the same site. TA55 also falls into this group, but in this case this copper-coloured friable vitreous material is extremely high in both soda and potash, the two alkalis forming more than 25 wt%, which along with silica almost account for its total composition. Magnesia and alumina levels both fall within the acceptable limits for an Egyptian glass. This extremely high concentration of potash is anomalous when compared to Egyptian glass compositions, although some plant ashes, for example *S.kali* published by Brill (1999b:486), can

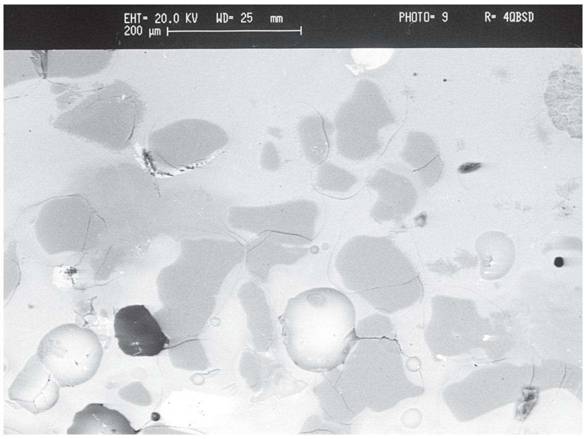


Plate 5.3. Backscattered SEM image of sample TA22 which has been fired to a high temperature and exhibits a more vitrified appearance. (Photo: Caroline Jackson/Paul T. Nicholson).

contain equal parts of both alkalis. This sample is an unlikely candidate as a glassmaking ingredient as the glasses found at Amarna and elsewhere at this time are much richer in soda and have very little in the way of potash.

Three other samples which could be placed in this group all appear to be partially formed glasses but are all different in composition (TA64, 73, 104). All contain high concentrations of silica in their glassy matrix at around 65–70 wt%, but have varying concentrations of soda (7–15 wt%), lime (4–7 wt%), potash (3–7 wt%) and magnesia (1.5–5 wt%). Iron oxide and alumina are high in TA104 which is a reflection of the ceramic it is adhering to. The closest to an Egyptian glass is TA73 which is high in soda (c.15 wt%) and has moderate concentrations of potash (3.4 wt%). All are coloured blue with copper. These samples may have degraded during burial which could account for their varying compositions. While glasses are more resistant to weathering because they are fully vitrified, partially vitrified samples may have more mobile alkalis which may be removed over time.

For reference a sample of ceramic was analysed (TA64). This sample has alumina at 20 wt% which in theory would make it suitable for refractory purposes, but with iron at 8 wt% and a combined alkali of over 10 wt% would explain its deformation in some contexts at temperatures under 1200^{o}C (Turner 1954). The high concentration of alumina in this ceramic sample would confirm why some samples of vitrified material adhering to ceramic have higher concentrations of alumina.

The Egyptian blue (UC22922) examined was too porous to obtain a secure analysis, but comprised copper calcium silicate as would be expected (Brill 1999b: 470).

Therefore, some samples analysed in this category of material are clearly related to the glass production process. Others are too badly degraded to be certain what role they played in the vitreous materials industry and others have compositions which may be related to the production of "frits" or faience.

Glasses found on "yellow plaster"

Two samples of the blue glassy/crystalline substances (or "frit") adhering to "yellow plaster" were analysed. The analyses were taken from areas which appeared to be glassy or certainly looked as though they were vitrified. In one case (MAN1967B) this substance was coloured with high concentrations of copper. The other sample (TA24) showed the presence of a blue substance, coloured by copper, but which may be related in some way to pyroxines or wollastonite as it comprised mainly silica, lime, alumina and iron, which may be the product of the decay of the vitreous material. These analyses are ambiguous by their nature as it is impossible to isolate the mineral or glassy phase from the underlying plaster, they are likely to be highly contaminated, and they may be only the residue of part of the production process—the nature of which it is impossible to determine. Only further work on these types of material will determine their use.

Glasses adhering to ceramic

Glass adhering to ceramic vessels falls compositionally into the typical New Kingdom glass composition, and is representative of the glasses seen from Amarna. Some of these samples appear to be from cylindrical vessels (e.g. Plate 5.4). Compositional analysis suggests the material contained in these vessels is typical of a glass produced with a high soda plant ash, seen in the ratios of potash and magnesia (Fig. 5.5, here called crucible glass for ease of labelling).

The colours of glasses found in these vessels ranged from dark blue, turquoise and red, the red colour intermixed with samples of turquoise of glass, indicative of a copper colourant in different redox states. Four samples are coloured blue by cobalt (MAN1967G, MAN2611, UC22922E, TA132), the rest by copper. The glasses containing cobalt all fall within the low potash, high alumina group observed in the finished glasses (Fig. 5.6). The remaining samples are all coloured blue by the addition of copper, some of these showing traces of tin where this could be detected (which Shortland 2005 attributes to a production location in Egypt). One sample is a light green glass recovered from the rim of a cylindrical vessel (MAN2609), which shows no discernable addition of a colourant although the colourants could be below detection. TA146 has a similar composition but is clearly contaminated by the adhering ceramic showing concentrations of alumina at 9 wt%, the same can be said of TA144 and 141 which

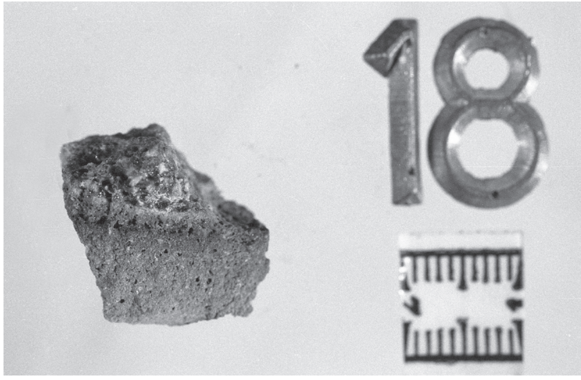


Plate 5.4. *Sample of TA18 with blue glass adhering to the ceramic body of a cylindrical vessel (Photograph: Walter Gneisinger).*

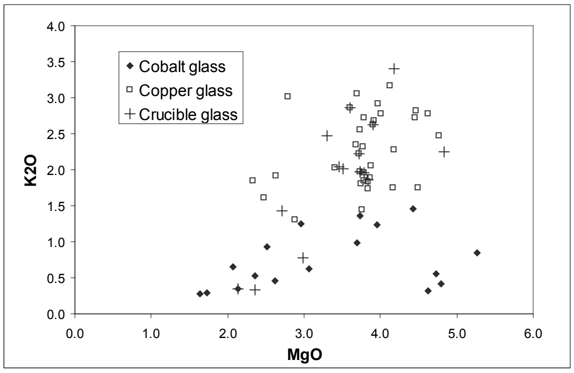


Figure 5.5. A comparison of blue glass compositions found in glassy waste, finished artefacts and that adhering to the cylindrical vessels (crucible glass).

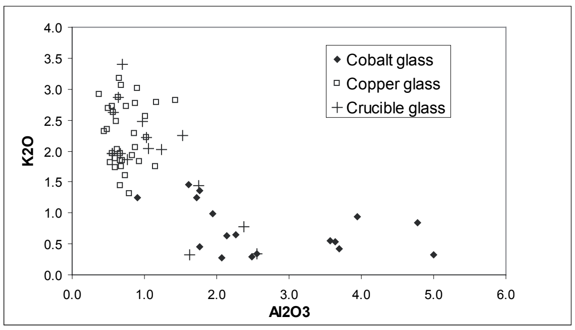


Figure 5.6 The relationship between the glass found on the cylindrical vessels and that from other samples of blue glass from Amarna.

are contaminated with alumina and lime respectively. The high concentration of lime in the latter sample is not surprising; it has been noted that the cylindrical vessels have a thin layer of lime which would act as a parting layer to stop the glass sticking directly to the ceramic and to reduce contamination of the glass from the crucible walls (Chapter 6). It has been debated whether these cylindrical vessels were used to cast the glass (after prior heating), or were deliberately placed in the fire and heated strongly to contain the raw materials (Rehren 2000b). The contamination of a few of the adhering glasses with material from the ceramic vessel walls is not sufficient proof that they were heated directly, but it may indicate that the glass was very fluid when it was contained in the vessels, so that it could react with the ceramic and lining before cooling.

Uluburun samples

Three samples from the Uluburun ingots were kindly donated by Professor Çemal Pulak for analysis by SEM. Publication of the results was delayed to wait for the publication of samples analysed by Robert Brill.[1] From the colours of the glasses it would indicate that two samples are coloured by cobalt and display a characteristic deep blue colour, the other sample is a turquoise blue and coloured by copper, although copper was below detection in these samples and only one deep blue sample showed concentrations of cobalt above detection. Rather neatly, when the ratios of alumina and potash were plotted the samples separated by colour related to alumina concentration (Fig. 5.7). It is of interest that all three had concentrations of potash below 1% which may indicate that these samples were produced using the same species of plant ash (and are related locationally?). The three analyses compare well with the Uluburun ingots analysed by Brill (1999a:53). Significantly, the two "light blue" copper-coloured samples he analysed were also low in potash (0.61 and 1.61 wt% respectively), as were all the other dark blue cobalt ingots, but not the one purple ingot analysed which had potash at 2.18 wt%. Therefore the analysis of the Uluburun ingots suggests cobalt-coloured ingots fall into the same compositional group as the cobalt-coloured glasses and glass manufacturing waste from Amarna, but the copper ingots contain lower concentrations of potash than is generally found in the copper blue glasses from Amarna.

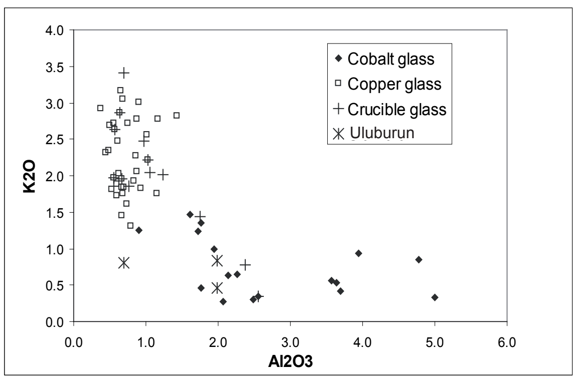


Figure 5.7. Compositional links between the blue Uluburun ingots analysed in this study and the blue glasses.

Faience

Bulk compositional analysis of faience is not helpful for determining manufacturing method or the nature of the raw materials used to produce it. The glaze analysis on the four specimens shows that the glaze is one which is marginally richer in soda rather than potash (ratio ranging from 1.5:1 to 5:1), but these ratios are by their nature variable as the faience is a material which has structure and represents a semi vitrified matrix. The glaze compositions, where measured, are indicative again of a plant ash alkali used in manufacture. All the glazes are coloured with copper at high concentrations, measured here up to nearly 17 wt%. Rather than by analysis of the composition, method of manufacture can best be suggested through examination of the microstructure through photomicrographs (e.g. TA122, Plate 5.5), which suggested, in the cases examined, the faience had been produced by application, although this interpretation should be treated with caution as the original surface of the faience has degraded in many cases, and assignation of manufacturing method by micro-observation is fraught with difficulties. A more detailed examination of faience production at Amarna can be found in Shortland (2000), and a summary of some of the analytical data is found in Appendix 6.

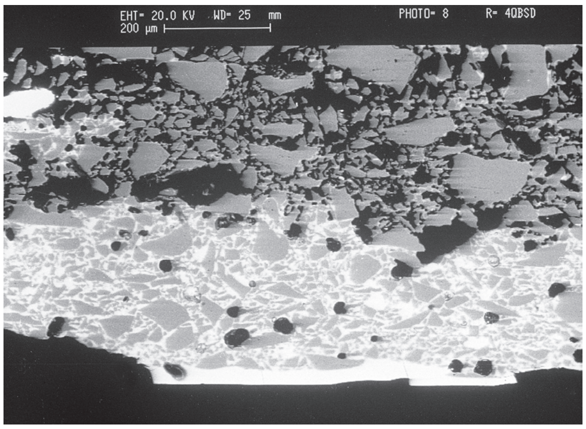


Plate 5.5. Backscattered SEM image of sample TA122, a piece of faience apparently glazed by application. (Photo: Caroline Jackson/Paul T. Nicholson).

General discussion: Egyptian glass compositions

The compositional constancy of Egyptian glasses is one feature which makes them distinguishable from later glasses produced with wood ashes (Jackson *et al.* 2005). There have been a number of attempts to explain this constancy which are based on different hypotheses. Three main strands can be determined; (a) those based upon the nature of the raw materials used to produce the glass, (b) those which centre upon the technology used in glass production and finally (c) those which explain the phenomenon by examining the organisation of production. The first two of these theories have more recently been revisited by Tite *et al.* (2006) and Rehren (2000a and b) respectively and are discussed below. The organisation of production is then discussed in the light of these two different ideas.

Tite *et al.* (2006) suggest that the glass compositions can be explained by the use of ashes from specific plants in glass manufacture. To investigate this the authors characterised plant ashes collected from a variety of locations and collated these, along with published analyses, to produce a dataset upon which to compare plant ash compositions with the compositions of Egyptian glasses. They found that halophytic plants collected from different habitats within Northern Europe and the Mediterranean were shown to have very similar compositions. Therefore the glasses produced using ashes of the same plant, grown in different locations, would be compositionally similar. The majority of their analyses were of *Salsola kali* which they suggest, without further refining, does not match the composition of Egyptian glasses. This would suggest that *Salsola kali* was not the ash used in Egyptian glass production. From available analyses, the authors could not suggest which plant ash would match the composition of Egyptian glasses.

While Tite *et al.* (2006) could not identify the plant ash species used in Egyptian glass production, they suggest using three different compositional ratios to determine the possible "composition" of the plant which may have been used. These ratios are (a) soda to potash (Na_2O/K_2O), (b) lime and magnesia contents against total alkali ((CaO+MgO)/(Na2O+K2O)) and (c) the percentage of alkali present as carbonates.

The ratios of soda to potash and the lime/magnesia against total alkali ratios can be applied to the compositional data collected during this project. Although the general composition fits that of an "Egyptian" glass, sub-groups have now been identified. The best documented of these are copper and cobalt blue glasses. Some of the compositional differences relate to the introduction of impurities with the colourant. However, the underlying glass composition is suggestive of the use of different types of plants, one which is lower in potash than the other (Brill 1993 in Lilyquist *et al*. 1993, Rehren 2001).

Table 5.1 and Appendix 5 show that the copper glasses follow a more common glass composition for this period, and one which is recognised more readily as one which is typical of Egyptian glasses. These glasses are high in soda with a mean around 17% and have a potash composition of around 2.5%. This gives a soda:potash ratio for the copper glasses of between

5–11:1 and an alkaline earth metals/alkali ratio of 0.55–0.91:1. These ratios suggest that the copper-coloured glasses could fall within the range of some of the ashes analysed by Brill (1999a and b) and Turner (1956: 85Tff.) (ratios quoted in Tite *et al.* 2006) from Syria and neighbouring areas. The highest matching ratios of soda:potash are those quoted by Brill (1999b:483) for Spanish *Salicornia* at a ratio of 10:1, with a ratio of alkaline earths/alkalis slightly lower than observed in these glasses (0.17–0.42:1). The origins of these plants does not necessarily mean that the only plants of these species that have similar compositions come from either Syria or Spain, and so this does not rule out an Egyptian origin for these glasses. Indeed, if the ratios of iron oxide and titania are used instead, Shortland's (2005) formula would suggest an Egyptian origin for the glasses analysed here.

The cobalt glasses pose a different problem. It has been noted that these glasses are lower in potash and higher in soda, but the ratio of soda:potash is between 12–74:1, and the alkaline earth metals/alkalis ratio is between 0.25–0.70:1. The alkali ratio in particular gives a value which is very much greater than any of the plants presented by Tite *et al.* (2006). It may be argued that the higher soda content is due to purification of the alum, but it is clear that such a high soda:potash ratio is an order of magnitudes higher than would be expected, and is principally due to the low potash concentration. These high ratios are mirrored in the glass from the Uluburun shipwreck, analysed in this study, and published by Brill (1999a and b). In this case the high soda:potash ratio of between 21–34:1 (11–40:1 in the data published by Brill) is observed in *both* the cobalt and copper-coloured ingots. Alkali ratios of the magnitude seen in the cobalt blue glasses and the Uluburun ingots, are not mirrored in any ash analyses published for halophytic plants to the authors' knowledge.

These high soda:potash ratios are not reserved for blue glasses, but can be seen in some of the blue-turquoise-green and red glasses (Appendix 5), although to a lesser extent. The remainder of the glasses, including all of the colourless/white, yellow and brown/purple glasses fall within the range of the copper blue glasses.

Whilst the complexities of plant ash compositions and their transformation in the glasses is not yet fully understood, it is clear that the ashes used to produce the cobalt-coloured glasses were significantly different to those used to produce a copper-coloured glass (even taking into account the addition of soda through the cobalt-colouring process). Rehren (2000a: 10) suggests that lower potash values may indicate a coastal or desert oasis habitat for the plants, while higher potash an inland origin. What is clear from these analyses and other published examples of Egyptian glasses is that they all have a higher soda:potash ratio than can be attributed to the use of the *Salsola kali* ashes characterised by Tite and frequently quoted as a likely source of plant ash in Egyptian glass manufacture (Freestone 1991:41; Nicholson 1993:42).

To group the glasses by alkali type, and investigate compositional groupings, the ratios of alkalis and alkali earth metals are plotted in Figure 5.8. The results are tentative (because of the small number of samples in some groups) but suggests that the glasses group compositionally by colour, which indicates that each glass colour was produced with the same/similar plant ash alkali. While the greens and turquoises, coloured by copper, have a wide distribution, small numbers of yellow, purple, white, and possibly red (with one outlier) all fall within discrete ranges (cobalt blue is not plotted here as it forms a widely different group). Further work will suggest whether this holds true for larger samples of glasses, but possible explanations for this pattern are explored at the end of this section.

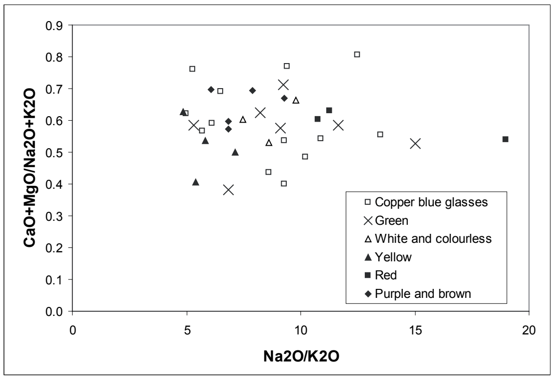


Figure 5.8. Compositional groupings of coloured glasses of the Amarna period.

The second hypothesis, that the technology of production is responsible for the relatively constant composition of Egyptian glasses, has been suggested by Rehren (2000a and b). Rehren suggests that the constant chemical composition observed in Egyptian glasses can be expressed by a ''partial batch melting model'' rather than a total batch melting model which relies upon centralised production or the adherence to a strict recipe. The partial batch melting model does not rely on specific homogenous raw materials which can be melted in their entirety, but follows a model whereby the composition is controlled "by the course of the appropriate eutectic trough and the maximum temperature reached in melting" (Rehren 2000a: 15). Therefore, a glass of a "typical" composition would be formed at a particular temperature, with the remainder of the unreacted materials being removed in a sort of "beneficiation" process. The composition would only change if the temperature was increased or reduced significantly.

These ideas could be seen to tie in closely with the comments made by Petrie and discussed in Chapter 2 here. Petrie suggests during manufacture glasses would not be poured out but cooled in their containers because the surface of the glass is "frothy and worthless" (1894:26). Only when cooled would the container be removed and the good glass removed for reworking (although no such "frothy" material was observed in the material from site O45.1).

The model, which Rehren (2000a and b) suggests was adopted in the New Kingdom, adequately describes why the composition is so invariable, and why the amount of glass present in the archaeological record suddenly increases because a greater variety of raw materials would be available for glass production. The model does not allow for an exploration of the nature of the plant ashes used in glass production, as the ratios of elements in the ashes may not be directly transferred into the glass as some components may be removed in the unfused portions of the batch. However, it does acknowledge that differences between different colour groups can be attributed to the use of different alkali raw materials and different melting eutectics.

This theory can be explored with the glass data and is presented in Figure 5.8 (although the base compositions in this case have not been normalised to 100% as Rehren 2000a suggests). Although the glasses form a clear compositional group, which in Rehren's model would be explained by the partial melting model, it is also clear that within the overall assemblage glasses of the same colour group together (cobalt-coloured glasses are not plotted because they are so distinctive).

Rehren (2000a) attributes the sub-groups within the overall data to the production of different colours of glasses at different workshops and this takes us to the third hypothesis based upon the organisation of production. The copper blue glasses demonstrate the largest spread of values in Figure 5.8, which Rehren suggests, may have been produced at a number of different manufacturing locations. This is because copper is readily available locally and easily produces a blue or green colour in the glasses. Certainly the data here supports the wide variability of compositions seen elsewhere for copper blue, turquoise and green glasses. Other groups of glasses have a more controlled and ''tighter'' composition. Rehren links this to glasses such as cobalt-blue, manganese-purple, antimony-white, antimony-yellow or copper red which would have been produced at specialist sites because they are "exotica" or required a certain amount of "technical know-how". However, there may be other social reasons, too, why "colour-centred" complexes may have arisen.

The recent excavations at Amarna and at the later Ramesside industrial complex at Qantir in the Delta (Rehren and Pusch 1997) suggest that centres producing different colours of glass may exist. Certainly in the case of Qantir, it is clear that copper-red glasses were produced, but cobalt and copper-blue glasses have also been found there. We await the publication of the site to ascertain if blue glasses were also produced in any significant quantity there. It has been suggested that the earlier site of Amarna may have specialised in cobalt blue glasses (Chapter 2). These hypotheses are difficult to confirm at this present time, but it is clear from the data presented here that certain glass colours have discrete compositions which may suggest a different provenance for these glasses.

Conclusions

The data presented here, which shows that there are compositionally distinct groups of glasses, suggests that a combination of these hypotheses could be valid. As yet we cannot determine which alkali raw materials were used to produce Egyptian glasses, although it seems that there are differences in the alkalis used for different coloured groups of glasses. This may be linked to availability of particular plants at different glassmaking sites, which may support a glassmaking model in Bronze Age Egypt which is based upon specific locations producing different colours of glass. The finds at Qantir are reported to support the partial melting model (Rehren and Pusch 2005) which indicates that the raw materials were heated in a two stage process. In the case of Qantir a specialist production is required to produce the distinctive red glass found at the site. In turn this supports the notion of specialist centres producing different colours of glass. Therefore, it may be argued that all these hypotheses have a place in Egyptian glassmaking. It is to future archaeological evidence and scientific discovery that we must look to further explore the nature of the Egyptian glass industry.

The nature of the industrial debris found at O45.1 is relatively enigmatic; some artefacts are the remains of a vitreous materials industry, some appear to be related to glass production. The most easily identifiable component, which points to the involvement of some categories of material in the glass production process, is the identification of colourants in the glassy deposits. For example, the glassy deposits on the sandstone contain significant concentrations of copper, which produces the typical blue colour of many of the vitreous materials found at the site. As its context is uncertain, it is not possible at this stage to suggest its role in the production of glassy materials. Likewise the nature of the blue semi-vitrified substance adhering to the yellow plaster cannot be determined from chemical analysis alone, although the blue colouration again points to a likely stage in the production of vitreous materials at Amarna.

Most of the frits examined are also copper-blue-coloured and at least two are typical of those examined by Shortland and Tite (2000), which they attribute to a stage in glass production. Their composition is not typical of an Egyptian blue glass as they contain lower concentrations of lime and soda. It is impossible to suggest their intended original composition because they are contaminated by the underlying ceramic they adhere to. Whether they are related directly to *glass* production cannot be determined, although Shortland and Tite believe they are part of a complex production process whereby they are added to the glass with the addition of further high soda plant ash (see Chapter 6). At least one sample, clearly related to the glass production process, is coloured by cobalt, and sits well in the compositional range for these glasses. It is adhering to a ceramic fragment which may be a fragment of a cylindrical vessel, although the highly fired nature of the fabric makes this difficult to confirm. Other samples of partially formed copper glasses were also analysed but because of the nature of the material they had very variable compositions probably due to contamination and decay of the vitreous matrix.

Most significant, is the blue-coloured glasses found adhering to the cylindrical vessels. In all cases, whether cobalt or copper-coloured blue, these samples fit very well within the compositional ranges of the glasses from Amarna and of other published Egyptian glass compositions. The glass compositions also match, certainly in the case of the cobalt-blue glasses, the compositions of the glass ingots from Uluburun. The likelihood that glass was produced at O45.1 Amarna cannot be proved from these vessels, except to suggest that because the cylindrical vessels were found at Amarna in significant numbers the glass contained in them was probably manufactured there. There is no archaeological evidence that glass ingots, such as those found in the Uluburun wreck, were transported in their ceramic formers. As no ingots were found at the site it is suggested that these vessels were the waste product of a glass manufacturing industry at Amarna, or a closely related centre.

All of this industrial debris is of a blue colour. Red, yellow, white and purple glass, is in the form of a small number of chunks and of rods. These may have been brought to the site for reworking as vessel decoration, although their provenance cannot be determined. This would point to a glass industry at Amarna centred upon the production of blue glasses, and may indicate that Amarna did specialise in cobalt-coloured vitreous materials but also produced vitreous materials coloured with copper, as Rehren (2000a) has hypothesised.

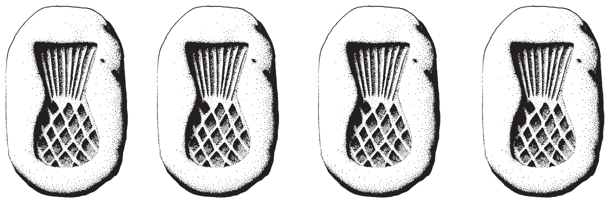
The remains of industrial debris associated with glassmaking, alongside fully and partly formed glasses at Amarna, indicate that glass was manufactured and also worked at Amarna, some of it at secondary workshops beyond the confines of O45.1. As yet, although there have been finds of glassworking in the city, no large secondary workshops have been located. This points to a royal centre which had a significant glass industry, in one or more locations, which probably produced glass from the raw materials at O45.1 and worked it at another location or locations in the city. There is evidence that blue was the predominant colour manufactured at O45.1. Analysis of other finds found in the city would suggest others colours of glass were also worked in this royal centre. The nature of the raw materials used to produce the glass have yet to be determined and cannot be matched closely to any of the raw material compositions which have been characterised. Nor can we securely suggest from analytical work alone the exact recipe used to produce the glass, the number of stages used in glass production or the firing technology used at Amarna, although we are gaining a better understanding of this through analytical and experimental means (see Chapter 4). Through this, a picture is slowly emerging of a well developed glass industry within New Kingdom Egypt, one element of which is the manufactory at Amarna.

Endnotes

1. We are indebted to these institutions for generously making samples available to us.
2. Electron Probe Micro Analysis. We are indebted to Mr Dave Plant for his help with the samples and Ms. Emmanouela Apostolaki who ran the samples as part of her MSc. project at Sheffield University. The analysis was sponsered by N.E.R.C.
3. Scanning Electron Microscope with Energy Dispersive X-Ray Spectrometer.
4. Inductively Coupled Plasma—Atomic Emission Spectrometry.
5. Inductively Coupled Plasma—Mass Spectrometry.
6. We are indebted to Mr. Peter Fisher of the School of Earth Sciences at Cardiff for his help and training on the instrument.
7. Numerical average.
8. However, in the field this distinction was used as a short-hand description for the colours. The analytical work suggests that such practice should be abandoned in future. Caution must therefore be exercised in using the colour attributions in the finds catalogue given here.
9. Redox = reduction/oxidation conditions.
10. Who had been given samples prior to our work, and who had priority of publication.

Chapter 6

A Reconstruction Of Glass Production At Amarna Site O45.1



Introduction

The purpose of this chapter is to place the finds relating to glass production in context and to attempt a reconstruction of how they might have functioned in the industry. Since many of the finds are fragmentary, or may be classed as "industrial waste", they do not lend themselves to publication in the form normally reserved for "small finds" and so are better treated as a group within such an interpretive framework. A "catalogue" of the most significant pieces is given in this volume, and a complete catalogue of finds is given on the accompanying DVD.

In attempting to examine those finds which relate to glass production one immediately encounters a difficulty: precisely which finds *are* those relating to glass production? On a site where only glass was being produced this would be a simple question, but at site O45.1 pottery, glass, faience and frit/pigment are all being produced. Furthermore, we are dealing with what is—so far—the earliest glass factory excavated in modern times, and as a result production methods need not be the same as those encountered in later periods.

There are, of course, clues as to which finds belong to which industries. Pottery production is well understood, and its finds are generally easy to distinguish. The making of frit/pigment is represented on a smaller scale, and most of its stages can be distinguished. The difficulty then remains of distinguishing between the evidence for glass and faience. Petrie's work is not particularly helpful in this respect. As has been shown, at least one of his factory sites was discovered and "grubbed in" (10-24th Jan. 1892) by local children, rather than properly excavated, and he does not distinguish between workshops when publishing his evidence for the glass and faience production sites. Indeed, it was questions regarding Petrie's reconstruction of the glassmaking process which prompted the current investigations. Whilst it is helpful to know that earlier work yielded finds similar to those from the present work, and that they are probably connected with either glass or faience production, it is not possible to put great reliance upon them.

It is also possible to turn to literary evidence in our attempt to reconstruct ancient industrial processes. In the case of glassmaking, the earliest texts we have come from Mesopotamia/Assyria, and particularly from the library of Assurbanipal (668–c.627 B.C.) at Nineveh which contained works of much earlier date, including mid-second millennium texts such as those dealing with glass. These texts have attracted considerable attention, though early attempts at translation proved in various degrees unsatisfactory (Cambell Thompson 1925; Gadd and Cambell Thompson 1936). They were re-examined in the late 1960s (von Saldern *et al.* 1970) when Oppenheim's new translation was made in association with technical work by Brill. Such literary evidence is undoubtedly valuable but, as I have argued elsewhere (Nicholson in press), must be treated with caution. These texts are copies of copies, frequently contain words whose meaning is unclear and which belong to a different, albeit neighbouring, culture in a different environment and could belong to a time several centuries before Amarna. Textual information can certainly be valuable, but its limitations must be recalled if we are not to develop a "text hindered archaeology."[1]

The Nature Of Glass

Glass is a remarkable material. A material which, from the point of view of the user, is solid and yet can be translucent or transparent, which can take on a range of colours and which can be used to imitate materials found in nature, such as minerals or semiprecious stones. It can be deformed whilst hot and, with sufficient skill, be worked cold as though it were a gemstone. The gem-like qualities of faience and glass make them the "brilliant things" sought by the Egyptians. Equally important in terms of its prestige during the period in which we are interested, is the fact that it was new. New materials, and even new technologies, frequently gain such kudos initially, before they become more commonplace. With materials, as with so much else, familiarity breeds contempt.

However, it is not enough to enumerate the novelty value of glass to its users in the second millennium B.C. Rather it is necessary to provide a more objective definition of glass. Fortunately, this has already been done by Robert Brill (1962) in a classic paper *A note on the scientist's definition of glass*. In his paper Brill shows that glass does not neatly fit any of the classically defined states of matter: liquid, solid, gas, but rather is to be seen as a "glassy" or "vitreous" state (1962:129–30) of its own, similar to the polymerised state of plastic, rubber or dough (1962:132). It follows then, that it does not have the well ordered crystal lattice of a mineral, but is much more disordered, such that it "is an inorganic product of fusion which has cooled to a rigid condition without crystallizing" (*American Society for Testing and Materials*, quoted in Pollard and Heron 1996:150). The vitreous state itself "is believed to be that of a solid with the molecular disorder of a liquid frozen into its structure" (Holland 1964:1, quoted in Pollard and Heron 1996:150).

Similarly, there is no one "glass" but a near infinite number of chemical combinations which produced "glasses" of one form or another. For convenience these glasses can be grouped into various combinations, and those which are of concern here are the soda-lime-silicate glasses.

The principal ingredient of soda-lime-silicate glass is the silica, which provides what is known as the network former. It would in fact be possible to make a glass from pure silica by melting it and reforming it, but the temperature required for this is around 1500ºC (melting point 1410ºC) beyond the reach of furnaces until modern times. In order to be able to melt silica therefore, it was necessary to modify it in some way, by the use of network modifiers. These take the form of soda, either in its mineral or plant ash forms. The addition of soda reduces the melting point, particularly in the presence of the third element of these glasses, lime (Brill 1962:132). The lime also serves to make the glass chemically stable, and less susceptible to deterioration in the presence of water (Brill 1962:134).

The addition of soda and lime to the glass has a dramatic result. For a composition of 21.9% Na_2O, 5.0% CaO and 73.9% SiO_2 the minimum liquidus temperature at the ternary eutectic[2] would be 725ºC (Shortland 2000:2), or just over half the temperature needed to melt pure silica. Consequently, it is important to know the source of the alkali and other materials used in the glass, and their proportions.

Whilst minerals have a well defined melting point, glasses do not, rather they soften gradually over a range of temperatures, and as a result they may be discussed in terms of their viscosity. Shortland (2000:3, Table 1:1) has conveniently summarised Brill's (1962:137) diagram of comparative viscosities in tabular form, and I have added to this significant glass working points from Brill (1962:137, c.f. Shortland 2000:3) as follows:

Viscosity Point Poises	***Material/Significant Glass Working***
10^{-2}	Water
10^{0}	SAE 30 Motor Oil
10^{1}	Molasses
10^{4}	***Glass Working Point***
$10^{7.65}$	***Glass Softening Point***
10^{8}	Cheddar Cheese
10^{9}	Solid Pitch
10^{11}	Lead Metal
$10^{13.5}$	***Glass Annealing Point***
$10^{14.5}$	***Glass Strain Point***
10^{15}	Aluminium Metal
10^{19}–10^{22}	Most Glasses

It will be apparent from the above that in order to work glass into objects it is necessary to continually re-heat it in order to keep it sufficiently viscous. Similarly, by heating beyond the working point it is possible to soften the glass such that it can be moulded. Consequently, it is important that we try to gain an understanding of the furnace arrangements used in the production of early glass.

Reconstruction

Raw Materials

The raw materials of glass production are silica, soda and lime. Because the procurement and initial treatment of these materials leads to their being used up, or modified, evidence for them may be difficult to detect archaeologically. It is therefore necessary to invoke the widest possible range of evidence in attempting to reconstruct the raw materials.

Silica

Silica can be obtained from quartz or from quartz sand, and there has been some debate about the source used in the earliest Egyptian glass. Petrie (1894:26) noted that "among the furnace waste there were many pebbles of quartz. These had been laid as a cobble floor in the furnace….Doubtless this use of the pebbles was two-fold; they provided a clean furnace floor, and they became disintegrated by the repeated heating so that they were the more readily crushed for mixture in the frits afterwards". However, as has already been discussed (Chapter 2), Petrie found no actual furnaces and therefore this reconstruction is entirely hypothetical. Similarly, he provides no quantification of how many such pebbles were found, they are not commonly represented in museum collections, nor are they said to be present in their thousands in the way that clay moulds are said to be (Petrie 1894:30). All that can really be determined is that quartz pebbles were found in some numbers, and that some of them had drips of glaze on them showing that they had been present in a furnace where either glass, frit or —perhaps less likely—faience was being produced.

The continual heating and cooling of the pebbles would certainly lead to their disintegration, and this could provide a very valuable source of high quality silica, which could be further crushed if required. It has been suggested in Chapter 1 that the very earliest glass in Egypt might have used such crushed quartz as a means of providing the highest quality raw materials for an industry whose refinements were not yet understood.

Shortland (2000:44) believed that crushed quartz was the source of the silica used in all of the Amarna vitreous materials. The source of this quartz was, he believed, the river and that such pebbles are "commonly found scattered over the Nile floodplain" (Shortland 2000:44). It is true that such pebbles can be found on the desert fringe, and with sufficient organisation could be collected. However, they are not common along the agricultural land of the Nile, though it is possible that they were more plentiful before the construction of the Aswan High dam ended the inundation. In examining the Nile banks at Amarna large beds of such quartz pebbles have not been encountered. It is known that in Iran in the 1960s quartz pebbles were collected for use in making faience and frit, and that only the purest were used, but these were collected from a dry river bed (Wulff *et al.* 1968:99). Interestingly, these pebbles were not broken up by heating, but by hammer and grindstones.

Despite the lack of large deposits of quartz pebbles at Amarna, Shortland demonstrates that some of the frits contain angular grains of silica which are unlike the rounded profiles of the Amarna sand. However, Hatton (2005:52) believes that the source of silica used in Egyptian Blue frit was sand, based on the presence of iron-titanium from Titanomagnetite, an accessory mineral in the desert sand. It would thus appear that there are two possible sources of silica for the frits,[3] and if this is true for the frit it may also hold for at least some of the glass and faience.

However, in 2003 Shortland reconsidered his interpretation of the Amarna evidence (Tite and Shortland 2003). In reviewing this he was not able to be certain of the source of the silica, and though crushed quartz was still felt to be a likely source "it must be emphasised that the available quartz sands can vary very significantly in composition, with alumina contents being as low as 1% in some cases. Furthermore, quartz sand particles that have been subjected to only limited abrasion through transportation can retain some angularity. Therefore the possibility that quartz sand, rather than crushed quartz pebbles, was used cannot be entirely ruled out" (Tite and Shortland 2003:299).

It is worth noting that from the excavations at O45.1 there has been no indication of any working area for the crushing of quartz, nor significant finds of grinding stones which could be tied to this purpose. This is not to say that such areas did not exist, merely that the excavations have not unearthed them.

Petrie's (1894) account of glass production was early compared with the Assyrian glassmaking texts. Oppenheim (1970:35) translates *Tablet A* as including *immanakku*–stone, which he gives in the glossary (1970:90) as "sand". Brill (1970:109) agrees that the term refers to the principal source of the silica used in the glass, and sees the material as river pebbles, though they do not look like "river silt dotted with pebbles" as the text suggests they should. He rules out sandstone as being likely to dilute the silica content because of its cement. Brill's argument for pebbles, rather than sand, seems to be heavily influenced by prior knowledge of Petrie's finds and does not fit well with the textual description, which appears to be much more like either a compact sand or sandstone. However, he goes on to note that had sandstone been used in his experimental replication it would not "be likely to alter the results of the experiment to any great extent" (1970:4). Once again, we come up against the problem of assigning modern terms to ancient words, and so must proceed with caution.

Soda

The obvious source of soda in ancient Egypt would be the Wadi Natrun in the north of the country, which has given its name to the mineral soda, natron. Natron was widely used in ancient Egypt as a means of purification for corpses, for laundry "soap", as a toothpaste etc. This evaporite mineral is of variable composition, but is basically a mixture of sodium bicarbonate, sodium carbonate with sodium chloride, and sodium sulphate (Turner 1956:284T and table IV). According to Henderson (2000b:26) however, it has more recently been identified as the sodium sesquicarbonate mineral trona by Brill.[4] Examination of ancient Egyptian glasses, however, showed them to be high in magnesia, and this is associated with the use of plant ash alkali rather than a mineral source. This key division of glasses into HMG (high magnesia glass) and LMG (low magnesia glass) stems from the work of Sayre and Smith (1967:281–93) and has subsequently been widely used (c.f. Henderson 2000a, 2000b).

Consequently, it has widely been assumed that the alkali source was derived from the burning of plants, particularly of halophytic varieties such as *Salsola kali* and this has been the source quoted in the literature (e.g. Freestone 1991:41; Nicholson 1993:42). The ancient distribution of these plants is unknown, but it is not improbable to assume that they may have been found at or near Amarna, and the ashes could have easily been imported from more favourable regions should that have proved necessary. It is clear from Oppenheim (1970:35) that the ashes of the *naga* plant were used in the production of Mesopotamian glasses, although the specific plant cannot be identified with certainty. Wulff *et al.* (1968:100) working in Iran in the 1960s note that *Salsola kali* and *Salsola soda* were harvested "before the plants dry up in the summer heat [when] collectors cut them above the roots with a small hoe and burn them in large pits where the ashes sinter into hard blocks. Some collectors prefer to burn the plants in open heaps and men gather the powdery ash and carry it to their village where they melt it in calcining furnaces into hard blocks. This, they claim, removes all traces of unburnt organic matter." Pits for the burning of plant ashes may be hard to recognise archaeologically, whilst the blocks of ash would be broken up before use, and in any case may not survive well in any but the most favourable conditions. It is interesting that the plants are harvested before the heat of summer, since that would make the ashes available during the hottest time of the year, which is when, one might suspect, conditions would be most favourable for the manufacture of glass.

Work by Shortland (2000:45–46), however, suggested that the pattern of alkali use may be more complex than first thought. He states that Caley (1962) had already found that some alkali-lime-magnesia-silica glasses of the 18th and 19th Dynasty[5] have soda contents in excess of 28%, though in fact this figure seems to be for Ptolemaic and Roman glasses (Caley 1962:69).[6] Whatever the truth of this matter, it is the case that glasses of this date are found with more than 22% of soda, and total alkali content may exceed 30% (Shortland 2000:45). The Amarna glasses average 3.7% magnesia, but such a figure masks the differences in magnesia associated with different types of colourant. When potash was plotted against magnesia two clear groups emerged, one with cobalt colourant, the other with copper. The copper-coloured glasses plot in the region associated with the use of plant ashes, but the cobalt ones whilst having similar magnesia are lower in potash, plotting instead with natron glasses. It appeared that the magnesia was entering these glasses with the cobalt colourant[7]. For many years it was assumed that cobalt was not available in Egypt (see Dayton 1993:12)[8] although Lucas (1962:260)[9] was aware of the cobalt alums of the Kharga and Dakhla oases. In 1986 Kaczmarczyk (1986:1991), reviewed the cobalt alum source in the Dakhla Oasis of Egypt's Western Desert and took the view that, *contra* Lucas, it had been known to the ancient Egyptians, a view which analytical work has tended to confirm, albeit with the suggestion that the alum was modified before use (Henderson 2000b:31).

The cobalt alums of the Western Oases are rich in magnesia and, it was argued, would easily produce the low potash with magnesia effect observed in the plots. Shortland (2000:45–46) determined that the average content of the cobalt glasses was 0.16%, and that this level of cobalt would bring with it 3% of magnesia. The average magnesia level in the glasses is 3.6%, the additional 0.6% coming from the alkali source. Taking away the 3% derived from the cobalt alum allows the glass to plot with the natron glasses.

However, Tite and Shortland (2003) subsequently reviewed this evidence and found the situation to be more complicated than had first been thought. It was found necessary to determine the form in which the cobalt was added to the glass. The cobalt may be added as untreated alum, or as a mixture of hydroxides precipitated from a solution as Rehren (2001:486–87) has suggested, following the work of Noll (1981a, 1981b:150). This would be achieved by using an alkali, believed to be natron. Tite and Shortland (2003:294) showed that this precipitation could be replicated in the laboratory and found that the glass was enriched in cobalt oxide as well as alumina and magnesia when compared to the original alum. However, the level of magnesia in the glass was higher than would be expected from the cobalt alone and must be associated with the alkali, suggesting that plant ashes, albeit of a different type, might have been used, a suggestion first made by Lilyquist *et al*. (1993:42).

The finding of different plant ashes for copper-blue and cobalt-blue glasses, the last with some possible contribution from natron, is important, and demonstrates a more complex pattern of early glassmaking than had hitherto been expected.

From the excavation there is no trace of pits for the burning of plant ashes nor facilities for the storage of natron. However, the absence of such features is not surprising, since the halophytic plants may have been ashed near to their source, whether this was near to Amarna or at some distance from it, and transported as ash. The natron too would have been transported as blocks or in sacks or baskets, and may well have been stored in these until required. Whilst it is dangerous to apply analogies from distant times and places, it is noteworthy that the well known illustration from Sir John Mandeville's *Travels*[10] of the 15th Century A.D. shows the pit for the burning of wood to make ash —apparently—at some distance from the workshop itself.

Lime

The question of the addition of lime to make soda-lime-silicate glasses is a vexed one. Lime acts as a stabiliser in the glass, helping it to resist the destructive properties of water. However, the ancient Mesopotamian/Assyrian glassmaking texts (von Saldern *et al*. 1970, Newton 1980:175) do not call for any deliberate addition of lime to the mixture.

Pliny the Elder (A.D. 23/4–79) in his *Natural History* (Book 36) provides a romanticised account of the accidental discovery of glass, but again gives no suggestion that lime was initially added to the mixture, though he goes on to say that soon shells and quarried sand were added (see Rotländer 1979) which would provide such lime.

Good evidence for the deliberate addition of lime is therefore not well attested. One reason for this is, perhaps, that the glassworkers in the earliest times were not aware that they were adding it. This is not so surprising as it might first appear, since the lime may have been added unintentionally. The most obvious way for this to happen is for it to be brought in with the silica or the alkali. Lucas (1962:481) long ago analysed a variety of sands from Egypt and found that the one most rich in lime was that from Amarna (18.9% CaO) followed by one from Karnak (12%).[11] Experimental work (Chapter 4) has convincingly shown that it is possible to make glass using the Amarna sand without adding further lime to the mixture.

Should extra lime have been required it would have been possible to produce it through the burning of limestone, and such stone is common in Egypt, and is the most prominent feature of the geology at Amarna.

It is worth noting that large quantities of lime were found in the excavation at O45.1, not least around Kilns 2 and 3. The possibility that these were in fact lime kilns was considered, but their design suggests that they would be impractical for such a purpose (see Williams 1989) since there appears to be no way of fuelling them when the limestone was added. The purpose of the lime can only be speculated upon, but it may be that it was used as a separating agent. It is also possible, but in my view unlikely, that this was the remains of a natural pocket of lime present at the site before the factory was established. Such pockets are sometimes found as lenses within the sand, but more commonly to the east of Amarna proper on the high desert.

Preparing The Raw Materials

To Frit or Not to Frit?

Fritting has become one of the major areas of controversy in the study of ancient glass. Fritting is the process by which the three main constituents of a glass are reacted together, in a solid state reaction, at a temperature of 700–850ºC. By this means the silica starts to react with the other constituents, but more importantly they react with one another and evolve gases, particularly carbon dioxide. Because the frit is fairly granular and spongy, rather than dense and melted like honey or molasses, it is easy for the gases to escape from the mixture and be lost to the atmosphere. This is regarded as desirable, since if they were to be generated in a more liquid melt the glass might be filled with bubbles ("seed") and thereby be difficult to work when re-melted/softened.

Turner (1956:293) followed Petrie (1894:25; 1909a:124) in believing that fritting was a necessary stage in the manufacture of early glass, and there is good authority for such practices from some of the Medieval glassmaking treatises. Both Theophilus, writing in the 10th Century A.D. and Neri (1612, see translation—Neri and Merret 1662/2004) describe the process of fritting for the production of glass in their own times. Similarly, the Mesopotamian/Assyrian texts suggest that glass was not produced in a single operation, but was rather the product of fritting and then melting (Oppenheim 1970, Brill 1970).

Given that Petrie was aware of the early European tradition of glassmaking, it is not surprising that he interpreted the frits which he found as being the first stage in the production of glass, and that Turner, still better versed in the history of glassmaking, followed suit. The support lent to these views by the ancient texts from Mesopotamia would seem, at first, to suggest that it would not be possible for glass in the earliest times to be produced without fritting. However, there is a problem with this argument.

It has been shown that the frits found at Amarna have a much higher silica content and lower amounts of lime and alkali. The frit is also richer in cobalt and its associated alumina. "It is clear therefore that crushing and melting the frit yields a product with a composition far different from that of the glass, strongly suggesting that the simple currently accepted hypothesis is incorrect" (Shortland 2000:54–55). Making a frit and then adding more lime at the stage at which the frit is melted to make glass would make no sense, since gases would again be evolved, defeating the object of the fritting process. Similarly, to remove unwanted, unreacted silica would be tedious and difficult. Furthermore, work on determining the temperatures at which the Amarna frits were produced suggests that they were made at around 1050–1200ºC rather than 750ºC suggested by Turner (1956:294T) on the basis of examination of Medieval and later texts.

Tite and Shortland (2003) have, however, revised this interpretation somewhat. Whilst they retain the view that the cobalt blue glass was not made simply by grinding and re-melting the frit, they reconsidered the means by which the glass was produced. They concluded that "the compositions of the cobalt-blue glass and frit are consistent with the hypothesis that the cobalt-blue glass was produced from a mixture of cobalt-blue frit with additional plant ash and quartz. However, it is still possible that the cobalt-blue glass was produced directly from a mixture of quartz, plant ash and precipitated hydroxides" (2003:307).

The case for the necessity of fritting materials in the manner suggested by Petrie in order to make glass, would therefore seem to be less secure than might have been supposed. There is still further evidence to suggest that it may not be necessary at all, even for the production of these early glasses.

The furnace experiment conducted by the writer and Dr. Jackson (Nicholson and Jackson 1998; and Chapter 4 here) at Amarna in 1996, conclusively proved that glass could be made using sand from Amarna mixed with plant ashes and without additional lime.[12] The ratio used was two parts of ash to one part of sand by weight, and the glass was produced without recourse to a separate fritting stage.[13] The glass made was free of bubbles and similarly free of unreacted material, despite having reached a maximum temperature of 1150ºC. It is fair to say that this result was unexpected by the experimenters, both of whom were familiar with the conventional wisdom that fritting was essential.

Some years later Shortland (2000) published the results of his laboratory replication experiments. In these he found that it was possible to produce a glass of Amarna composition using laboratory reagents after 10 hours of firing at 1050–1100ºC without fritting. His work agrees in all respects with the field experimentation as he notes "experimental reproduction of glasses in both the laboratory and the field suggest that it is possible to produce a good glass straight from the raw materials in a one stage process, without the necessity of a fritting stage. It is therefore likely that the Amarna glass was produced in this way and that the frits are an intermediate stage in the production of not glass, but some other vitreous material" (Shortland 2000:56). The possibility of a one stage process is retained by Tite and Shortland (2003:301).

These experiments have far reaching implications for the archaeology of glass production in ancient Egypt. It has long been held that glass production sites will yield frit, as an intermediary stage in glassmaking. However, only rarely can archaeologists working on still later periods, when fritting is attested, agree on what such material looks like. At Amarna where the preservation of materials is generally excellent, no indication of frit has yet been found,[14] quite possibly because it never existed. It can no longer be argued that absence of frit is the same as absence of glass production.

The Making Process

Present evidence does not allow us to determine with certainty what source of silica was used. Suffice it to say that quartz pebbles are known from sites associated with glass production at Amarna in unknown quantities. If they were used in the production of glass then they must first have been crushed. There is so far no evidence for the crushing of such materials, and Hatton (2005) has suggested that at least for Egyptian Blue frit the source material was sand. It is therefore quite possible that sand was at least one source of silica for the Amarna glass, particularly since it is rich in lime. The examination of the glasses by Jackson and Nicholson is equivocal as to source (Chapter 5).

Whatever the source of the silica it may well have needed some refinement. In the case of crushed quartz any over-sized pieces would need to be picked out, perhaps by sieving. The same would be true of sand, though if the source was carefully chosen it might be possible to find material which had already been quite well sorted by the wind. Pieces which were obviously impure or unsuitable would be picked out, but given that most of the glass was going to be coloured in some way impurities may have been of much lesser importance than Petrie (1894:25) suggests. Only when a clear colourless glass was desired might more care have been taken or, indeed, crushed quartz have been used.

The silica material would be mixed with the alkali. For glasses to be coloured copper blue the alkali would have been in the form of plant ashes. For cobalt-blue glasses the process is less certain, either a single stage process would be used in which natron might be introduced from precipitated cobalt added to the mixture, or a frit might be used and additional plant ashes—probably of a different kind to those used in copper-blue glass—would be added.

Where plant ashes were used these would need to be refined, since initial burning leaves a mass to which small stones, surface sand and other non-combustible materials are attached. The ashes would need to be crushed and sieved before use. It may be that they were washed, but when dealing with fine materials the tendency is to produce a very dense lump which then requires further crushing and grinding before use. If sufficiently clean material could be produced from simple crushing and sieving this would seem to be the more likely practice. Colourant could be added at the dry mixing stage, or later as required.

The question now arises as to what the glassmaking ingredients were reacted in. The shallow saucer-like vessels proposed by Petrie (1894:26 and Pl. xiii: 62) may be discounted for the production of glass frit, since it now seems likely that this never existed at Amarna. The next most likely candidate is the cylindrical vessel.

Cylindrical Vessels

These vessels are well known from sites producing vitreous materials and were first described by Petrie (1894:26) who believed them to be stands for the saucer-like vessels used in fritting. Those from site O45.1 have diameters of between 16.0 and 24.0cm the norm being c.18.0cm. This is consistent with the vessels examined from elsewhere at Amarna (Nicholson *et al*. 1997:145). Complete profiles of the vessels are uncommon, but the full height is normally between 9.0 and 11.0cm. Similar vessels are also known from Qantir (Rehren 1997, and below).

Petrie failed to comment on the white coating on their interior, which is almost unique to vessels of this type. Turner (1954:440T) seems to have been the first to realise that the interior slip of these vessels might be important, and that they must therefore have served as containers, not merely as stands. He saw this layer as helping to protect the vessels against corrosion from the glass. His analyses showed the layer to be rich in both lime and silica. Subsequent study of these vessels by the author and Dr. Jackson has shown that a subdivision is possible, and Shortland (2000:33) reaches the same conclusion. The first group has a flat base with walls that rise almost vertically from it, whilst in the second group the junction between the walls and base is less sharp, giving a convex cross section to the vessel.

There is good evidence that these vessels contained glass. Even before the new excavations at Amarna were begun surface finds from the Palace Dumps demonstrated that glass could be found in these vessels (Nicholson 1993:51, here Plate 6.1). The excavated examples from O45.1 (below) also show that glass was present in these vessels, but it is possible to infer somewhat more about them.

I do not accept Petrie's (1894:26) view that the vessels served as stands, nor Turner's (1954:440T) that they served this purpose whilst unfired, so being given their preliminary firing prior to use as actual containers. Both Petrie and Turner base their view that these stood upside down on the runs of glass coming from base to rim, and in most cases it is actually impossible to tell the direction of the glass flow. Whilst I do not doubt that vessels may occasionally have been used upside down, I do not think that this was a common or intended practice. The white calcareous lining on the inside of the vessel, rather than the runs of glass outside, should be seen as the defining feature of these pots. As Turner noted, this lining would serve to protect the raw glass from contamination from iron in the clay, furthermore it would help serve as a parting agent for removing the blocks of glass (below) and generally serve as a parting layer/anti-contaminant layer for frit or even faience objects, if the vessels were sometimes used as containers for firing small items.

As has been discussed above, several types of glass may have been made at Amarna, and quite possibly several more worked there. The role of the cylindrical vessel may be somewhat different in each case. If Tite and Shortland (2003:307) are correct in their belief that the cobalt blue glass could have been made by combining frit colourant with additional quartz and plant ashes, then this may be the explanation for the

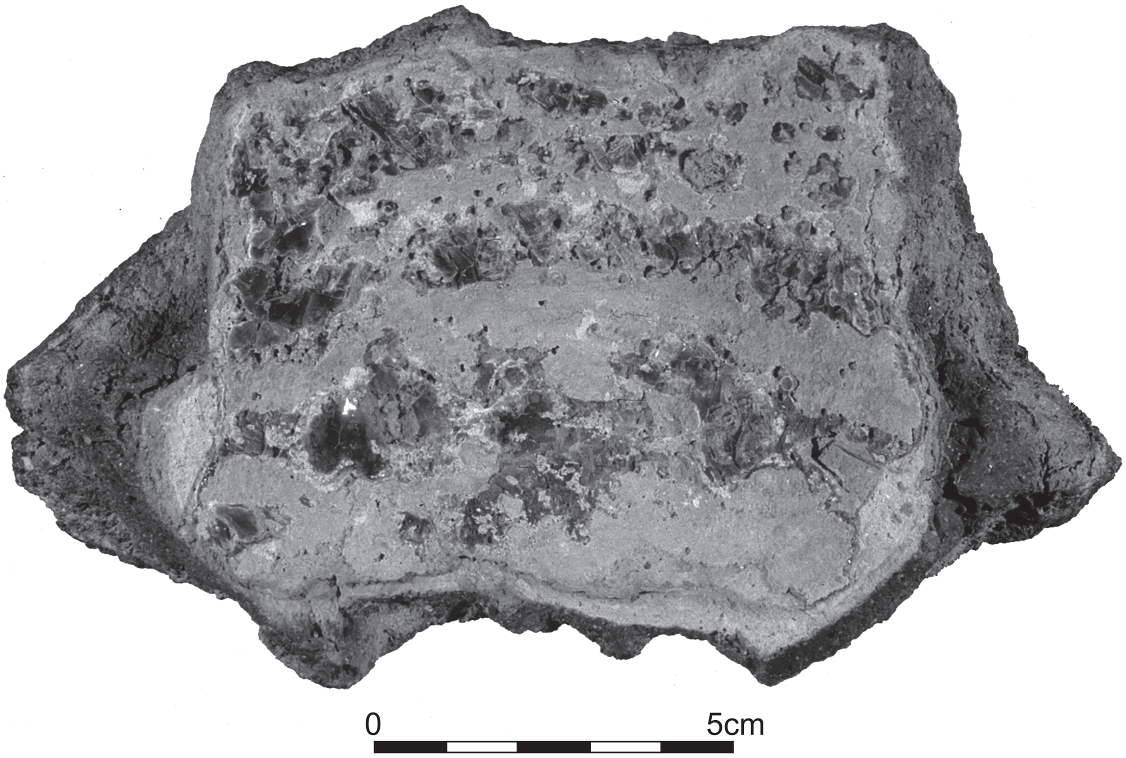


Figure 6.1. A cylindrical vessel from the Palace Dumps at Amarna, containing dark blue glass, probably coloured by cobalt. (Photo: Gwil Owen/E.E.S.).

discovery of blue frit adhering to the inside of some of the cylindrical vessels, the frit itself having first been prepared in the open saucer like vessels well known to Petrie.[15]

If the cobalt blue glass were prepared in a single stage operation then it is possible that this is the glass found adhering to some of the vessels, though it could equally be the result of the two stage process taking place in the cylindrical vessels. There is further evidence relating to how the vessels may have been charged. It has been noted for some time at Amarna that at the rim of these vessels the glass is often broken away, as though something has been stuck to the rim and pulled away. Rehren and Pusch (2005:1756) comment on this feature from similar cylindrical vessels at Qantir, and are able to offer an explanation for it. They believe that the feature is the result of the cylindrical vessels being fitted with a clay funnel.

This funnel, made from a coarse fabric, was luted —unfired—onto the cylindrical vessel and served to direct powdered glass into the vessel during the firing process. The reason that this would be necessary is that chunks of glass would take up more space than when melted, and so in order to fill the vessel more glass would need to be added. The same argument would hold true if the glass were being made from its raw materials in a single stage operation (see Chapters 1 and 4). As the powdered materials react with one another and liquefy so their density increases and their volume decreases. In order to make a useful quantity of glass additional powdered material would have to be added. Similarly, if frit were being melted in these vessels and additional silica and plant ashes were being added a funnel may be similarly helpful.

Rehren and Pusch have nine fragments of these funnel shaped attachments from Qantir. They have a characteristic profile, as demonstrated by fragment 00/0166 (2005:1757 Fig. 3), described by the authors as “a right-angle triangle in cross section (with) a groove in the short side that fits over the rims of the crucibles and a protrusion on the long side that reaches into the crucibles” (2005:1756). From the excavation at O45.1 there have been no such characteristically shaped fragments, however, there is some evidence that such funnels existed.

All of the pottery, slag and brick fragments recovered from the excavation at O45.1 have been individually examined. It was noted that amongst the brick fragments was a coarse, sandy fabric, somewhat friable in nature and which may have been from a kiln lining or peculiar type of brick. No recognisable edges were observed, and the pieces were often somewhat rounded. However, when I first saw photographs of the Qantir funnels it seemed likely that the fabric was similar to the unusual brick fragments, and I suspect that this was their true purpose.[16]

Given that there are cylindrical vessels at Amarna which have the same kinds of damage near the rim as those at Qantir, and that the unusual brick fragments are similar in fabric to the Qantir funnels, I would suggest that there is evidence for their existence at Amarna. However, at Amarna I would suggest that their primary function was to facilitate the introduction of raw materials into the vessels, rather than of pieces of glass. Since no recognisable profiles were found this must remain speculation, but the fact that glass was apparently made in some quantities in these vessels strongly argues for the likelihood that some kind of funnel was used, as does the breaking away of glass near the rims.

With regard to the quantities of glass made in the vessels we have some important evidence. The discovery of the Uluburun shipwreck off the coast of Turkey in 1984 led to the excavation of approximately 175 glass ingots.[17] Most of these are cobalt blue in colour, with at least 21 examples of turquoise-copper blue and one lavender/purple example. Examination of photographs published by Bass (1987:716) clearly showed concentric ridges on one surface of the ingots. This ridging appeared to match the kind of finger grooves commonly found inside the cylindrical vessels from Amarna. Examination of the shape and size of the ingots from drawings published by Bass (1986:282) suggested these ingots might well have come from moulds of the type found at Amarna, and this was confirmed by fitting a cast of one of the ingots (KW4)[18] into an Amarna mould.

Examination of 24 of the original ingots was undertaken at Bodrum in 1996 and strongly suggested that they had come from Amarna-type moulds (Nicholson *et al*. 1997).[19] The maximum thickness of any cobalt ingot examined was c.7.0cm, and the maximum diameter c.15.0cm, which is consistent with the Amarna vessels. The weight of 15 cobalt blue examples recovered in 1984 ranges from 1597–2607 grams, (Bass 1986:282), the mean being 1953.3 grams. If the Egyptian unit of weight, the *dbn,* is taken to be c.100 grams in the 18th Dynasty then the ingots would average 19.5 *dbn.* Given the range of values this might suggest that 20 *dbn* was the intended average weight. Without a full set of weights for the ingots this must remain speculative, if suggestive, of an Egyptian origin. The glass itself may also suggest this.

An analysis of the glass from Uluburun ingots[20] show them to have approximately 68% silica, 18% soda, 6% lime, 0.6% potash and 2.6% magnesia (Jackson *et al.* 1998:22, see also Chapter 5) comparable results have also been obtained by Brill (1999b:53–54, also Brill 1999a:47–48) on a larger number of samples. The ship is believed to have sunk at around 1306 B.C. (www3), within a few decades of the reign of Akhenaten, and was carrying items which related to Amarna, notably a gold scarab of Nefertiti (Weinstein 1989).

It would appear then that one of the main functions of the cylindrical vessels is the making of glass ingots, and to this end they have been referred to as "ingot moulds" (Nicholson *et al.* 1997:152) for cobalt glass. The copper blue ingots from Uluburun are of a different size and do not convincingly match the Amarna material. If the cobalt blue ingots did actually come from "old stock" at Amarna, rather than from similar moulds of around the same time, then it would suggest that the copper ones may have been from a different source. The use of the cylindrical vessels as ingot moulds in no way precludes them being used as melting vessels for other colours of glass, including copper blue, which may or may not have been manufactured at the site from raw materials.

It was suggested some time ago (Nicholson *et al.* 1997:146) that the Amarna industry may centre on the production of vitreous materials, particularly using cobalt, whilst the later Qantir industry centred around metal, notably copper. This argument has been expanded by Rehren *et al.* (2001) and Tite and Shortland (2003:305–6), who suggest that it may be that only the cobalt blue glass was actually produced at Amarna, with the copper blue being produced elsewhere and using plant ashes of a different composition to those at Amarna. This might explain why it is that where substantial amounts of glass have been found in the vessels at Amarna it is generally cobalt blue, although other colours are also known, perhaps from working.

For the moment it must remain uncertain whether or not copper blue glass was also *made* rather than simply *worked* at site O45.1. Many cylindrical vessels have indications of this colour, and since there is relatively little evidence for the working of glass into objects at the site, this may indicate primary manufacture of both colours of glass. Shortland (2000:31) states that "Nicholson….concedes that the vessels may have had a dual purpose". In fact no concession is necessary here. Whilst I believe that the vessels had an important role as moulds (below), they were clearly used in a variety of contexts relating to the production of vitreous materials, and had more than a dual role. Indeed, the fact that they are found at many locations at Amarna where vitreous materials are being made or worked, might suggest a link between the craftsmen involved in these activities whether they be primary or secondary producers.

Distribution of Cylindrical Vessels at O45.1

The excavation of O45.1 has yielded numerous fragments of cylindrical vessels, though they do not join. If surface finds and those from the illegal excavation of foundation trenches north of the modern Water Tower are discounted, there are 44 fragments from the excavation. Of the surviving examples many show traces of glass, the colours ranging from what is probably a copper-coloured glass of turquoise or light blue colour, through cobalt blue to green.

Examination of the finds database indicates that the squares producing most cylindrical vessels are J80 (n =8) and J85 (n=8). These are the squares associated with the potter's workshop, and share between them unit [9438] a deposit which comprises building debris, but which has been damaged by modern agricultural traffic. This unit accounts for 6 of the 16 vessel fragments in these squares. It is noteworthy that where any material is adhering to the vessels it may be either light or dark blue, and in one case is thought to be frit. In other words, there is no consistency of colour by unit or square here. Unit [9433] was believed by the excavators to be part of [9438] and accounts for a further one vessel in J85. Unit [9440] in J80 yielded two more fragments. This unit is close to the surface, though considered to be a genuine, if heterogeneous, deposit.

Two further squares yielded 6 and 5 fragments respectively, these are L75 and M75, situated immediately south of Kilns 2 and 3, believed to be the glass furnaces. In these squares unit [8979] accounts for 4 of the vessels. This unit is a stony deposit covering much of the area, and possibly to be associated with the levelling of the site after it had gone out of use. Once again frit and blue glasses are found adhering to the pans. Two further fragments come from a trench clean [10187] in M75.

Square K100 also produced 4 fragments but three of these are from the surface unit [10173] and so can have little weight placed upon them. Other fragments are distributed across the site. Thus it would appear that with the possible exception of units [9438] and perhaps less likely [8979], few if any of these vessels can be considered as in a primary context. However, it is worth noting that studies in the U.K. have indicated that even where ploughing of sites has taken place, finds are often moved only a few metres from their original context. It may be therefore, that the vessel fragments here are similarly close to their original place of deposition (Haselgrove *et al.* 1985; www.2).[21]

It is worth pointing out that the number of vessel fragments found in this area is greater than one would expect from areas of Amarna not associated with the production of vitreous materials. Whilst no survey of these vessels across the site exists, it has been observed from walking over the site during the last twenty years or so that cylindrical vessels have quite closely defined locations and are indicative of areas of vitreous material production. They are frequently associated with the slaggy *khorfush* material. The vessels are frequently observed on the Palace Dumps, and although this area itself was probably not directly associated with glass manufacture it does seem to be the area in which industrial remains were dumped. There remains the possibility that workshop remains may lie beneath the surface covering of refuse, though given that Petrie was "clearing" (28th March-3rd April 1892) these the possibility of underlying structures is remote.

Reaction Vessels?

It seems that at Amarna the reaction between the raw materials, whether carried out in a single stage operation or in a two stage operation whereby additional silica and plant ash was added to the batch, took place in the cylindrical vessels.

However, Rehren and Pusch (2005:1756) have evidence for a second type of vessel which they believe may have been used as a primary reaction vessel at Qantir. This vessel is the type of ovoid jar sometimes known as a "beer jar". Indeed, it may be a standard domestic vessel which has simply been reused or assigned a different function. As with the cylindrical vessels, the important feature of these jars is that their interiors have been coated with the same calcareous slip as that found on the cylindrical vessels. They believe that it was in these vessels that the glass was made from its raw materials before being melted in cylindrical vessels.

Whilst this may well be true of Qantir it should also be noted that they have a cylindrical vessel (00/0344) which appears to have "a heavily corroded block of raw glass" (Rehren and Pusch 2005:1756) still in it. This contains many grains of quartz, both rounded and angular and was apparently "abandoned before the batch material had fused completely, in effect preserving much of the original raw material" (2005:1756). This would imply that even if ovoid jars were being used for some of the reactions they were not the universally chosen vessel type.

Despite the gap of over half a century between the end of the reign of Akhenaten and the start of that of Ramesses II, and thus between Amarna and most of the material from Qantir, it was clearly worth investigating whether Amarna might also have ovoid reaction vessels. Since all sherds with evidence of white slip were kept it was possible to check for any fragments which were not from cylindrical vessels. A couple of possible candidates were found, 31783 and 31883, both of which are marl clay sherds, one of them notably overfired. Marl clay is less resistant to high temperatures, and would tend to bloat and collapse at around 1050°C, making it less suitable than the silt beer jars as a reaction vessel. Since such fragments are rare at Amarna one must assume that vessels other than cylindrical ones were used only occasionally for reaction, or were occasionally coated in the same calcareous slip, for whatever reason.

It may be that by the time of Qantir the process had become more refined or that the red glass in which Qantir specialised required a modified method of production. Whilst ovoid reaction vessels cannot be completely ruled out at Amarna there is at present no firm evidence for them, although there does appear to be evidence for the production of glass from its raw materials.

The Kilns/Furnaces

The kilns from O45.1 have already been discussed in terms of their archaeology (Chapter 3). It would appear that Kilns 1 and 6 are probably for the production of pottery, whilst Kiln 5 is either a hearth or the remains of a small kiln, possibly for use in glass working or possibly for heating small quantities of copper/bronze as a colourant. Kilns 2 and 3 are clearly different to the others and are discussed below, along with Kiln 4.

The Function of the Kilns

Kilns 2 and 3 are of approximately the same size, 2.50–2.90m in diameter and the preserved depths are between 0.65 and 0.90m. The shape of the structure and the brickwork pattern strongly suggest that the function of the two kilns was probably the same.

The thickness of the kiln walls is c.0.5m, and the brickwork is carefully constructed in order to cope with the stresses imposed by high temperatures. The fact that the structure is set into the ground is an additional help in coping with thermal stresses, as well as providing insulation. Kiln 3 has a lining of plaster, the so-called "sacrificial render" which could be removed when it became vitrified so that the kiln could be freed from slag without the need to replace the whole structure. The lining is missing in Kiln 2, suggesting that it was either abandoned or, more likely, was in the process of being prepared for rebuilding. This would mean that glassmaking could go on continuously in one or other kiln, perhaps exploiting a defined season suitable for the craft. The experimental firing suggested that the firings benefited from draught provided by the north-wind, and it may be that glassmaking took place when the wind was most favourable and the weather at its driest.

It has been suggested that the superstructure of these two kilns, more properly described as furnaces, would have been domed, since the surviving brickwork on Kiln 3 strongly indicates such a curvature, as does a lose brick with slag at an angle to its surface (see Chapter 4, and Plates 3.8–3.12). The effect of this dome would have been to concentrate and contain heat within the structure, and this effect would be enhanced as the brickwork of the dome became slagged and, as a result, shiny.

There would have been a minimal number of openings in the dome structure. These would comprise a stoke hole, through which fuel was fed to the fire, a small hole in the top of the dome through which smoke could escape and probably several openings through which the cylindrical vessels were introduced into the furnace, and through which they could be topped-up with raw materials or— in the case of glass not made on site—with raw glass. In the experimental furnace three such openings were allowed for. The vessels themselves probably stood on shelves projecting from the wall of the furnace.

Although no furnaces have yet been found at Qantir, Rehren and Pusch (2005:1757) have identified "hot spots" on the cylindrical vessels suggesting that some areas of the vessel received more direct heat than others. In discussion following a paper by Rehren,[22] it was suggested that this differential heating might be the result of directing heat using blow-pipes. If this were so a small furnace with openings for 3 or 4 pipes to reach a single crucible might be implied, a quite different arrangement to that suggested for Amarna. Whilst the Amarna cylindrical vessels do show areas of differential heating such "hot spots" are, in my opinion, more likely to be the result of close contact between vessels in the furnace than deliberately directed heat. So far as I am aware, the ovoid vessels at Qantir show no sign of such differential heating. It is, of course, entirely possible that the details of production at Amarna and Qantir are quite different since they are chronologically and geographically separated.

Examination of charcoal from O45.1 has been carried out by Dr. Rainer Gerisch (Appendix 3). He found that the charcoal embedded in the slag of Kiln 3 was *Acacia nilotica* which was by far the most common type of charcoal found on the site overall. It is possible, too, that rubbish was being burned in the kilns. Bone fragments were found in both Kilns 2 (units [8066=8980] and [8067]) and 3 (unit [8065]) although the contexts from which they come are either close to the surface or demolition/collapse contexts rather than primary ones. The possibility that bone, as an indicator of refuse, was being burned in these furnaces cannot be proven. However, there are some fragments of bone with signs of burning from the upper fill of Kiln 1 ([8034]) which might suggest that it was at least an occasional practice for the potters, if not the glass makers (Appendix 2).

The provision of fuel for the furnaces in a location like Middle Egypt would normally be considered a limiting factor. However, if we are right to regard the workshops at O45.1 as being in some measure under royal control then the supply of fuel becomes a less problematic matter. An institution which could obtain cobalt-alum from the oases would certainly have been able to ensure a supply of timber for the glass makers. It may be that the timber was managed, and/or that the supply of acacia was supplemented with the burning of palm, which leaves only fine ash.

It is not known for how long the glass makers fired their furnaces. To some extent this would depend upon whether they first prepared a coloured frit and then had a second firing some days later to make the final glass, or whether the whole operation took place in a single stage. Similarly, the time would depend upon the amount of glass to be made. Since it is more fuel efficient to make as much glass as possible whilst the furnace is hot, it might be expected that this was the practice, rather than making a small amount, allowing the structure to go cold and then having to re-heat it again. The large quantities of *khorfush* might argue for quite prolonged firings. The experimental firing (Chapter 4) lasted for 8 hours and 50 minutes, but there was no attempt to add additional raw materials to the batch, which would have led to a period of heat loss whilst the furnace sieges were opened. It might be assumed that a firing of about three times this length might be required in order to obtain ingots of the size discovered at Uluburun.

Post Firing

After the firing was complete the stoke hole and any other openings in the furnace would have been blocked up, probably using loose bricks, large pots, or bats as appropriate. This blocking would provide a measure of insulation and allow the furnace to cool gradually. The effect would be that in the short term the temperature would continue to be high enough to continue the firing, but would rapidly start to decline. The drop in temperature however, would not be so rapid as to cool the glass so quickly that it caused stresses within it. Rather the glass would cool over many hours, the furnace would still be warm some 24 hours after firing, with ash temperatures around 100°C, as observed experimentally.

Once cold, the cylindrical vessels would be removed from the furnace so that the ingots of glass could be removed. The vessels themselves would, in some instances, show signs of vitrification or failure, whilst in others the fabric would be densified but not noticeably damaged. Whatever the case, it seems that the standard way of removing an ingot would have been to break its mould. The white calcareous layer, which had served to protect the glass from the iron in the ceramic fabric, and to help prevent corrosion of the crucible by the glass, now served as a parting layer.

In speaking of the similar moulds at Qantir it is noted that the fact "that many of these fragments show barely any traces of glass on them relates to the effectiveness of the parting or protective layer of lime which was regularly applied to their inside" (Rehren and Pusch 1999:173). The same is certainly true of Amarna, and the effectiveness of the layer seems to mean that the moulds are broken into as few pieces as possible and where they adhered to the glass would be pulled away. Since the rim of the cylindrical vessel stood proud of the ingot this could have been used to help prize away the sherd from the glass on such occasions as this was necessary. Since the glass would have shrunk slightly on cooling, its separation from the ceramic may not have been such a difficult process as might be imagined. It may be that in some cases the ingot could be removed without breaking the mould, and so might have been available for reuse.[23] Where it broke, the ceramic fragments could be discarded once the glass was removed.

The glass ingot produced might then be stock-piled ready to be sent to other parts of Egypt, such as Memphis or Thebes for working into objects, or it might be sent abroad, as the Uluburun evidence suggests. Since it is clear that glassworking also took place at Amarna itself some of the glass would also be used there by secondary workshops.

Glass Working at O45.1

A measure of how little is yet known about the early history of glass in Egypt is that there is still argument about what archaeological evidence should be expected from a manufactory where glass is being made from its raw materials, as opposed to a workshop where pre-formed glass is re-melted and shaped into objects.

As will be clear from the discussion above, there is in the view of this author evidence to support the view that glass was being made from its raw materials at site O45.1. However, that does not necessarily mean that all the glass unearthed at the site was made there, it is entirely possible that some colours were imported to the site, and even imported into Egypt. It is therefore worth considering the evidence for glass working at O45.1 in some depth.

Rehren and Pusch (1999) cast doubt on Amarna as a centre for primary glass production, preferring instead to see the evidence as entirely for glass working.

However, as has been shown above, there is substantial evidence to support the view that glass was actually made at site O45.1, and Petrie (1894) held similar views for at least some of the areas he excavated at Amarna.

One of the reasons that Rehren and Pusch feel that glass was made at Qantir but not at Amarna is that "at Qantir there are none of the drawn rods or canes of coloured glass nor any significant numbers of fragments of glass vessels which were found in such large numbers at the glass workshops at Tell el-Amarna and Lisht, the other major New Kingdom *glass working sites* in Egypt" (1999:173, my emphasis). Lisht has already been discussed in Chapter 2 and appears to be quite different to Amarna. However, the whole of Amarna cannot be treated as uniform, and the evidence from O45.1 is not the same as that from all other vitreous materials sites in the city.

In fact, from site O45.1 there are only 21 fragments of glass rod. This is equivalent to a little over one rod fragment per 5m square of the excavation. A density of this sort is not high. As for "large numbers" of glass vessel fragments, O45.1 has yielded only three (30604, 31805 and 33715, less likely is 33608).

I believe that the direct comparison of the evidence from Amarna and that from Qantir is of only limited value. Amarna is significantly earlier than Qantir, and it may very well be that the O45.1 workshop had a much shorter life than that/those[24] at Qantir. One should not therefore expect the evidence from the two sites to be identical, though there are bound to be some similarities. Indeed, whilst Qantir does not have rods or canes it does have "thin plates of red glass…which may have served in the production of inlays or plaques" (Rehren and Pusch 1999:173). In other words some working of glass is going on in what is argued to be a primary production centre. I see no difficulty in glass working and glassmaking going on in close proximity, not least since other vitreous materials and pottery are being made in the same complex (Amarna) and metal production is taking place nearby (Qantir). Whilst cross-cultural comparisons must be used with caution, it is worth noting that at Jalesar in Uttar-Pradesh Province, India, there are furnaces for the making of raw glass situated within c.100m of workshops producing glass beads.[25]

What then of evidence for glass *working* at O45.1? It can only be said that the evidence at present is slight, a very few fragments of rod, a piece of inlay, and two vessel fragments—which may not even be related to the workshops—though one expects that they should be. Since the industrial remains at O45.1 extend beyond the boundaries of the excavation by an unknown amount, it is possible that glass working areas exist there. One should also consider the range of glass found at O45.1. Cobalt- and copper-blue glass may very well have been made at the site but other, less well represented, colours may not. For example, there are 5 pieces of red glass, four of them fragments, one from a strip. The rarity of this colour, as well as the difficulty in manufacturing it, make it less likely to be a local product, particularly if cobalt is one of the aspects of production which has led to the grouping of crafts at O45.1. However, there are a number of fragments of crucible which contain small amounts of copper or copper-alloy, and these may have been used for the preparing of colourant for copper-blue glass. That the copper was regularly used for red glass at the site cannot be supported.

Yellow glass is still rarer, apparently confined to a single bead (31642) broken along the perforation, and so clearly showing it to be glass rather than faience. A single bead may have come to the site entirely accidentally, rather than have been made there. The colourant for yellow glass is lead antimonate, probably from stibnite. In his study Shortland (2000:51–52) found that some of this may have come from an Egyptian source at the Gebel Zeit, though Lilyquist *et al*. (1993:61) found that the lead in the yellow vitreous material from the earlier find at Wadi Qirud probably had a Mesopotamian source. Yellow at Amarna might therefore be a recent Egyptian development, or still be imported from abroad.

Similarly, there is only one example of white glass (30474), once again in the form of a bead. Since the piece is not broken it is possible that it is actually faience. White glass would be made opaque using calcium antimonate. The lack of white rods or canes of glass at O45.1 might argue that vessels were not being made at the site, since white, like yellow, is one of the colours most frequently used in trail decoration.

Green glass, as well as turquoise, was probably produced using copper, and comes within the range of glasses quite probably produced at the site itself. Similarly, "black" glass is likely to be a blue with an excess of cobalt, leading to the dark colour.

It may be that the kilns/furnaces may also have served for the working of glass at times. If we are right in thinking that glass was only made during certain favourable times of the year, it is possible that the installations transferred to working the glass during times when the weather or other conditions were regarded as unfavourable.

It should also be borne in mind that glass was a new, rare and valuable material. One should not expect it

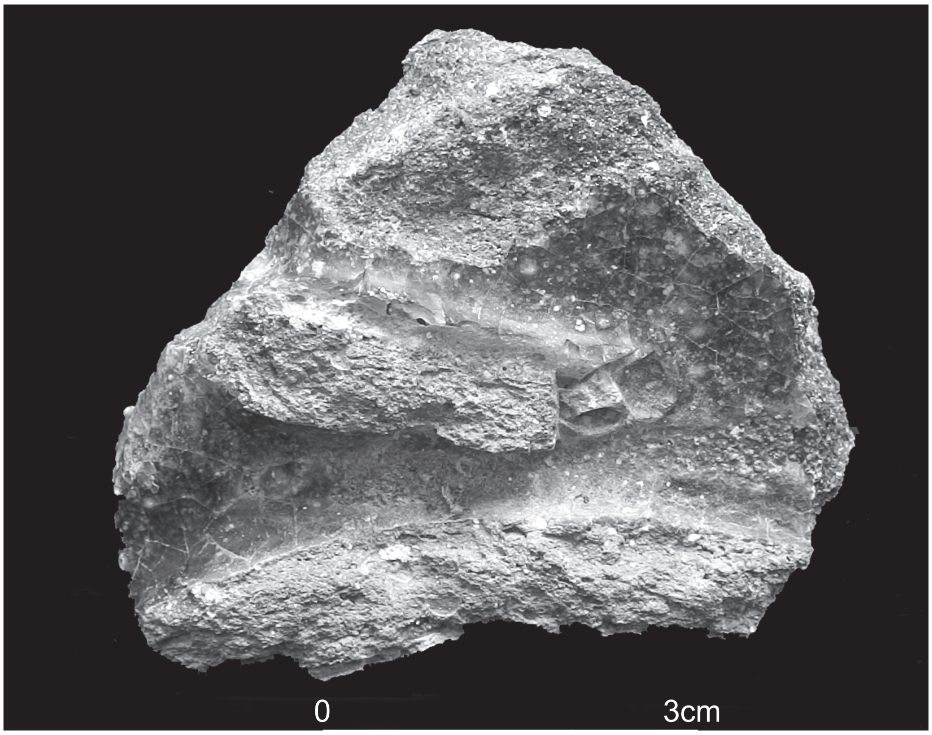


Figure 6.2. Cylindrical vessel base with the rims of other such vessels adhering to it. (Photo: Anna Stagg/ E.E.S.)

to be found lying around in great quantities, any more than one would expect to find large amounts of waste gold in the workshop of a goldsmith.

Glass Working Beyond O45.1

It is quite possible that glass was being manufactured at sites other than O45.1 at Amarna. Because Petrie does not give the locations of the sites he investigated it is not possible to say with certainty where these other sites were. However, since it is clear that Petrie did not excavate that part of O45.1 investigated by the present project it can be said, on the basis of his finds, that at least one other primary glass workshop probably existed at Amarna. Since the O45.1 workshop seems to be put out of use at quite an early stage in the history of Amarna, it is likely that its craftsmen were moved to another part of the city.

The situation is certainly different when the working of glass is considered. As Shortland (2000:67–68) notes, building N50.23 has evidence of glass and faience working, with numerous pieces of glass rod and two lumps of glass having been found there (Borchardt and Ricke 1980:311–12). It is not possible to say on this evidence alone whether the site was a primary or secondary workshop, but the large number of glass rods, and one of the two blocks of glass being red, might suggest that it was secondary. The other block of glass was blue.

Building M50.14 was excavated by Peet and Woolley on behalf of the E.E.S. in 1922. They report the building as "a series of workrooms attached to the dwelling houses M.50.15 and 16" and discovered there "a glaze kiln [comprising] a pit cut in the sand 1.00m in diam. by 0.50m deep, full of burnt brick, glass and glaze slag, and fragments of the pots used in the kiln for standing the glazed vessels on: the bottoms and sides of these are covered with tricklings of glaze" (Peet and Woolley 1923:19). Unfortunately, such was the lack of interest in industrial structures at this time that they did not publish a detailed plan of the excavation or a photograph of the structure. This too may well have been a primary production site, however one must proceed with some caution here. Given that glass is being made at Amarna, at O45.1 and elsewhere, it may be that the ingots were provided to local workshops still in their moulds. As a result, the presence of fragments of cylindrical vessels need not by itself imply primary production. It has also been noted above that these vessels, whilst confined to workshops producing vitreous materials, may have had several uses, including faience and frit production. A fragment from the base of a cylindrical vessel, recovered from the southern part of the Palace Dumps, has the remains of the rims of other cylindrical vessels adhering to its underside (Plate 6.2), perhaps indicating that it had been used as a saggar for glazing faience, reinforcing the need for caution in examining these vessels.[26]

Chapter 6

Endnotes

1. Credit for this concept belongs to Professor John Collis of Sheffield University, who has used it in speaking of the use of Classical texts to "interpret" Iron Age Europe. It is at least as appropriate in the present context.
2. The ternary eutectic refers to a mixture of three components such that they have the lowest freezing point possible for their combination in the percentages stated.
3. Shortland (2000) is not, however, concerned with Egyptian blue frit.
4. $Na_2CO_3.NaHCO_3.2H_2O$.
5. Which may be considered as soda-lime-silicates.
6. Shortland (2000) gives no page references for his citation of Caley's work, hence the uncertainty over what the figure refers to.
7. Cobalt was first identified as a deliberate colourant in Egyptian glass by Farnsworth and Ritchie (1938:160).
8. Dayton (1993) seems to have been unaware of the work of Kaczmarczyk (1986).
9. Lucas was here following the geological work of Beadnell (1899: 222).
10. British Library, Add. MS24189, f.16r.
11. Similar work was also carried out by Parodi (1908) though he did not include Amarna sand.
12. It does not, of course, prove that it *was* produced in this way.
13. Frit was formed in some of the crucibles where the temperature was lower. However, there was no intentional fritting stage with the deliberate raking of the material as is usually thought necessary.
14. This, of course, excludes frit deliberately produced for colourant and whose composition is unlike that of glass.
15. For example UC36457.
16. It should be noted that I have not had the opportunity to examine any of the Qantir pieces myself, and have only been able to compare the fabric from photographs of the fragments.
17. The number remains uncertain. It was estimated at 170 in 1996 (Nicholson *et al.* 1997:147) and more recently at 175 (www3).
18. I am grateful to Professors Bass and Pulak for supplying additional drawings of some of the ingots and to their colleagues Jane Pannell and Claire Peachey for providing the cast. The hospitality of Professor Pulak and Ms. Peachey during the visit by Dr. Trott and myself to Bodrum to examine the ingots is also gratefully acknowledged.
19. This seems to be the paper referred to by Shortland (2000:31).
20. Samples kindly supplied by Professor Bass, numbers KW1422 and 4110.
21. Note that whilst this website deals with the undoubtedly destructive effects of ploughing it is clear that the artefacts are not widespread. Damage by surface trampling moving objects around might lead to still less widespread redistribution of the objects. I am grateful to Mr. T. Clare of Liverpool John Moore's University for providing this reference.
22. Aegean Seminar, Sheffield 22-1-2005.
23. Rehren has made similar, more detailed, observations in a paper given at a London meeting of the U.K. A.I.H.V. on November 22nd, 2006.
24. No actual workshops have yet been unearthed at Qantir, though they were undoubtedly present.
25. Both are surrounded by workshops producing bronze bells, but there appears to be little direct contact between the metal and glass workshops.
26. Shortland (2000:68), apparently quoting from Peet and Woolley (1923) states that "a mass of beads of glaze, carnelian and glass" came from house P46.11 which might indicate a further working area, or at least a jewellery workshop. However, the description of house P46.11 by Peet and Woolley (1923:32) does not seem to include such a quote and I have been unable to trace it.

Chapter 7

A Reconstruction of Faience Making at Amarna Site O45.1

Introduction

The aim of this chapter is to review the evidence for the steps in the production of faience at site O45.1 and to make some observations about its practice elsewhere at Amarna.

There are, however, difficulties in examining the evidence for faience production. Despite this being, arguably, the best understood and most archaeologically visible, of the vitreous materials produced at Amarna, its clear identification at O45.1 is somewhat problematic, perhaps for good reason.

Whilst there is clear evidence for the production of pottery at the site, in the form of a trampling floor, clay preparation pit, kilns etc., and for glass in the form of lumps of glass and what are believed to be two substantial glass furnaces, the evidence for faience has to be separated from these two. For example, there are many clay moulds and misfired or misshapen faience objects, making it clear that this was a production site. However, there are no obvious working areas associated with the craft, and though there are several kilns/furnaces which may be for faience production it is not possible to claim them as such with certainty. In a workshop where only moulds and faience pieces were being recovered and where there was a kiln beside it, the obvious implication would be that this was a faience workshop, but where other crafts are present, using similar technologies, it is much more difficult to be certain whether any particular kiln/furnace was for any particular purpose.

Faience has often been thought of as a poor substitute for semiprecious stones and, later, for glass. This view is, however, misguided. As "the first high-tech ceramic" (Vandiver and Kingery 1987a:9), faience should not be regarded as a poor substitute for either of these (Patch 1998). It was a material which was as much part of the royal household as that of the most lowly of workmen. As such, it should not be surprising to find it represented alongside glass at O45.1, whether or not one accepts the view that this part of Amarna was under direct state control.

It is quite possible that these related, high temperature vitreous materials industries shared craftsmen, and equally that they shared facilities. Indeed, it is quite possible that workers in vitreous materials were not differentiated, at least where they worked together. As a result it is perhaps not surprising that identifying features specific to the "faience workshop" may be difficult, if not impossible—such features may not have existed.

The Nature of Faience

Despite the fact that much is now known about the methods of forming and glazing faience, it remains a confused term and is frequently mis-described as "frit", "composition" or "glazed composition".

The term faience, more correctly "Egyptian faience", comes from the early history of Egyptology and was probably applied to the material because the bright colours of its glaze reminded the early travellers of the glazes on pottery from Faenze in Northern Italy (Noble 1969:435). These clay-based ceramics are in fact tin-glazed, and as they spread across Europe in later Medieval times they became known as "faience" or "Fayence". The term itself has now largely been replaced with the name maiolica,[1] making any confusion between the clay based ceramic and the Egyptian non-clay ceramic less likely (Nicholson 1993:9).

Frit, as has been demonstrated above (Chapter 6), is a very different material, produced either as a pigment or as a stage in the making of glass. Its only similarities to faience are in its raw materials and its crystalline nature. The two finished products are normally quite distinct, particularly in broken section. "Glazed composition" offers little advantage over "faience" and begs the question "composed of what?".

In fact, faience is composed of the same materials as glass and frit, namely silica, soda, lime and some kind of colourant. Much the same debates about the sources of these materials and their preparation are relevant to faience and to glass (summarised above in Chapter 6). The relevant points are discussed below.

Silica

Silica is the major component of faience, comprising between 92 and 99% of the body (Vandiver 1982:167). Shortland (2000:29) found an average of 94.5% in his bulk analyses, with an average of 74.6% in the glaze and 71.2% in the matrix of finger rings. The debate about the source of the silica is the same as that for glass, it may have come either from the crushing of quartz pebbles, perhaps already weakened by heating in the kiln, or from sand. Since some faience exhibits a layered structure, with a fine white layer beneath the glaze and a coarser, sometimes browner layer, beneath that, it may be that both quartz pebbles and sand were used. Kiefer and Allibert (1971:113), on the basis of an X-ray diffraction and microscopic study, concluded that faience bodies were composed of natural sand, as the impurities which they identified were consistent with such sand. Manti's work (2004:66; for publication of this work see also Tite *et al*. in press), suggested that quartz sand was used for the coarse body material of one of the Amarna faience objects she studied, and could not rule out its use for the rest of the material, though ground quartz seemed to be more likely for most of it.

An ethnographic study, carried out in Iran in 1966, found that quartz pebbles for use in faience making were collected from a dry river bed, and that the collector "rejects all kinds of limestone pebbles; and of the quartzites he avoids those with brownish impurities" (Wulff *et al.* 1968:99). Analyses of the pebbles by the authors, however, revealed that substantial impurities remained (1968:102). Whilst a very valuable study, the Iranian situation can at best only draw attention to possibilities, since the glazing method used there was cementation (below), and in any case the Iranian production is separated from Amarna by over 3000 years, and several thousand miles. The brownness of some of the coarser faience suggests that the silica source may have been less pure than that used in Iran. At Qurna in Egypt too, quartz pebbles are used as a silica source, and are crushed on a grindstone (Sode and Schnell 1998:164–65).

There is a further possibility however. From site O45.1 come numerous fragments of sandstone, frequently these are of a grey banded sandstone, but more rarely red. Over 70 of these sandstone fragments are glazed, and it has been possible to fit some of them together. However, when joined these make no coherent object. Rather, it would appear that these pieces of sandstone were used in the kiln in some way, perhaps as stands or perhaps simply to become glazed by their reaction with fly ash.[2] Sometimes the sandstone fragments which lack glaze show a yellowish surface, and are quite friable, suggesting that they have been heated. It may be that what these sandstone pieces, both glazed and unglazed, represent is an attempt to obtain good quality silica by heating in the kiln. Where glaze is present this would become incorporated into the faience body when the sandstone was ground up, helping to make a stronger body material. The material is widely distributed across the excavation, and was also recovered from the dumps made by the illicit foundation trenches north of the water tower. This suggests that it must have been present in some quantity at O45.1. This glazed sandstone was not commented upon by Petrie, which may suggest that he either found none, or did not feel that it was worthy of report. Analysis of the glaze on the sandstone (Chapter 5) suggests that the glaze *may* be associated with glass rather than faience production, but this is uncertain.

Friedman (1998:17) raises the possibility of raw material selection according to customer or patron, with the best quality materials being selected for use by the king and court.

Soda

This is present at levels of 0.5–3% according to Vandiver (1982:167), whilst Shortland (2000:29) records an average of 0.8% in the bulk analysis of the blue finger rings, though the average for the glaze was 7.7% and for the matrix 6.3%. However, as will be discussed below, there are several different varieties of faience, and two of these—copper blue and cobalt/cobalt plus copper blue—are of particular significance. Shortland found that the copper blue was very low in magnesia (0.3%) but high in potash (4.1%) suggesting a plant ash source, whilst the cobalt blue plotted between the natron and plant ash sources (2000:46).

Wulff *et al.* in their study of the faience makers of Qom in Iran recorded the use of plant ashes as the alkali source. The production of these was a specialism of the Qom region and made use of *Salsola kali* and *Salsola soda* (1968:100; see Chapter 6). Since it is likely that plant ashes would have been prepared at Amarna, or at least would have been imported to the site for working, it would not be surprising to find that both the faience and the glass makers had access to them. This would be especially likely if, as is proposed, O45.1 was in some measure under state control and if the practitioners of both crafts were in fact the same individuals.

Lime

Vandiver (1982:167) found that lime comprised 1–3% of her bulk analyses of faience. In his examination of finger rings, Shortland (2000:29) found an average of 0.5% in the bulk composition, with averages of 1.2 and 2.2% in the glaze and glass matrix respectively.

This lime could have been introduced with the sand or with the alkali, as suggested by Tite *et al.* (1998:112) given that quartz pebbles were not the source of the silica. Wulff *et al.* (1968:100) noted that at Qom, where pebbles provided the silica source, the workers added three parts of hydrated (slaked)[3] lime to two parts of quartz powder and three of plant ash. The substantial amount of lime at the Amarna workshops may be related to such a practice, although the lime found in the sand may have rendered this unnecesssary. However, Griffin (2002:330) states that faience paste lacks dry strength, and so cannot be extensively re-touched, unless calcined lime is present. Indeed, she found (2002:332–33) that the addition of more than 2% lime by weight would greatly improve the working qualities of the material, making it easier to retouch and better able to be moulded.

If there were several grades of faience, as there appear to be, it may be that the finest was prepared using quartz pebbles and added lime, whilst the lower grade, coarser material, used sand with lime naturally present.

Clay

The question of the addition of clay to faience has been a vexed one. In hand specimen there is generally no visible sign of clay when examining pieces from the New Kingdom, and Lucas (1962:175) was sceptical of its use, though noting that levels of alumina averaging 1.2% might come from clay. He believed that this quantity would be insufficient to make any material difference to the mixture. Noble too (1969:436) thought that the small amounts of clay he detected were present only "as a result of impurities". However, Griffin (2002:335) found that "some clay was necessary for molded [*sic*] objects to correctly take the suface details of the mold". She found that 1–3% by weight gave the best results, whilst more than 6% was detrimental as the mixture became too wet.

Copper Colourant

Copper may be introduced into the mixture as either the copper ores azurite or malachite, or as corroded copper metal (Tite *et al.* 2002:586–87). Such corroded metal might be more easily obtained and worked at Amarna than would mineral ores. Some suggestion that the recycling of scrap metals did indeed take place is indicated by the correlation of copper and tin in some faience, indicating that scrap bronze was being used (Kaczmarczyk and Hedges 1983:279). The blue colour comes from the Cu^{2+} ion when present in the glass phase (Pollard and Heron 1996:168). A shift in the firing atmosphere can yield a blue rather than a green colour (McCarthy and Vandiver 1991:505).

Analyses of faience from a range of sources by Manti (2004:73, and Tite *et al*. in press) suggests that where there is a relationship between cobalt and copper, then the ratio between tin and copper is zero, and *vice versa*. This may suggest a deliberate selection of colouring materials. This implies that the copper ore source used contained some cobalt, and that where this was not used then the colouring came from the use of tin bronze.

Contemporary Egyptian faience makers use copper plates to separate objects in the fire, and after firings they scrape off the oxidised, flaking surface of these plates to mix with the faience paste as a colourant. If blue is required they fire in a bed of crushed, fused cow bones mixed with ground copper flakes and a little salt. More salt is added where green is required (Sode and Schnell 1998:166).

Cobalt Colourant

As already discussed in examining glass, cobalt could have been obtained from the Oases of the Western Desert (Kaczmarczyk 1986; 1991) and was being used in glass production. It was also used in the making of faience and, as discussed below, is an important distinguishing feature of certain types.

Ready Mixed Ingredients

Denys Stocks has for some time conducted valuable experiments into aspects of Egyptian technology. His view is that the mixture from which certain faience pieces were manufactured was derived as a by-product of drilling hard stones with a cylindrical copper drill. The resulting powder, which includes ground copper could, he contends (Stocks 1997), be collected and used as the raw material for faience production.

His theory depends upon the making of a faience core and its subsequent glazing by application, once again using a mixture derived from the by-products of drilling so that "after c.3500 B.C. craftsmen did not have to produce special powders for faience, or frit because the powders required were available as a by-product of the drilling of stone by copper tubes" (Stocks 1997:182). Whilst this might initially seem an attractive suggestion, and is one which cannot be completely ruled out, it does have some limitations. It depends on drilling operations taking place either in close proximity to faience workshops, or there being individuals who would collect and redistribute the waste from drilling. It is likely that a great deal of the powder produced in drilling was lost to wind action, making specialised collecting a difficult and unlikely task. Whilst it is certainly true that the Egyptians were not generally wasteful of materials, particularly those involving metals, the case for the production of ready made faience powders is unproven, and seems, on balance, to be unlikely.

Methods of Glazing

There are three main methods of faience glazing, although it is likely that for some pieces two or more methods might sometimes be used in combination. The methods used are Application, Efflorescence and Cementation (Vandiver and Kingery 1987a).

The Application method is that which Petrie (1894:28) and Lucas (1962:155–78) considered to be the only one used in faience production. Not unreasonably, they based this assumption on what they knew of the production of pottery, namely that the object was first shaped and dried or fired, before being coated with a glazing powder or slurry which was then dried and fused to the surface of the vessel in firing. It was the expectation that glazing was by application that led Petrie to interpret the finds as he did.

Since Petrie's time two further methods have been identified, both of them so-called "self glazing" techniques. The first of these was actually discovered within the lifetime of both Petrie and Lucas, but did not become widely known. This is the technique known as Efflorescence and was recorded by Binns, Klem and Mott (1932). They compared the microstructure of some faience beads made from a self-glazing paste by a Miss Crawford of Pennsylvania with those of ancient finger rings and found that "the fracture of the rings showed a gradual growth of the blue glaze from within to the surface, that is, it looked as if the rings, like Miss Crawford's beads, were self glazing" (Binns *et al.* 1932:271). Their own experiments confirmed this view.

The efflorescence technique relies on the presence of soluble salts in the faience mixture being deposited on the surface of the object as it dries. This effloresced scum then becomes fused to a bright clear glaze during firing. The disadvantage of such a process is that any re-touching of the surface removes the effloresced salts and will not therefore produce a good glaze. As a result it may be necessary to apply a slurry of the glazing mixture to the affected areas. The disadvantages were, however, considered minor for much of the production of the 18th Dynasty, not least since most small moulded items were not re-touched, and this method seems to be the predominant one during the New Kingdom (Vandiver 1983:A108). The development of the glaze from the body has the advantage that on firing, the mixture remaining within the body becomes fused to create a glassy phase between the silica grains. This interstitial glass has the effect of making the body much harder than would otherwise be the case, rendering it more suitable for use in finger rings, and other applications, than might otherwise be the case.

The second self glazing technique is Cementation. This is the method re-discovered by Wulff *et al.* (1968) at Qom in Iran. Here the faience object is shaped, either by moulding or by hand, and allowed to dry. Once dry they are buried in a glazing powder in sealed containers which are then heated in the kiln. During the firing the glazing powder reacts with the surface of the objects to produce a bright blue glaze. The powder itself does not become a solid block of glaze, as one might expect, but reacts only when in contact with the object. It was found that a void of c.0.5mm forms between the powder and the object as glazing takes place, such that the powder not in contact with the object remains unreacted (Wulff *et al.* 1968:107). Evidence for this technique was already known from the Islamic period in Egypt by 1930, when Bahgat and Massoul (1930: Pl. B,19) published an illustration of beads still stuck in their glazing matrix. However, the significance of this find was not recognised at the time. This technique is attested from ancient Egypt but does not seem to have been particularly common, although the difficulty in recognising it may have led to its underrepresentation in archaeological reports.

It is not always easy to distinguish which glazing method was used for any particular object. Pieces glazed by application may show drips or runs of glaze, brush marks and occasionally finger marks. There may also be marks where the piece has stood on kiln setters during firing. The glaze may also pool on the interior of a vessel base. When viewed in broken section under the Scanning Electron Microscope there is a clearly defined glaze layer sitting on top of the silica body.

Pieces glazed by efflorescence will have the best glazed areas on those parts of the object which have dried most freely. So, for example, on a cylindrical faience vessel the exterior and the rim will be well glazed because they have been exposed to the moving air, whilst the interior may have a thinner glaze since it has been in its own shadow and has not benefited from the free flow of air. The underside of the base may be virtually unglazed where it has been in contact with the ground or a bat or board on which it was placed to dry. The edges of the underside of effloresced pieces are particularly telling, since the free flow of air often penetrates a few millimetres beneath the piece and leaves a partly glazed rim. When a broken section is viewed under the S.E.M. there is no clearly defined glaze layer, rather the interstitial glass gradually increases toward the glazed surface. It was this glassy phase which prompted Kühne (1969:14) to suggest that ground glass might have been added to the faience to strengthen it. The realisation that the glassy phase comes from the self glazing process has overtaken this view (c.f. Tite 1987:24).

Pieces glazed by Cementation are particularly difficult to identify with certainty in hand specimen. The glaze is generally even and will show no marks from kiln setters, brushes etc. though larger pieces may show some marks. In broken section the glaze may be very slightly thicker on one side or another due to the effects of gravity, but this is barely noticeable. The interface between the glaze and the core is well defined. There is minimal interstitial glass in the core (Nicholson and Peltenburg 2000:190).[4]

These three glazing techniques were not always used independently, and there has been an increasing realisation that combinations of technique were sometimes used. Griffin (2002:329; Griffin in Bermann and Bohač 1999:307) has recognised applied glaze applied over effloresced pieces during the New Kingdom, notably an inlay allegedly from Amarna.[5] It is not surprising to find that the most competent craftsmen might make use of multiple techniques to achieve the best possible standard of work.

Whilst most of the Amarna pieces were probably glazed by efflorescence, some seem to have been glazed by application (see Chapter 5). It is likely that techniques might be combined where workers thought this beneficial.

Types of Faience

The various raw materials were combined into a variety of faience types. Lucas (1962:161–67) defined 8 different types which are listed below, since some of them are relevant to the discussion of technological processes at Amarna.

Ordinary Faience
A body material (core) which has been glazed using a vitreous alkali glaze. The core material itself may be slightly coloured to a brown, grey, yellow, blue or green. This type accounts for the great majority of pieces known from Egypt.

Variant A
Faience with an extra layer. This type has a layer of very fine silica immediately below the glaze and on top of the coarse body material. It was first recognised as a type by Reisner (1923:134–75) who described the layer as resembling plaster of Paris, and was used to enhance or modify the colour of the glaze. Lucas (1962:161) believed the type to be relatively uncommon, but it is now known to be more commonly encountered.

Variant B
Black faience. An uncommon type, known from as early as the 3rd Dynasty, and occurring at Amarna and into the 20th Dynasty.

Variant C
Red faience. Very occasionally this may be ordinary faience with a red glaze, but more usually the body material is itself red whilst the glaze may be either red or almost colourless. At the time Petrie prepared his “Glass and Glazing” entry for the Burlington Fine Arts Club (Petrie 1895:xxviii) the red faience was believed to be virtually confined to the reign of Akhenaten, and seldom if ever found in Ramesside or later times. However, by the time Lucas prepared his text (1962:162) it was known to have a much greater chronological span from the 3rd Dynasty well into Ramesside times.

Variant D
Faience with a hard blue or green body. Here the core is harder than in ordinary faience, and is tinted blue or green. The glaze is always the same colour as the core, but of a lighter shade (Lucas 1962:163). Lucas initially thought that the colour might come from glaze penetrating the core, but since the colour was uniform throughout, and not most intense near the glaze, and because the glaze would in his view be too viscous, he abandoned this idea. It should be noted that it was not until some years after the last edition of Lucas's work (1962) that the idea that faience was glazed only

by application was challenged. Lucas came close to realising the truth in noting that "a little finely powdered glaze, or a powdered mixture of glaze materials, was deliberately mixed with the quartz in order to make the fused object harder" (1962:164). Initially attributed to the 26th Dynasty, this type is now more widely known and is represented at Amarna.

Variant E
Glassy faience. This is unlike all other types of faience, in that it shows no clear core as distinct from a glaze layer, but is homogenous throughout. As defined by Lucas it was a 26th Dynasty innovation, normally pale apple-green or turquoise blue and with a matt surface. This material has, however, been much re-defined and re-interpreted and is now considered to include items such as the marbleised goblet from the Wadi Qirud[6] (Lilyquist *et al*. 1993:10) dating to the reign of Tuthmosis III. Lucas states that the "material is certainly not faience, and is equally certainly a kind of glass, though not normal glass, (so) to call it 'glassy faience' or 'imperfect glass' seems to describe its nature and composition better than any other name" (1962:165). This material deserves much fuller investigation than it has so far enjoyed, and may offer further evidence of the link between the makers of faience and of glass.

Variant F
Faience with lead glaze. This was believed to be a 22nd Dynasty innovation which ran into Islamic times and was ultimately used in glazing pottery. Kaczmarczyk and Hedges (1983:213) found no evidence for this class of faience and so disregarded it.

Faience Working

The initial preparation would involve the sieving or sifting of sand if it were to be used as a silica source. If crushed quartz was to be used then it would need to be crushed and ground. Kiefer and Allibert (1971:110) were of the opinion that natural sand might also need to be ground, depending upon its original size and the size of the object to be produced. There is only one possible fragment of quernstone from the site (object 30581) a curved piece of granite, though very damaged.[7] There are several stones which may have been used as pounders, or possibly as top-stones for such a grindstone, but certain evidence is lacking. That faience pastes probably were ground is suggested by recent excavations at Harappa, Pakistan (www4) where a grindstone was unearthed in a factory context. Manti (2004:17) notes that the size and shape of the silica grains will affect not only the propensity of the faience to be moulded or shaped, but also the degree of efflorescence where this is the glazing method. Griffin (2002:332) stresses the importance of particle size for the fine retouching of faience artefacts and for the quality, and apparent depth, of the glaze. Finer grain size allows more retouching and a shinier, deeper finish than does coarse material. Obviously, the fineness of the glaze might depend upon the final function of the piece. Some architectural inlays may not have needed such quality work as would the best vessels or shabtis.

The next stage would be to take the faience materials and mix them together with water to form a dough-like paste. This material is however, thixotropic, that is soft and flowing at first, but then prone to tearing and breaking without warning. It may also disintegrate if the grain size is too great or the mixture too dry (Noble 1969:436), emphasising the need for careful control of the particle size (Manti 2004:19). The quantity of alkali has also been found to have an important affect on working properties. This property of faience makes it more difficult to work with than clay. It also tends to slump once shaped, so that sharply defined edges become rounded and raised or impressed details blurred or even lost.

It is possible that a further binding medium might be added to this mixture. Wulff *et al.* (1968:99) report the use of gum tragacanth[8] in their Iranian study. However, a binder like this is not well suited when efflorescence glazing is the method to be used, though it may have been used anciently for cementation glazing, as in the Iranian situation.

It is apparent then, that the composition of the faience paste will be dependent upon the glazing method to be used, and that some compositions will more easily lend themselves to shaping by particular methods. So, for example, although it is possible to mould bodies which contain an organic binder such as gum tragacanth, moulding may be easier in mixtures which do not contain it. Since much of the Amarna faience was produced using efflorescence as the glazing method, and since moulding was widely used, it is likely that these objects were made without an organic binder. Instead the alkali or lime would act as a binder.

Vandiver (1983:A108) notes that "there seems to be design in the use of various bodies for various purposes", emphasising that the practioners of this craft were masters of their art.

Moulds and Moulding
Moulding seems to have been the predominant technique for shaping during the New Kingdom (Vandiver 1983:A108). Faience amulets, rings (see Boyce 1989) and inlays were usually made in ceramic moulds. Such moulds are common finds at Amarna,

though they were visibly more common on the surface at site O45.1 and in the subsequent excavation than elsewhere. A total of 80 have been found from the excavation and surface collection at site O45.1, whilst a further 7 were recovered from the examination of spoil heaps resulting from the digging of foundation trenches for a slaughter house, immediately south of the modern water tower, whose construction was halted by the S.C.A.[9] The recovery of so many moulds from the slaughter house site in a period of only a few hours suggests that the workshop complex, or its debris, may have spread somewhat north of O45.1 itself.

It is likely that these moulds were produced at the site, since there is a potter's workshop there. There is in fact an unfired mould for making a ring shank (No. 31973) which comes from square J80, the southern part of the potter's workshop area.

The moulds seem to have been made by impressing a metal (Hayes 1951:166, also Boyce 1989:165 note 11), stone or well-produced faience, original into the wet clay and then removing it to leave an impression. Many moulds show traces of cord on the upper surface, coming from the impression, and it may be that the piece was attached by string to make it easier to remove, but this is not certain.

Once an image had been impressed into the wet clay it was allowed to harden before being fired to make it ceramic. Once fired the mould would remain somewhat porous, but would nonetheless be capable of producing numerous images before the efflorescent paste soaked into the fabric sufficient for the mould itself to become clogged by efflorescence.

That Petrie's (1894:28) contention that the moulds were pressed against a pad of faience paste and then the cameo cut from the lump is incorrect, is suggested by finds such as 34235. This is a mould for a circular object and is still largely filled with faience paste. As Boyce (1989:165) notes, where such quantities of faience paste are found they are unlikely to be from efflorescence alone, but from some accident of manufacture. Either the paste was left in the mould for too long and became stuck there, or the piece was lost or no longer required, so that the paste was never removed. Such finds are by no means confined to Amarna, and several are known from museum collections.[10]

What should have happened is that the paste would be tipped out of the mould and allowed to dry, perhaps on one of the lime plaster trays (below). If any finishing were required on the piece this could be carried out using a sharp knife or other modelling tool once it had dried sufficiently to be handled. In the case of rings it would often be necessary to attach the bezel to the shank by luting it into place with a small blob of faience paste. However, re-touching with a knife would involve removing some the efflorescing surface and might therefore result in a poor glaze. It is likely that some reapplication of paste was necessary in some cases, as on some of the larger pieces of faience such as chalices (Vandiver and Kingery 1987b:82–83).

Boyce (1989:162) notes that some moulds for rings feature the complete shape of the ring. However, he considers that the "bezel" part of such a ring is not actually a bezel but simply a "connecting bar" which would presumably have prevented the otherwise open ends of the ring from moving apart and distorting it. He also notes that both Petrie (1894:29) and Hayes (1951:395) believed that rings were made in one piece and the design later cut into the bezel face. The practice of cutting an inscription into a friable paste, particularly when an effloresced glaze was desired, seems to be extremely unlikely, and the fact that moulds for bezels are known from Amarna seems to support Boyce's view. However, as is shown by Boyce's Fig. 8.2 (1989:162) the so-called connecting bar in such moulds can be much deeper than the thickness of the actual ring shank. There would seem to be no reason for this if the channel were only to make a connecting bar, and it might even be something of a disadvantage, since it would make the ring more difficult to remove from its mould.

It is, perhaps, possible that the bar is in fact to be seen as a bezel and that the ring would be removed from the mould sufficiently soon that it was still soft enough to take an impression from a metal or stone dye. However, until experimental work on the feasibility of this suggestion is carried out it must be treated with caution.

Drying

The drying of faience objects may have taken place simply on boards or flat surfaces where the warm air or breeze would remove the moisture from them. However, it seems likely that another form of drying may have taken place, utilising shallow trays. These trays are made of what we have termed "lime ceramic" or "lime plaster" on account of its calcareous nature. The trays are flat, usually with a rim of less than 1cm high and frequently show textile impressions on their interior surface (Plate 7.1). The impressions are usually from a fine textile, presumably linen.

Fragments of the lime plaster trays are instantly recognisable by their distinctive fabric. This is a pale pinkish or buff colour interspersed with a large quantity of fragments of clean, white, limestone. These fragments make up an estimated 30% of the

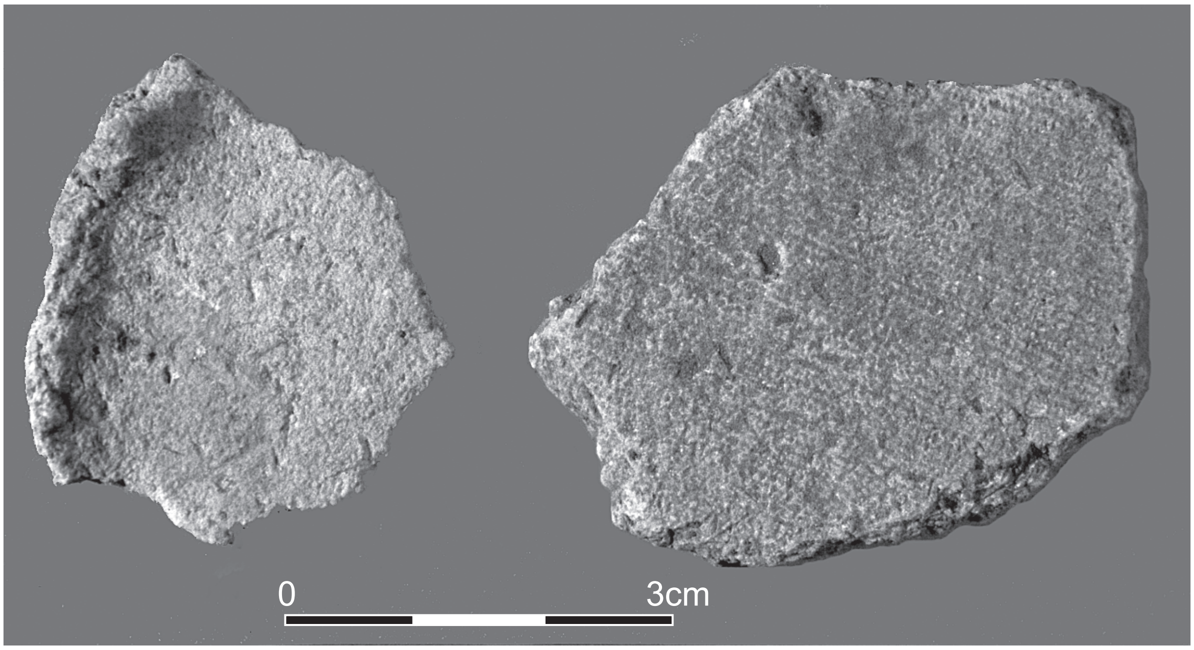


Plate 7.1. Fragments of "Lime Plaster" trays (30554) showing a "rim" and also the characteristic textile impressions.

fabric. The matrix itself is calcareous, presumably made from the calcareous clays which form on the desert surface, particularly in wadis close to the cliffs which surround Amarna (for the collection and use of these see Nicholson 1989b:243ff).

The surfaces of the fragments are distinguished from other ceramic materials by their texture. The upper surface is almost invariably covered by textile impressions. These are not from wiping the piece, or from accidentally resting it on textile, but are quite deliberate. The textile appears to have been stretched taut and deliberately impressed. None of the pieces found show any creasing of the material. The underside of the fragments is more varied, but commonly shows impressions from chaff, suggesting that the vessels were formed or placed to dry on surfaces which had been deliberately dusted with this material to prevent them from sticking. Such practices are well known amongst potters.

Such trays were in fact found by Petrie at Amarna, but do not feature in his publication, presumably because he was unsure as to their function. There are several particularly informative examples in the Petrie Museum. One of these (UC40569a) was evidently circular, with an internal diameter of approximately 19cm, the inside is textile impressed and the outside has straw impressions. UC40569b seems to come from a square or rectangular tray, this time with straw impressions on both sides, whilst UC40570 has straw impressions on the interior. Both this example and UC40569a have adhering fragments of fired brick, suggesting either that they were attached to fired bricks in the kiln, or that ground up brick was used in whatever mortar was used to adhere them. None of the pieces from the recent excavations has such a distinctive rim, although one of the fragments from find 30554 approaches this. The thickness of these tray fragments is usually between 5 and 7mm.

It would seem that these trays were manufactured at site O45.1 itself, since there are finds of lumps of the fabric used in their making, some of them apparently including actual trays which were discarded before completion (No. 32199). Find 32174 has a large lump of lime plaster fabric with glazed red sandstone, small bits of charcoal and mudbrick. One surface of the piece has mud and charcoal, fired ceramic and two balls of the lime plaster fabric. This and other fragments suggest that some of this material was dumped onto the dirty workshop floor and allowed to set. There are well over a hundred fragments of this lime plaster (some registered under a single find number). Much of the lime plaster material comes from a pit context [9006] in square M80.

One fragment of lime plaster, find 31982, has a series of ribs in it, and may be intended to serve either to hold tubular beads during firing or, perhaps more likely, to serve as a rolling tray to produce pill-like balls of faience which could then be pierced. As only one small fragment of this survives it is not possible to be certain of its function. Such a piece might also serve to produce segmented beads, or to split beads in much the same way as that described by Sode and Schnell (1998:165), when faience paste is rolled on a block with razor blades in it.

There must be some question as to the use of these trays. The possibility that they may have been intended to go into a kiln or furnace has been mentioned, but since the ceramic adhering to some of them, including some of those in the Petrie Museum, may have come from the workshop environment generally rather than the kiln in particular, it is not possible to be certain of this. Since they contain a high proportion of limestone and are made of calcareous clay there is some argument that they may not be intended to be placed in a kiln, since the lime would decompose at temperatures above 750°C (Rye 1981:107). None of the trays found shows any sign of vitrification, of limestone burning out, or of surface burning.

If these are not for firing some other use must be sought for them. The most obvious one might be that they are intended as drying trays for the faience objects. The fabric is porous and might have acted much like the plaster of Paris bats used by contemporary potters, to prevent pieces sticking whilst drying and to take some of the moisture from them and lose it in evaporation. Some support for this view might be found in the textile impressions on the upper surface of the trays. It has been noted previously (Nicholson 1993:33) that faience frequently displays textile impressions on its reverse, and it was assumed that this might be from having been set to dry on textile. However, it is possible that such impressions come not from textile itself but from the textile impressed trays.

This raises the question as to why the trays should have been textile impressed in the first place. It would appear that the fabric was rolled out on a flat, usually chaff-covered, surface and the textile then impressed onto the fabric in a single action. It might be suggested that the textile was used during the rolling operation to prevent the lime fabric sticking to the roller. However, if this were so one would expect very distorted textile impressions and folds in the textile. Rather, what is found is a single clear impression suggesting that it was carefully impressed in a single operation. Perhaps its purpose was initially to stop the fabric drying out too rapidly and cracking. A secondary purpose might be to provide a surface with just sufficient relief to help to prevent beads and other small objects becoming stuck to it as they dried.

A similar fabric to that found in the lime plaster trays is known from the excavations by Jean and Helen Jacquet at Karnak. However, here the flat slabs of lime ceramic are luted together with similar material to make rectangular boxes. It is possible that these were used for cementation glazing.[11]

The Objects

Most of the objects being produced at site O45.1 were relatively small. However, faience objects of any great size are rare at any period of Egyptian history, and one needs to examine the type of product rather than the sizes in order to determine the nature of the Amarna workshops.

Examination of the corpus of faience items from O45.1 is of some interest as it confirms the production of these small items. Beads and bead fragments are the most commonly represented items, numbering over 180 pieces. There are over 100 tile fragments, over 60 inlay fragments,[12] almost 40 ring fragments and less than 10 amulets.[13] It is not surprising that bead fragments should be the commonest finds, since they are also the smallest and would easily be lost. Ring making is clearly attested, and is borne out by finds of clay moulds for the manufacture of these. Perhaps the biggest surprise is the lack of conventional amulets. If one discounts the cartouche mould of the Aten as being a special form of amulet, and takes the *nfr* sign to be part of a necklace rather than a single amulet, then what is left are figures of Bes and of Tauert—which may themselves be necklace elements, at least for wealthier individuals (see Boyce 1995). Examination of the clay moulds from the site shows that only these two are present, and that the bulk of the moulds are for making geometrical shapes, floral designs, or rings.

The relatively large number of tile fragments, along with inlay fragments suggests very clearly that this workshop was producing items for use in architecture or furnishings, and as will be suggested below these may indicate its attachment to the State. The high quality of the mould for the making of the Aten cartouche may be a similar indication. No fragments of faience vessel were recognised from the workshop, which may also be indicative of a fairly specialised production.

Beads And Their Manufacture

The term "bead" hides a great range of forms and possible shaping technologies, and each requires some explanation.

Although free hand-modelling can be used this was unusual by the time of New Kingdom. Beads might be rolled by hand or wrapped around a wire or reed and then cut to length, and fold lines can sometimes be seen in them. The making of tiny wafer beads, often less than 1mm in thickness and with a central perforation, must have been exceptionally difficult.

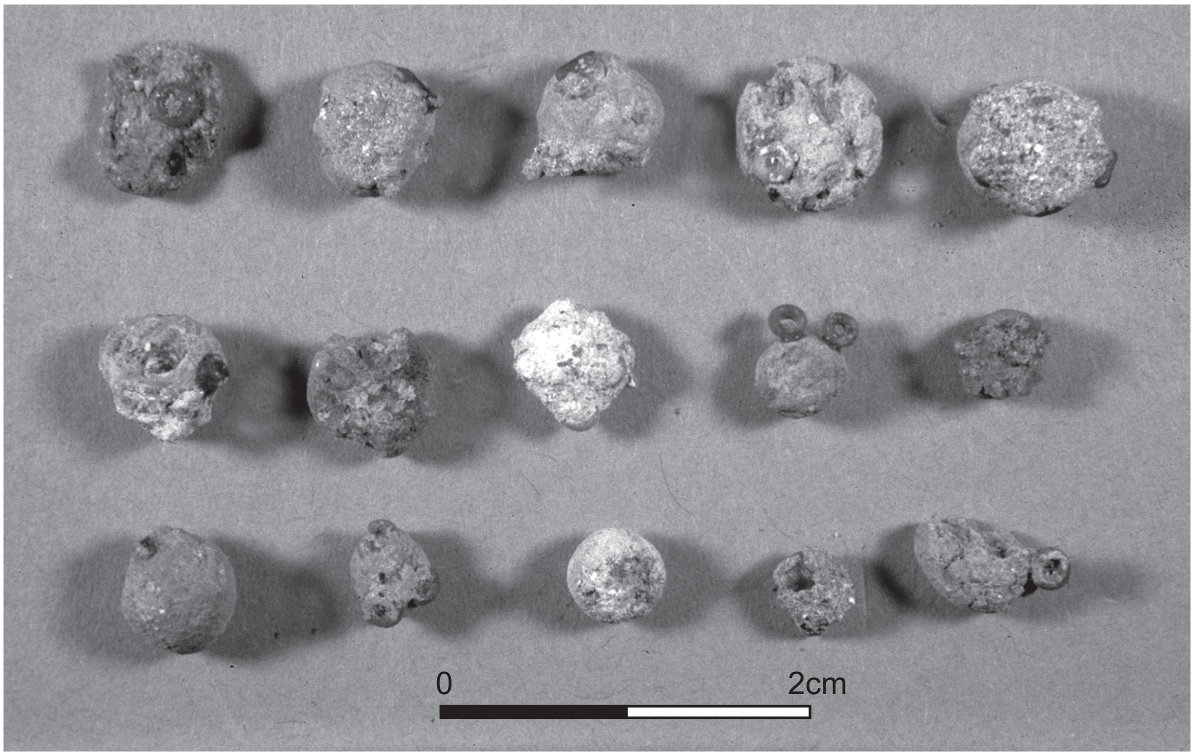


Plate 7.2. Small balls of clay (30689) which seem to have been used as supports for making tiny faience beads.

The excavation has produced around 200 small faience beads. Many are so tiny as to have lost their faience core entirely during firing so that they are, technically speaking, of glass although they would have the chemical composition of faience (see also Vandiver 1983:A113).

Although these beads have been typed to Petrie's corpora from Amarna (Petrie 1894: Pl. xviii-xx) and more especially that from Gurob (Brunton and Engelbach 1927:Pl. xlii-xlv), many are so small that such typing seems superfluous, as their shape would be affected by temperature of firing, such that a sharply defined profile might be softened to a rounded, "doughnut", shape by further heating.

The very small size of these beads, frequently less than 2.0mm in diameter, and 1.0mm or less in thickness begs the question as to how they were manufactured. To this we are able to give only a partial answer. It would appear that the small beads may have been pressed out of a sheet of faience paste using a copper tube of some kind, and then pierced with a wire. This might explain why some of them have sharply defined edges.

Alternatively, they may have been formed around a wire, removed, and then cut into sections. This might also give a sharp edge, but would also lead to some deformation of one edge, and perhaps a flattening of the side which rested on a hard surface during cutting. Sode and Schnell (1998:165) found that the contemporary faience makers of Qurna form tubular beads around a piece of straw, cutting them into sections whilst already on the straw and then rolling them in talc. Disc beads are produced by rolling the mixture, again on a piece of straw, on a block of clay which has closely set razor blades in it, thus cutting the long tube into shorter sections. After drying, the straw is removed from the disc beads, but is left *in situ* for the tubular ones and burns out during the firing.

However the beads were formed, they would be so tiny as to make handling them difficult in the extreme. In order to type them we have generally had to handle them with tweezers, so collecting them for firing would be extremely difficult.

It seems that the craftsmen at O45.1 resolved this difficulty by rolling small balls of soft clay and gently pressing these against the loose beads, so that they stuck to the clay ball (Plates 7.2 and 7.3). The aim was obviously to collect the bead without impressing it so deeply that it became impossible to remove it from the clay. In some instances, such as find 31545, this was not achieved, and some beads remained embedded, whilst the impressions of others are clearly visible in the clay. This technique was not a New Kingdom development but is attested at the Middle Kingdom site of Lisht, where a marl clay pad was used in a similar way (see Nicholson in Friedman 1998:254).

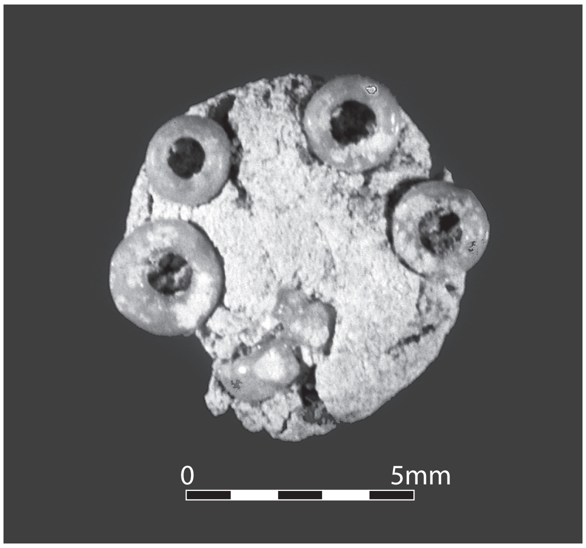


Plate 7.3. A group of tiny faience beads on their clay pad (30801) (Photo: Gwil Owen/E.E.S.).

Re-examination of the finds during the 2004 season initially suggested that these clay balls, once dried and incorporating the faience beads, were placed into some kind of container filled with a mixture of lime, charcoal (apparently in the form of carbonised chaff) and ground up ceramic. Hart observed that find 30742 included two such clay balls, complete with adhering

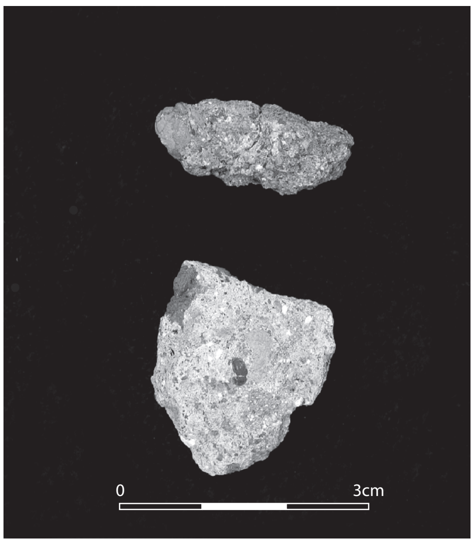


Plate 7.4. Find 30742, a matrix of lime and charcoal with faience beads and clay balls incorporated into it.

bead, still embedded in the lime mixture (Plate 7.4). It was thought that this mixture was intended to allow the material to glaze without becoming stuck to the container, the lime acting as both a flux and a wetting agent.

Once firing was complete it was assumed that the containers were emptied out and the powder crumbled away from the clay pads with their adhering beads.

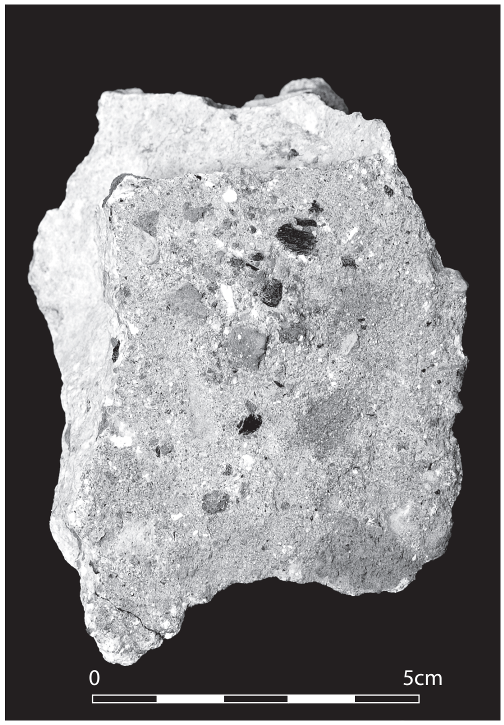


Plate 7.5. Find 32226 incorporating fragments of brick and charcoal as well as beads, mudbrick etc.

During this process it is likely that many beads would become detached from their pads and fall into the lime. This may have been the intended result, and perhaps the lime mixture was then washed away in water, the beads being collected in a fine sieve or linen gauze.

However, further investigation of other finds suggests a rather different picture. The "glazing matrix" in fact appears—in larger samples—to be ash and other debris mixed with the raw material for the manufacture of the so-called "lime-plaster" trays. Find 32226 has this material with pieces of fired ceramic (probably brick), mudbrick and charcoal. Blue and red-brown beads are also included in the piece (Plate 7.5). The upper surface of this piece is brownish-grey, and appears dirty. The lump is probably the result of being part of a trample layer in the workshop. One fragment has a smooth but undulating surface as though it has been pressed, possibly by bare feet. A further fragment, find 32199, includes what are clearly the remains of plaster trays within it. These are very compacted, but are still discernible as layers within the piece. One surface, thought to be the lower one, has the characteristic fragments of mud and charcoal in it (Plate 7.6). This matrix material cannot certainly be associated with the actual glazing process, other than—in the case of the lime—to serve as an agent to prevent sticking. However, one should bear in mind that the debris on the workshop floor could actually come, in part, from the emptying out of containers of glazing material.

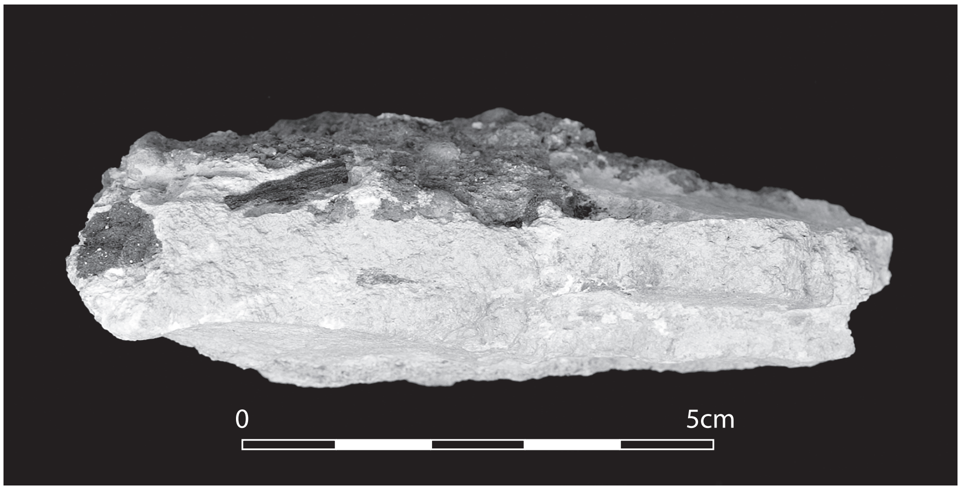


Plate 7.6. Find 321993 with fragments of lime plaster tray as well as brick and charcoal fragments, probably picked up from the workshop floor.

As well as beads on pads, there are numerous examples, particularly of wafer beads, where the beads are still embedded in lime, but without a pad. It is possible that beads of this type, which are of greater diameter than most of the types found adhering to clay pads, were simply dropped into lime mixture to be glazed and collected afterwards. Alternatively they may have been lost into the lime deposits which are widely spread in the workshop complex.

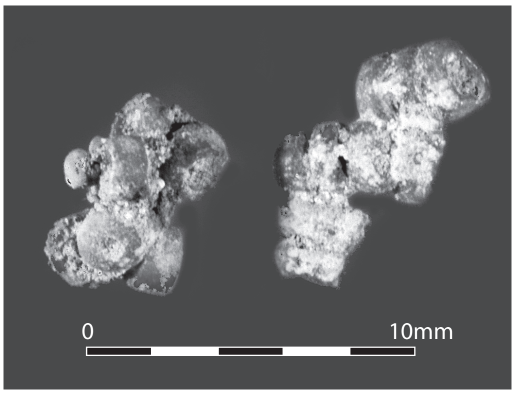


Plate 7.7. A cluster of faience beads which have become stuck together on a pad, now lost (30779) (Photo: Gwil Owen/E.E.S.).

Find 30668 is a good example of a wafer bead embedded in the mixture without a clay pad, whilst 30779 is a collection of small beads of the sort normally found adhering to clay pads, which have become fused together, presumably from being in too close proximity during the firing (Plate 7.7).

That not all small beads were too small to be handled is evidenced by the production of what might be described as pendant-type beads. Here the beads are made in moulds in whatever shape might be required, and then have a suspension loop added to them instead of a hole pierced through them. These loops take the form of small beads and are attached to the moulded object using faience paste often of a different colour to the bead itself, and sometimes different to that of the suspension loop (cf. Vanidver 1983: A111). Sometimes a loop is attached to either end in order to take a second string of beads. It is possible that these "pendants" may have served not only as necklaces but as elements within bracelets and earrings (Boyce 1995:337).

Tile/Inlay Fragments

The distinction between tile and inlay fragments is often impossible to make. There is a tendency to call all blue fragments tile, and others inlay, but this is clearly not valid. Similarly, fragments of flat, blue glaze were at first thought to be from tiles, as many undoubtedly are, but this definition cannot be used as a hard and fast rule.

The tiles were probably made by rolling the paste between parallel rods and then cutting the tiles to length. Since no complete examples survive it is not possible to say whether they might also have been pressed out using a square/rectangular cutter. Glazing was largely by efflorescence, as is evident from the development of glaze on the tile edges and sometimes on the outermost edges of the underside.

It is noticeable that with fragments of tiles and inlays, that in profile many are chamfered on the underside, presumably to allow them to fit more easily into stonework and/or into the mortar which would hold them in place. This chamfering may have been achieved after they were fired, since it is normally the coarse backing layer of the tile or inlay which is ground away, possibly with some kind of rubbing stone. Tile 30864 is a good example of one of those with chamfering.

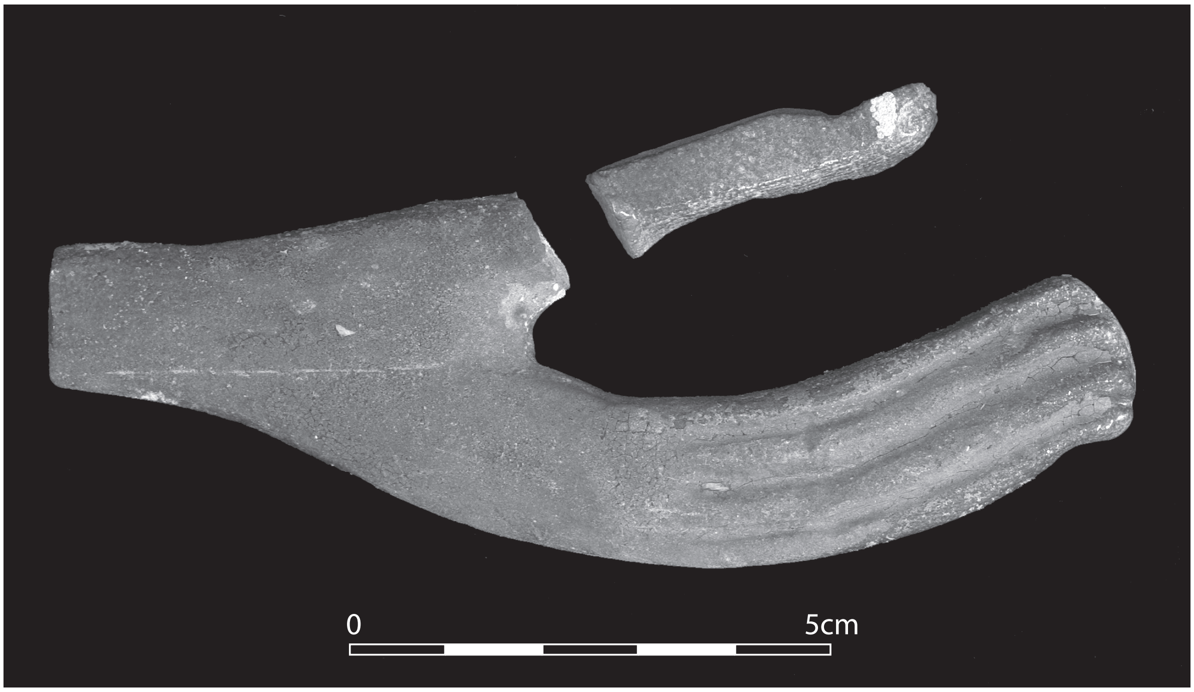


Plate 7.8. Red faience hand (33903) and thumb from another similar hand (33904). Both were probably made in the same mould but on different occasions. The thumb is correctly glazed, whilst the hand is glazed on the wrong side so that the detail appears matt.

Whilst fragments recorded as "tile" are much more common than those thought to be inlay they are arguably no less significant in suggesting the role of O45.1. Given the relatively small numbers of amulets, it seems likely that at least part of the workshop production was concentrated on the making of architectural pieces. One would not expect to find this in a workshop which had no connection to important building projects. Insufficient is known of the smaller factories to be clear whether they produced tiles and inlays for households, but it seems unlikely. As is well known, tiles could themselves be inlayed either with separately made elements, such as daisies[14] or with pastes which would shrink at a different rate to that of the body, leaving a slight void around the inlaid paste.[15] The excavation at O45.1 did not recover any tiles of these types, but their numbers at Amarna suggest that they must have been made there.

The inlay of a hand (No. 33903) has carefully moulded detail on the face side, with the fingers and nails clearly shaped. However, it has been glazed on the wrong side. That glazing was by efflorescence is suggested by the fact that on the face side there is some glaze on the fingers, and also around the edges of the piece. The thumb (No. 33904), probably intended for a similar hand but somewhat thicker, is glazed on the face side but also has some glaze on the reverse, again in those areas most likely to develop it through efflorescence. The thumb is slightly thickened at the base suggesting that an attempt has been made to lute it back onto the hand from which it had broken (Plate 7.8).

Inlays such as 33903 and 33904 are not objects of daily use, nor would they be required by the populace in general. They must have been specifically intended for use in architecture, and probably in State buildings. The same holds true of the fragment of faience torso (No. 33908). This piece is evidently made from two different pastes. The bulk of the piece is made from a red-brown paste like that used for the hand, but the best glazed surface, and therefore that which we may assume was to be viewed, is a cream, slightly pinkish, colour. This might suggest that the workshop had a lot of the red paste available and used it to bulk up the inlay, that the white/pink was more difficult to produce, or that the reaction between the two pastes was what gave the desired colour.

Faience Workers

Just as there is a paucity of pictorial and literary evidence for the making of glass, much the same holds true for the production of faience. Only one representation is known which *might* show faience workers. This comes from the tomb of Ibi (Aba) (TT36; see Davies 1902), chief steward of the divine adoratress in the time of Psamtek I (664–610 B.C.), and so is much later than the period in question here. It has been interpreted as showing a workman mixing ingredients whilst another completes an object. It is possible that what is actually being shown—if this is a faience making scene at all —is the grinding of the raw ingredients. The scene is so unusual and difficult to interpret that it can tell us nothing about the organisation of the workshops, nor the relationship between faience and the production of other vitreous materials.

A more useful document is the funerary papyrus of Qn-hr[16] who is described as *mr irw ḫsbḏ,* an "overseer of faience makers", more strictly the term *ḫsbḏ* refers to lapis lazuli but by the New Kingdom the word could also mean faience (Aufrere 1991:465) and even glass. This 19th Dynasty papyrus is supported by a further piece of the same dynasty, a faience stele of Rekhamun, "faience maker of Amun".[17] Gaballa (1979:45, 51) has demonstrated that such a title is not as uncommon as has sometimes been supposed. Whilst it is probably correct to envisage here a faience maker commemorated on a stele made from the material he worked, it is also possible that, because the term *ḫsbḏ* is used, he may also have worked in other vitreous materials. We know of no examples of a chief of glassmakers, which may lend weight to the view that as the most recent of the vitreous materials introduced to Egypt, glass came under the supervision of those who made faience. Friedman (1998:18) sees the upturn in faience quality during the reign of Amenhotep III as directly related to the recent introduction of glassmaking in Egypt, again stressing the interrelatedness of these crafts. For the moment we can only speculate on such things.

The Royal Scottish Museum in Edinburgh not only houses the stela of Rekhamun but also that of Kar,[18] also of the 19th Dynasty, and argued by Friedman (1998:250) to be from the same workshop. Kar was evidently a "servant of Amun" and "may not have been a man of substantial means..but he could still afford this faience stela" (Friedman 1998:250). If this artefact did indeed come from the same workshop as its companion then it might not be unreasonable to suppose that Kar was one of those supervised by Rekhamun. This view might be somewhat strengthened by a bichrome faience stela belonging to Amenemheb and his wife, also of 19th–20th Dynasty date and now in Leiden.[19] Amenemheb was an "Overseer of the Artisans of Ptah" at Memphis, and so may well have supervised those who produced faience there. One suspects that more stelae of this sort exist, but that they are in fragmentary condition and may have been mistaken for plaques or inlays.

The conditions under which such overseers might have worked at Amarna is uncertain. However, Bianchi (1998:22) is of the opinion that "faience manufacture was an institutionally affiliated craft" which could demand materials available only from those desert locations which formed part of the royal domain. Such materials were collected in "strictly regulated and religiously sanctioned operations" (Bianchi 1998:28). The most prestigious of these products, then, were destined only for the elite or for the buildings over which they held sway, such as temples. Whilst this may be true of the highest quality faience, the situation at Amarna suggests that there may have been many smaller workshops controlled by officials rather than the state. O45.1 however, may be one of those favoured with particular raw materials from such a royal domain, particularly in the form of cobalt.

An interesting observation is made by Vandiver (1983:110) who suggests that during the New Kingdom the amount of copper relative to lime decreases substantially, as if to suggest that it is now realised that the function of the copper is as a colourant rather than a flux or stabiliser. She sees this apparent realisation that copper is a colourant, and but one of many, as being linked with the development of glass production in Egypt. This would not be surprising if glass and faience workers shared facilities at O45.1, or indeed if they were the same individuals.

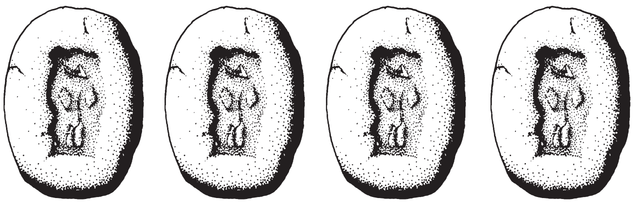
Chapter 7

Endnotes

1. Imitations made in Britain are more correctly referred to as "majolica".
2. This is the ash carried up through the kiln or furnace firing chamber.
3. For a useful summary of lime treatments see Griffin (2002:327).
4. Manti (pers. comm.) has suggested that the amount of intersitial glass may be related to the size of the object, and that it may be very difficult to determine whether beads were made by cementation and efflorescence on the basis of interstitial glass.
5. Cleveland Museum of Art 1920.1976, Catalogue entry 242 in Berman with Bohač (1999:306–7).
6. MMA26.7.1175.
7. Dr. Delwen Samuel, who has made a study of quernstones for grain-grinding at Amarna, believes that this may not be a quernstone.
8. A natural gum derived from plants of the genus *Astragalus*, a member of the *Leguminosae* family.
9. I am grateful to Mr. Samir Anis, Chief Inspector at the Minya office of the SCA for allowing us to examine the spoil heaps at the slaughter house site. This work was undertaken during the 2004 study season, the construction having been halted earlier in the year.
10. For example pieces MMA11.215.66, MMA11.215.667 and MMA11.215.668 in the collection of the Metropolitan Museum of Art, New York and which come from Malkata.
11. I am grateful to Helen Jacquet and Hiroko Kariya for the opportunity to examine these pieces and refer to them here.
12. Tiles may of course be used as inlays, but as applied here tiles are generally straight edged, and are almost invariably blue. Inlays have been classified as non-rectangular pieces. The division is an artificial one but allows the most likely pieces of inlay to be identified as such.
13. Boyce (1995:342) notes that "amulets" are in fact pendant elements. As a result their differentiation here is an artificial one.
14. E.g. UC23383, UC23396 etc.
15. E.g. Berlin 30541 (Crowell in Friedman 1998:188–89).
16. Also known as Qennou. Museo Vaticano Inv.38 574 (Gasse 1993:16).
17. Edinburgh No. 1956.153.
18. Edinburgh A.1956.152.
19. Rijksmuseum van Oudheden, Leiden AD 37.

Chapter 8

A Reconstruction of Pottery Production At Amarna O45.1



Introduction

A potter's kiln and workshop were the first traces of industrial evidence to be unearthed at site O45.1. They are located in the north-western area of the excavation, squares J80 and J85, and K80, K85 and K90 (Fig. 3.3). A kiln in K75 is probably also for pottery production, as may be that in L75. The discovery of pottery workshops at Amarna was a long time in coming. It was recognised that they were almost certain to be present at the site, but no evidence for them was found until the 1987 season (see Kirby and Tooley 1989, Nicholson 1989a) when a workshop was found in building Q48.4.

In fact, a workshop had been located by Borchardt (Borchardt 1932, Borchardt and Ricke 1980:128–29) in the house of Ramose Complex (P47.20) before the First World War, but the kiln had been mistakenly identified as a large bread oven, and as a result was not re-considered until after the discoveries of 1987. In 1988 the relevant rooms of this complex were re-excavated (Nicholson 1995b) and the identification of the structure as a pottery kiln confirmed. A similar structure was also unearthed in the same complex. In 1989 a further kiln was found in building P47.22, confirming the view that, as well as large workshops which probably supplied to the population at large, there were also smaller ones serving individual estates.

Consequently, the discovery of a pottery workshop at O45.1 came at a time when there was already some experience of examining such structures, and particularly kilns. It was nonetheless a welcome discovery as it added to the picture of pottery production at the site.

Reconstruction of the Potting Process

Clay

The first stage in the potting process is, of course, the procurement of suitable clay. In fact almost any clay can be rendered suitable for potting if it is treated appropriately, however, in practice the less treatment that is necessary the more likely a given clay source is to be worked. Fortunately for the potters of Amarna there was a good source of clay immediately to hand—the banks of the river Nile. This Nile clay is generally referred to by ceramicists working in Egypt as "Nile" or "Nile Silt" clay (Nordström and Bourriau 1993). It is the most common of the clays used by the ancient Egyptians, and has remained in use to the present day, including in Middle Egypt (Blackman 1927:135–53, Nicholson 1995c). It would have been collected from the banks as needed and transported to the workshop in baskets, either manually or by donkey. Should it have been necessary to modify the clay by mixing it with a calcareous clay, small quantities of suitable material could be found on the desert surface near the limestone cliffs (Nicholson 1989b:243). Where an addition of sand was needed to make the clay less sticky and to "open" the fabric, it was readily available. The chief limiting factors to the successful production of pottery would have been water and fuel.

Water and the Processing of Clay

Ready access to water is necessary for all of the pre-firing stages of pottery production. At O45.1 this need is met by what appear to be two large wells, one close to the workshop in L85 and M85 (and beyond in unexcavated squares) and a more distant one in M75. The water is necessary in order to soften the clay so that it can be homogenised, and have any impurities removed from it or additions made to it. It also allows the plasticity of the clay to be exploited for the shaping process.

The clay trampling pit located at the junction of squares J80, J85, K80 and K85 is the only clay trampling pit to survive from the site. It may be that there were others, perhaps located to the west of the surviving example, where the workshop is more damaged. If further pits did exist, they are likely to have been for the initial preparation of the clay, when it would be soaked and trampled to remove any unwanted plant material or freshwater shells from it. Such shells are particularly problematic as they are calcium rich and after firing will re-hydrate and cause spalling of vessel surfaces, or if present in great enough amounts will cause vessels to collapse (see Rye 1976, 1981:114). That such shells exist in the Nile clay, at least at the present time, has been shown by the study of the clay used at Deir Mawas across the river from Amarna where *Cleopatra bulimoides* (Olivier), *Melanoides tuberculata* (Müller), *Lanistes carinata* (Olivier), *Valvata nilotica Jickeli,* and *Corbicula fluminalis consorbrina* (Cailliauidi) have all been identified by Drs. Cooper and Brown of the British Museum (Natural History) (Nicholson 1995c:281). It may be that if/when sand was required as a filler[1] it would also be added in this undiscovered soaking/trampling pit.

It should be noted, in passing, that a pit such as that postulated, or that discovered, is not the same as a "levigation pit" or tank. These latter are used when it is necessary to refine clay by separating it into fractions. The mixing of a large quantity of water with the clay will allow the coarse material to separate out from the fine which can then be skimmed off for use in making vessels of fine fabric. There is very little evidence for the making of such fine fabrics in Nile silt clay at this time, and no archaeological evidence for levigation tanks of the New Kingdom is known to the writer.

The extant clay trampling pit should be considered along with its surrounding floor of fired mudbricks. If this were the only trampling pit associated with the workshop, then all stages of the clay preparation would take place here, as described above. Its scale would be indicative of relatively small scale production, with the need for repeated trips to the river to bring clay and prepare it in relatively small quantities. As discovered, the pit was lined with clay, a compacted surface of the same material which was being used in the production of pottery vessels. The clay extended from the pit onto the brick floor.

The purpose of the floor would be to further homogenise the clay and to drive out any pockets of air which it might contain. This is essentially the same process as that known as "wedging" which is carried out at the workbench before a small amount of clay is actually to be shaped. The trampling process is well attested ethnographically, including in Egypt (Nicholson and Patterson 1985).

Shaping

Although no trace of an actual potter's wheel was found at O45.1 the form of such equipment is well known, and comprised two stones which acted as bearings. On top of these it seems to have been usual to attach a large disc which served as the wheel head (Powell 1995). A large *zir* [9501] was found set into the ground in square J80 (Plate 3.24). This may have served as water storage vessel for damping the clay in the pit, but more likely served to provide water for wetting the clay on the wheel head, and is likely to have been close to the location of the wheel itself. We may also have some indication of the position of the wheel from the relative position of the clay pit.

When discovered, the pit contained evidence of vessel "turning", one of the means by which the final shape of a vessel which has previously been "thrown" is achieved. After the potter has thrown a pot on the wheel, using pressure and centrifugal force to draw up the shape from the wet clay, it may be put aside to dry for a time. Because a vessel may be quite tall or wide it can be a risky process to try to achieve the final form in one operation, since to thin areas of a vessel to their desired thickness when wet may lead to collapse or deformation. It is therefore more effective to throw the general shape, though thicker than intended, and then reduce its thickness to that desired by turning. For turning the vessel is returned to the wheel, and is frequently inverted. A sharp tool, usually of metal but conceivably of wood or bone, is then used to remove surplus, dry, clay from the revolving vessel. Powell (1995) has convincingly shown that such turning was possible with the ancient wheel in use at Amarna. The clay removed has already been prepared, and to discard it completely would be a waste of effort. It is therefore returned to the clay preparation pit for recycling. Such turned pieces have the appearance of shavings, similar to wood turned on a lathe (Plate 8.1). In addition there are long straight or concentric scratch lines in the clay

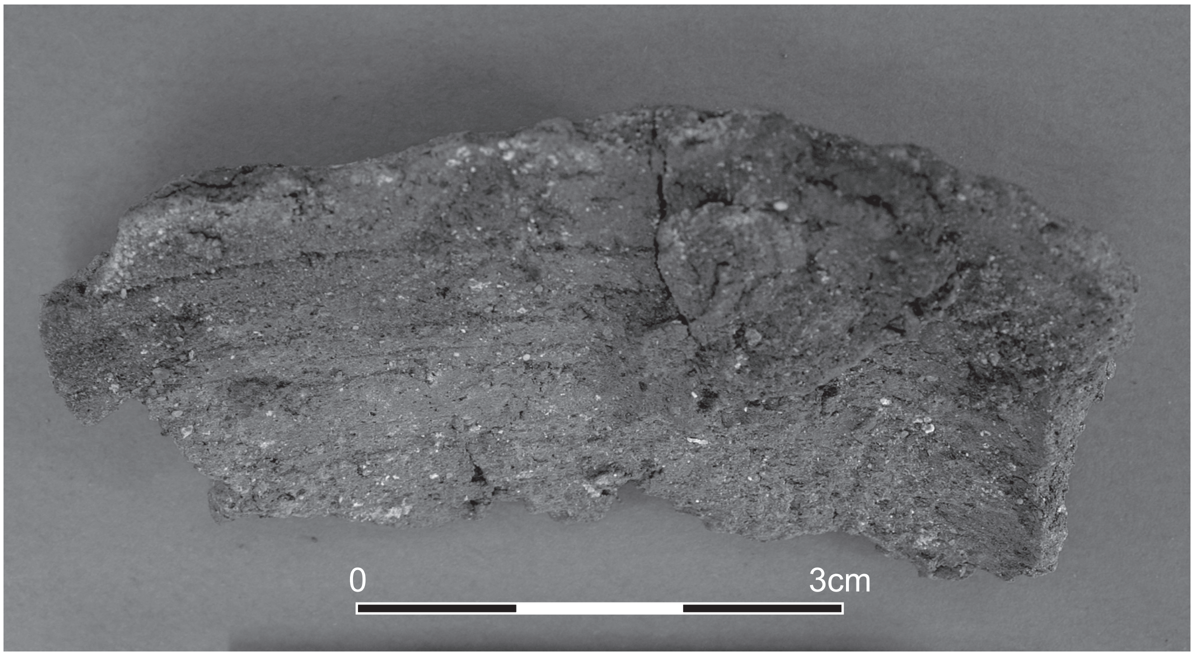


Plate 8.1. One of the "turnings" from the clay preparation pit [9482].

shavings where grains of sand or hard material have scratched them. Because of this desire to recycle the clay it is common for the pit to be located close to the wheel, so that shavings can be thrown into the pit or easily collected and deposited there.

A similar process to turning is that of scraping, where a vessel is reduced to its final shaping by manual scraping of the surface with a tool. This removes small shavings from the vessel. This process is often carried out with the worker actually sitting in the pit so that the scrapings fall into it. This is the case at Deir Mawas.

It is apparent then, that the O45.1 potter(s) produced some vessels which had to be given a final shape by turning after they were thrown. It is not uncommon to produce vessels, including those which might need further shaping, on a temporary wheel head known as a "bat", and there is evidence for these from O45.1 in the form of object number 32334. This is a fragment of bat of c.180mm in diameter, made from silt clay and tempered with chaff which has burned out. It is the only example known from the site (Plate 8.2).

It is not clear whether or not the wheel, *zir* and clay pit were under cover or not. However, the position of kerbs or walls around this area suggest that at least part of this area would have been roofed, though quite possibly with only a simple thatch on a frame supported on poles or simple brick pillars. It is unlikely that the building would have been more elaborate.

The vessels[2]

In considering the vessels produced at the site we should confine ourselves only to those which are known from unfired sherds. There are 189 unfired sherds[3], of which some 38 are rim sherds. The distribution of these sherds by square is of some interest. In the main block of 13 contiguous squares there are unfired sherds from all except the incompletely excavated J75. The numbers are summarised in Table 8.1 (overleaf).

The greatest number is clearly from K80, which includes the south-eastern most part of the potter's workshop, and if one takes the other three squares in this complex—J85, K85 and J80—the total for the

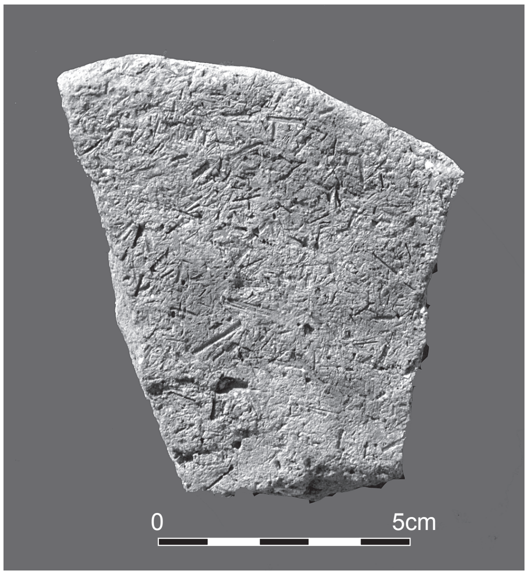


Plate 8.2. Fragment of a ceramic bat (32334).

Square	Unit	Unfired Sherds	Sq. Total	Comments
J80	9431	1		
J80	9459	1		
J80	9483	1		
J80/J85	9483	5	8	
J85	9431	1		
J85	9443	5	6	
K75	9431	2		
K75	9452	3		
K75	9495	16	21	
K80	7964	1		
K80	7966	1		
K80	7969	29		
K80	7981	5		
K80	7982	5		
K80	7984	17		
K80	7991	1		
K80	8027	1		
K80	8083	4		
K80	9478	3	67	
K85	7962	2		
K85	8036	1	3	
K90	10185	4	4	
L75	8979	2		
L75	9002	2		
L75	9010	4		
L75	9026	1		
L75	9035	3	12	
L80	7974	1		
L80	7986	1		
L80	8031	2		
L80	8985	3		Inc. Cone
L80	9001	1	8	
L85	7962	3		
L85	8029	3	6	
M75	8979	7		
M75	8981	3		
M75	9005	3		
M75	9015	5		
M75	10187	1	19	
M80	8987	1		
M80	8992	1		
M80	9012	10		
M80	9022	4		
M80				Hearth comprises 22 sherds
M80	9025	17	33	
M85	1096	2	2	
	Total	189	189	

Table 8.1 Summarised number of unfired sherds

four combined is 84, which is perhaps to be expected. Within K80 the greatest number of sherds comes from [7969] which contains rubble and may be from the demolition of the workshop itself, which might help to explain why sherds which might normally be expected to be in or close to the clay pit have been dispersed.

The other large concentration here [7984] comes from a pit which contained faience moulds, fragments of faience, slag etc. and could be a rubbish pit from the period of operation of the workshop.

There are other high concentrations elsewhere. Square K75 has the third highest total with 21 sherds, which is perhaps a strong indication that the kiln in that square is indeed for the production of pottery and may be seen as uniform with the four squares just discussed. Of the 21 sherds, 16 come from [9495] which is believed to be the fill of an ancient robber trench alongside wall [9487]. The context description mentions a patch of mud trample, and it is possible that the pit is a destroyed and refilled trampling surface, though there is far too little evidence to be certain of this.

It is more difficult to explain the distribution in squares M80 and M75 respectively. In M80 there are 55 sherds (if the 22 pieces of the hearth are counted individually, otherwise 33 sherds). Of these sherds 38 are from [9025] which is described as a pit fill with fragments of faience as well as sherds. It may be that this is either a hollow in the surface of the work area which has accumulated these pieces, or that they have been thrown there as the area was levelled. An alternative explanation is that there are other pottery making installations immediately east of the excavated area, and this is certainly a possibility. This square has the second highest concentration of unfired sherds from the grid. Some 19 sherds come from the square immediately to the south (M75) though they are distributed in small numbers amongst several units and appear likely to be from deliberate rubbish infill or accidental distribution through trampling, rather than being associated directly with a workshop.

It is interesting to note that from square L80 comes what is believed to be approximately 50% of an unfired bread mould (Plate 8.3), suggesting that amongst the products of these workshops were moulds for the temple bakeries.[4] Since this is the only occurrence of such a bread mould, and since they would have been required in their hundreds, if not thousands, it may be supposed that there are indeed other pottery making installations to be unearthed beyond the bounds of the site as currently uncovered. It may also be further evidence of the connection between site O45.1 and the offical buildings of the Central City.

The most complete domestic vessel is a hearth (Plate 8.4) bowl (group 11—for a vessel summary see Rose 1984: Fig. 10.1). This clearly suggests that production from the workshop was not limited to the making of industrial vessels for use in glass or faience production, and is borne out by the other finds of unfired sherds from the site. These include simple rimmed bowls

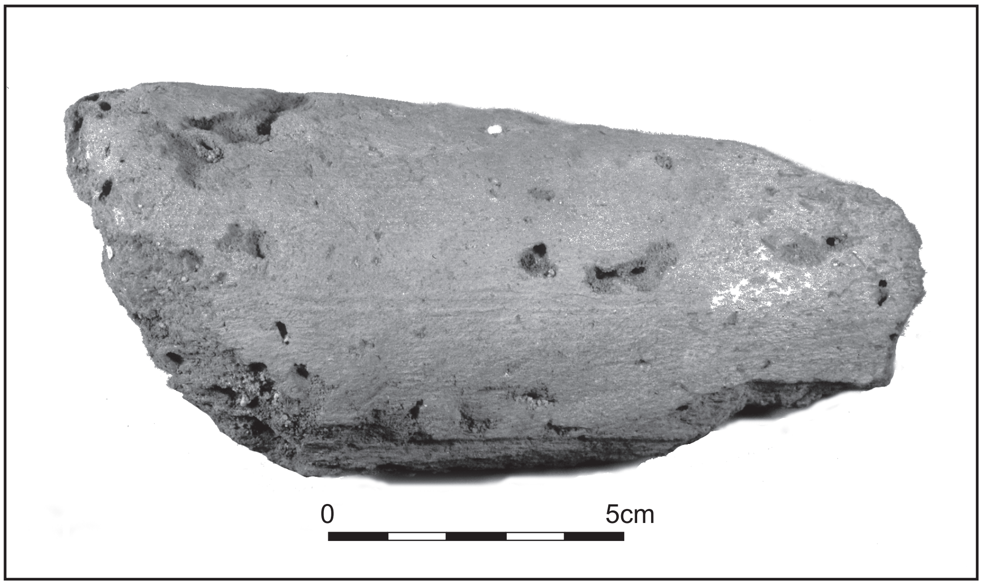


Plate 8.3. Unfired breadmould (sherd 118153) from L80 [8985].

(group 5) and a variety of jars. There is one sherd which may have come from the rim of a cylindrical vessel such as that used to produce glass, but its small size makes certainty in this matter difficult.

Some of the vessels have been coated with slip, which in its unfired state is either red or a yellow-green colour. One sherd has a splash of blue pigment on it, but this does not necessarily imply the making of the typical Amarna period blue-painted pottery at site O45.1. The pigment used in the decoration of blue painted pottery is cobalt based and has been the subject of a technological study by Noll (1981a, see also comments by Segnit 1987). It would appear that the pigment could have been applied in its pink form and then heated to blue, or as a ready-reacted blue pigment. Since cobalt is being used at the site for the colouring of glass and for pigment making, its appearance on a single unfired sherd cannot be used to imply the making of blue painted pottery at the site.

Drying

Before being turned, scraped, slipped and eventually fired vessels must be dried. This might seem a simple matter in Egypt, where there is plenty of warm dry weather. However, although it is undoubtedly the case that natural drying was the means used, vessels cannot simply be put out in the sun and left. On hot days they may dry too rapidly, as well as differentially, and so crack. Rather it is common for vessels to be dried, at least initially, under some kind of cover or shade. It is likely that close to the excavated workshop there was a drying area of some kind, perhaps with a simple thatched roof supported on poles or columns. If vessels were simply put outside, then they would have been positioned such that there was shade at the most vulnerable time in the drying regime. In winter vessels may sometimes be covered in straw or palm leaves to help protect them from the cold overnight. Drying areas are extremely difficult to identify archaeologically (see Nicholson and Patterson 1985)

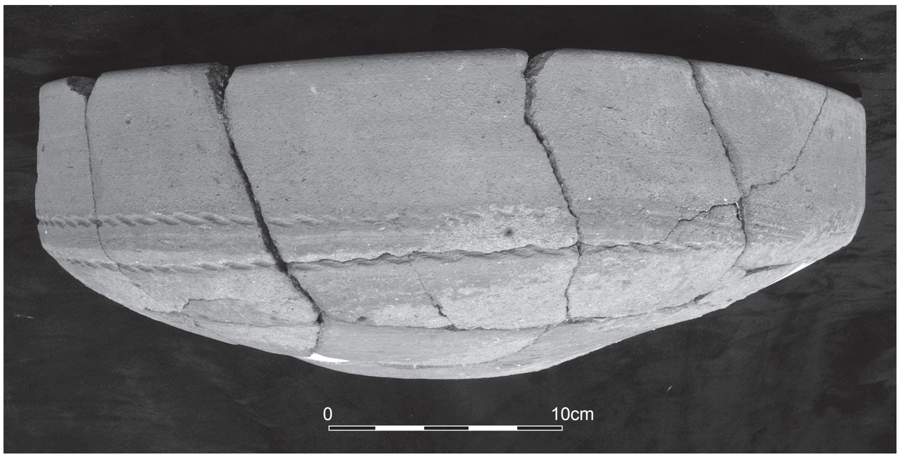


Plate 8.4. Unfired hearth vessel (118000) from square M80. Note the characteristic rope marks.

whether in or out of doors, and one should not be surprised to find that no positive identification has been made here.

Firing

The kilns used to fire pottery at O45.1 have already been commented upon when discussing the archaeology of the site (Chapter 3), and their features will not be extensively discussed here. The two which are most likely to have been solely for the production of pottery are Kiln 1 [8035] (Plate 3.2) and Kiln 6 [9485] (Plate 3.16). Both would have been tower-like structures. They comprise a lowermost course of bricks standing on their ends with their broad faces inward, arranged like barrel strakes. Above these comes a ring of horizontal bricks, again layed with their broad faces inwards. Above these, from approximately ground level, are horizontal brick courses. The perforated floor or "chequer", which separated the fire from the vessels to be fired is missing in all the kilns and furnaces excavated at O45.1, but these two kilns in particular are quite small and may well have had a simple floor made as a low vault using mudbricks or simply mud plaster over a frame. In either case the structure would fire *in situ* yielding a sufficiently strong floor for the purpose. It is, of course, possible that the floor was supported on a pillar of brick, but this seems unlikely since in such a small space the pillar would be more of a hindrance than a help and would make both firing and cleaning out the kiln difficult.

It is possible that Kiln 4 [10239] (Plate 3.14) was also used for pottery production, as it has all the features associated with pottery kilns, and there is some evidence to suggest the springing of its perforated floor. This kiln is comparable with the other two, and is situated very close to Kiln 4. It is not possible to determine whether Kiln 4 and perhaps 6, are the original kilns for the workshop and that they were replaced by Kiln 1 when the industrial phase was coming to an end, or whether all were contemporary. If any of these kilns was used contemporaneously then it might be assumed that production was on a significant scale, a view which might lend weight to the idea that further clay preparation pits might originally have been present at the workshop but have now been destroyed.

However, if we are to see at least some division of crafts at O45.1 then it may be possible to see Kiln 4 as being largely for the production of faience. Which kilns served to produce the fired clay moulds for faience production is uncertain. There is one unfired mould, object 31973 (Plate 8.5), unhelpfully it comes from J80, at a distance from any of the likely kilns. However, their appearance in that square, on the southern edge of the workshop, suggests that as well as producing vessels the potter here was

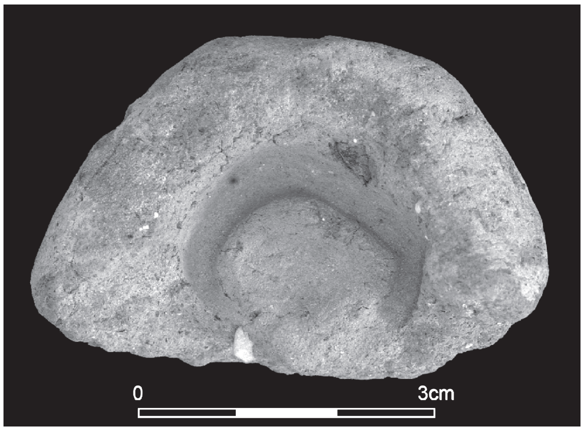


Plate 8.5. An unfired mould for producing a faience object (31973). (Photo: Anna Stagg/E.E.S.).

producing moulds for the production of faience by his colleagues. It might also argue for the abandonment of the pottery workshop at virtually the same time as the other industrial structures, since it would be expected that unfired clay would be recycled, and that if the production of faience were ended significantly earlier than that of pottery then there would be little chance of unfired clay moulds surviving.

The question of fuel used is an interesting one. Where Dr. Gerisch has been able to identify charcoal samples (Appendix 3) from the kilns/furnaces, the largest samples have come from Kiln 3, and have been from *Acacia nilotica*. However, it is fair to say that this is much the most common type of charcoal found across the site. It might be suggested that acacia was more common in the region around Amarna than it is today.

It is worth considering the provision of fuel to the pottery workshop, and indeed the glass and faience manufactories at O45.1. In a country with relatively little woodland, fuel must be considered an important limiting factor for high temperature industries. However, we know that these flourished at Amarna, and indeed elsewhere. In the case of O45.1, if we are right to regard this as being linked directly to the Palace there would be no difficulty in fuel being provided, even if it had to be brought in from increasing distances. However, it is also worth considering that the workshops here operated for only a short period of time and that firings were probably not a daily occurrence. If rubbish was being burned as well as wood, then the fuel situation might be less critical than modern thinking might suggest. Experimental work has shown that when palm fronds are burned they leave no charcoal, only a very fine ash. If palm were a fuel source then it may not be easily recognisable, even though it could have provided a useful fuel supplement. There is some evidence that refuse may have been burned in the form of bone from Kiln 1 ([8034]) where there are some 19.1 grams of burned and broken fragments, from Kiln 4 where there are bones from [8979], [9002] and [9010], a small proportion of them showing signs of burning. Kiln 6 also has some animal bone from units [9481] and [9484] but this is not obviously burned.

We do not currently know how far beyond the excavated limits of the site workshops extended around site O45.1, but it does seem very likely that they were more extensive than so far unearthed. That being so, it is quite possible that there were woodworkers in the vicinity, and that waste wood from their activities may have been available to the potters, glass- and faience-makers. Just as modern Egypt has a developed system of unofficial recycling it is likely that similar provision may have been made anciently, particularly in what may have been a group of workshops controlled by the state.

Endnotes

1. Filler is frequently referred to as "temper", "grog" or "opener". Its effect is to make the clay less sticky and to "open" the body to air, helping it to dry more quickly and evenly, and helping steam to escape from the body during firing.
2. I am indebted to Boris Trivan for providing a database of the unfired sherds recovered from the excavation.
3. Not including the restored hearth which comprises 22 sherds.
4. This interpretation seems more likely than the possibility that the fragment is a peculiarly conical jar seal. The fabric also seem more consistent with the other unfired sherds than with those normally found on jar sealings.

Chapter 9

Conclusion

In concluding the examination of the site of O45.1 one must offer a view as to its purpose and its social status.

In my view the evidence supports the idea that O45.1 was more than a workshop for the working of glass into objects, and for the making of faience and pottery. My reasons for drawing this conclusion are as follows:
(1) Scale. The O45.1 site cannot be described other than as an "industrial estate". The concentration of kilns and furnaces makes it clear that this is not a small scale operation serving small scale needs.
(2) Nature of the facility. O45.1 has five kilns or furnaces and what is probably a hearth ("Kiln 5") all situated within a 20m x 20m square. Two of these structures are of a size and complexity of construction thus far unknown from anywhere else at Amarna, or indeed Egypt so far as I am aware. This concentration of substantial kilns is otherwise unknown at Amarna.

The evidence for the production of glass from its raw materials at Amarna may be summarised as follows:
(1) The presence of two large furnaces (Kilns 2 and 3) which are here interpreted as glass furnaces, and which are demonstrably capable of reaching the temperatures necessary to make glass (Chapter 4).
(2) The relative paucity of finished glass products. The site has yielded pieces of glass, fragments of cylindrical vessels and large amounts of "slag" from the operation of the furnaces. This slag is not found on those pottery kilns known from Amarna thus far, though it could conceivably come from the production of faience. However, since other sites producing faience are known from Amarna, but lack structures akin to Kilns 2 and 3, it may be assumed that the slagged furnaces at O45.1 may be connected to the production of glass rather than faience, and operated at temperatures higher than those needed for faience. Glass rods or canes, and fragments of finished objects are few in number, less common than at other—probably secondary—workshops at Amarna. It is possible that glass inlays were produced at the site, but this remains uncertain.

The question of the status of the O45.1 site is open to question. However, I would see it as being a site under the control of the state. My reasons for this are as follows:
(1) Scale. Whilst it would not be impossible for private individuals to set up workshops for pottery, faience and glass, no other similar installations have been found amongst the villas at Amarna. Workshops for crafts have been found, but never on this scale or density. In this regard, Woolley's (1922:64) comments that "there were no workshops" is perhaps significant, since here we have evidence of a workshop for pottery, with furnace installations for a whole range of crafts, much more than the single kiln in a courtyard as represented at sites like M50.14 (Peet and Woolley 1923:19).

(2) Preferential access to materials. If we are correct in seeing O45.1 as a primary producer of glass, it would seem that its main product was cobalt blue glass. The cobalt from this comes from the Oases

of the Western Desert, and may well have required expeditions to go and collect it and bring it to the site. This would probably have been beyond the resources of all but the most powerful individuals. Similarly, the furnaces and kilns would require substantial amounts of fuel, and this is unlikely to have been available in the immediate locale. It is therefore likely that some means of supplying fuel from a distance must have been arranged.

(3) Type of product. There are few significant finds of glass objects from O45.1. The number of glass beads is deceptive, as some of them are likely to be faience which has become glass because of the small scale of the artefact. There are very few glass rods or canes which might be expected if this was a centre for the production of vessels, ear-decorations or the like. The faience objects are more difficult to interpret, but the moulds are mainly for producing geometric shapes, rather than amulets, and amongst the products are inlays of a scale sufficient to suggest that they were intended for use in architecture. Patch (1998) has convincingly argued that with the exception of jewellery elements and inlays which have fallen from architecture or furniture, finds of faience are relatively rare in houses at Amarna. She suggests that larger pieces of faience might have been for funerary use, including elite burials. The pottery is more diverse, but it is likely that the workshop produced the cylindrical vessels as well as domestic wares.

(4) Chronology. The site's stratigraphy suggests that it belongs to an early phase in the development of the city, and it may well be that it is contemporary with the construction of the *Hwt-Aten* and other buildings immediately to the north of the site. It may be that the workshop was levelled when these were complete, and its location moved elsewhere at Amarna or production abandoned. The finds suggest that faience was the main material being produced for inlays, but this may be deceptive since failed glass pieces could be re-cycled and so leave little evidence. There are a few finds of glass ribbon, probably intended as inlay, and it may be that this was one of the few “secondary” products being made at the site. That the primary making of glass took place at a site where faience inlays were also being produced may not be such an unusual situation as it might first appear. If the workers were regarded as producers of “vitreous materials” the same individuals might produce raw glass under state control, and produce faience inlays for state projects. The glass might then be issued to workshops whose purpose it was to produce actual glass objects. It is quite possible that work areas extend beyond the site as excavated, in which case glass working areas may remain to be discovered.

(5) Location. The situation of O45.1 would be a convenient one for the supply of materials to the State building projects to its north. It would also be sufficiently far from them that smoke from the site would not be a nuisance to those working on the buildings. The northerly wind would similarly help to blow smoke away to the south. Kemp has pointed out the proximity of O45.1 to the river, and it is possible that this location was deliberate, a convenient way to receive bundles of fuel for the furnaces. It could also have provided an easy route for the export of primary glass ingots destined for workshops elsewhere in Egypt and beyond.

I see this evidence as pointing to O45.1 being under State control. The site flourished whilst major construction works were underway, but was put out of use by later building. The workshops might then have shifted to a location elsewhere at the site. It is unclear whether all of the slag and glass waste from the Palace Dumps originally came from O45.1, or whether it stems from a workshop closer to the Dumps themselves, perhaps the second phase of production at Amarna, after the workshop was moved. The grouping together of workmen skilled in the production of high temperature, vitreous, materials might also be seen as the hand of the State, rather than of a private individual. For the moment the areas to the east and west of the O45.1 excavation trenches remain unknown, but it would not be surprising to find that other crafts might be located there.

The question of state control begs the further question of the status of glass overall. It has been shown in earlier chapters here that glass was, from the earliest times in Egypt, a material of royal interest. It has even been seen as being a royal “monopoly”, although a modern economic concept of this type is difficult to defend when applied to ancient Egypt. It might be better to regard the production of glass from its raw materials, that is primary glass production, as being an industry which was difficult and expensive to establish, and thereby beyond the scope of all but the king/state. Needless to say the reason for establishing such a novel industry would be the creation of novel and expensive items, and the craftsmen who produced them need not always have been the same ones who produced the raw glass, any more than we might expect a present day cabinet maker to have been responsible for growing his own timber. As a result we should expect to find that at least some of the glass is distributed to secondary workshops in the city, for example at Grid 12 (Kemp and Stevens forthcoming).

This redistribution of glass raises the further question of its final destination. If glass was being worked at several locations at Amarna, as it appears to be, then not all of it was destined for royal use. As is well known, by the time of Amarna, glass was being more widely used by the elite, albeit for relatively small items such as perfume vessels and earrings. Kemp (pers. comm.) has also suggested that it might be more widespread than is generally supposed, and that it was therefore commonly available. He bases this argument on the regular finds of pieces of glass on the surface at Amarna and from houses other than the villas. The famous glass fish[1] itself comes from a non-elite house (N.49.20), and Kemp suggests that it may have belonged to an "ordinary" person. Whilst it is quite possible that individuals regularly hid valuables under the floor of their houses, at least in uncertain times, the piece may have been looted and left for later retrieval, although its location beneath a "double plaster floor" (Peet and Woolley 1923:24) might argue against that. Its size and quality suggest that it was destined for someone of status. However, we know that high status gifts were sometimes given to individuals of modest status, as with the silver vessel of Kha (TT8) which contained an electrum cup of Amenhotep III, and a gold cubit-measure of Amenhotep II (Porter and Moss 1960:18), and it is quite possible that glass found its way to non-elite individuals by this means. Whatever its origin it was clearly regarded as sufficiently valuable to be worth concealing in uncertain times. Individuals of relatively modest status might also have obtained glass directly, as some vessel forms are relatively common. However, I do not see glass as a material that was—in practice—available to all. Some anecdotal support for this view comes from a statement made by Lord Carnarvon to the *Daily Mail* (1-12-1923) concerning the robbery of the tomb of Tutankhamun:

> "There is absolutely no doubt that the tomb was robbed…I think, strangely enough that glass was taken too because…I did not see any glass and in the passage leading down we found two bits…proving that glass had certainly been there and was either broken going in or coming out." (Quoted in Reeves 1990b: 200)

Carter's record card for object number 315 (www5) from the tomb records a box containing only packing material, which he thought had probably been intended to contain, now stolen, glass. Carter's comment under remarks "DAM!!!" [sic] summarises both his interest in ancient glass and the apparent rarity (in this case absence!) of it.[2] The tomb of Yuya and Thuya (KV46) was, when compared to tombs such as that of Kha, also lacking in glass following robbery (Reeves 1990a: 149, Patch 1998: 36).

Nolte (1968:13) states that glass vessels may sometimes be sufficiently valuable to attract theft, and so might be broken at the time of burial to lessen the risk of robbery. However, she also notes (1968:12) that even sherds might be sufficiently valuable to be worth stealing from tombs.

That glass was never "common" in any context is similarly shown by its relative rarity in museum collections. The time consuming nature of vessel production must always have made glass a relatively expensive commodity, and where it was available to the least privileged in society it is likely to have been so only in the form of small beads.

The proposed excavation of a non-elite cemetery at Amarna may throw further light on the distribution of glass amongst the less privileged in Amarna society.

Summary

In summary, it may be said that site O45.1 offers a so far unique picture of the concentrated production of vitreous materials by specialist craftsmen at Amarna. Glass appears to have been made at the site from its primary raw materials, although the working of glass at the site is less certainly attested. Faience was certainly made there, mostly in the form of inlays, whilst a pottery industry served not only the needs of these two crafts but also seems to have produced vessels for more general use. That an unfired breadmould is known from the site may suggest that it, at least occasionally, produced vessels intended for offering use. Whether this production was anything more than occasional must, for the moment, remain unknown. However, if it was significant this would add further weight to the argument that site was one under State control.

Whilst Petrie's views on the production of glass and faience at Amarna require considerable modification, it is clear how he arrived at them, and his conclusions are broadly correct. It may be hoped that at least some of the conclusions set out in this volume are similarly correct.

Endnotes

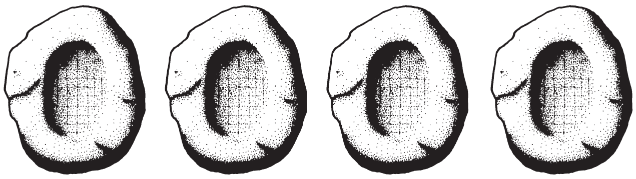
1 BM EA 55193. Petrie (1891: 16-18; 1892: 132-133) similarly found glass buried beneath floors at Gurob.

2 For the details of the card see www5, and Reeves 1990b:202.

Appendix 1

Geophysical Report

Ian Mathieson
Director Saqqara Geophysical Survey Project,
Glasgow Museums.



Introduction

A geophysical survey was undertaken at Amarna over several years as part of the Egypt Exploration Society's Amarna project directed by Professor Barry Kemp. In April 1992, as part of that work, the survey included the area immediately south of the modern water tower, in the area of O45.1 (see Map 3.2). This work was undertaken in order to test the possibility that this could have been an area for the production of vitreous materials, and in order to guide the work planned by Paul Nicholson in 1993.

Methodology

Magnetometry (see Clark 2001:64ff) has been used in the field of archaeology since early 1960 when the method was used to locate Etruscan tombs in Italy. There are various types of instrument which lend themselves to archaeological field prospection, the flux-gate and gradient magnetometers, the single-sensor proton-magnetometer and the double-sensor differential proton-magnetometer.

All of them, by using the magnetic field of the earth as a base, attempt to measure modifications to the earth's surface static field caused by local ore bodies, metallic iron or the small but measurable anomalies caused by ancient foundations, graves, pottery, kilns or ovens, hearths, cavities or changes in sub-surface materials. The searcher is fortunate that the magnetic field of the earth changes during the passage of time, and that the firing of clay or the destruction by fire of a site tends to freeze the magnetic field existing at the time of the event.

The magnetic field of the earth, though very weak, is easily measured and averages about 50,000 gammas,[1] the international units for measurement of the earth's magnetic intensity.

Diurnal changes can vary between very small amounts of 1 or 2 gammas to as much as 100 gammas during a solar magnetic storm which can last for several days. For research work in Egypt where structures can be at depths of up to ten metres, a double-sensor *Liebhazet differential proton-magnetometer* manufactured by M.L. Dalton Research of Dallas, Texas, U.S.A. was chosen (Plate A1.1). This instrument, allows the calculated value of the earth's magnetic field intensity to be used as a calibration factor at the geographic position of the survey site.

By fine tuning the instrument, a difference of O.5 of a gamma may be detected by using a beat frequency introduced into the decay sequence of the protons as the separate sensors. This enables the surveyor to field walk to a grid pattern knowing than any anomaly will be indicated immediately by the audio beat, digital meter or strip recorder.

For the survey of the area in question the instrument was calibrated at 425000 gammas and fine tuned to a maximum response at each portion of the site. An addition to the recording equipment of the survey was the purchase of a *Model 142*, strip chart recorder, manufactured by *Linear Incorporated*, U.S.A. which

Plate A1.1 Double-sensor Liebhazet differential proton-magnetometer manufactured by M.L. Dalton Research *of Dallas, Texas, U.S.A.*

enables permanent records to be kept of all anomalies found during survey.

Fieldwork

It was assumed that the area of "moulds" shown in Petrie's *Tell el-Amarna* (1894:Pl. xxxv) correlated with the area south of the water tower, where lumps of ''slag'' consistent with high temperature firing had been found. A trial profile was observed with the proton-magnetometer. At a position some 15m from the start, extending the 30m mark and located within the area of slag fragments, beat frequency signals between 2 and 10 were observed. A 12 by 16m grid was laid out covering this area and measurements taken at each one metre grid point.

Figures A1.1, A1.2 and A1.3 show the results which indicate very clearly the location of the kilns which, subsequent excavation has revealed, were responsible for the slag fragments found on the surface.

For the 1991 survey a linear graphic paper recorder was used to obtain a record of the anomalies observed and record the amplitudes.

Conclusions

The results of the research have been highly satisfactory and the magnetometer has proved to be a very useful addition to the armoury of the geo-archaeologist when used in the physical conditions of this survey area.

At site O45.1 five hours of survey located the kilns which subsequently served as the focus of the first two seasons of excavation at the site.

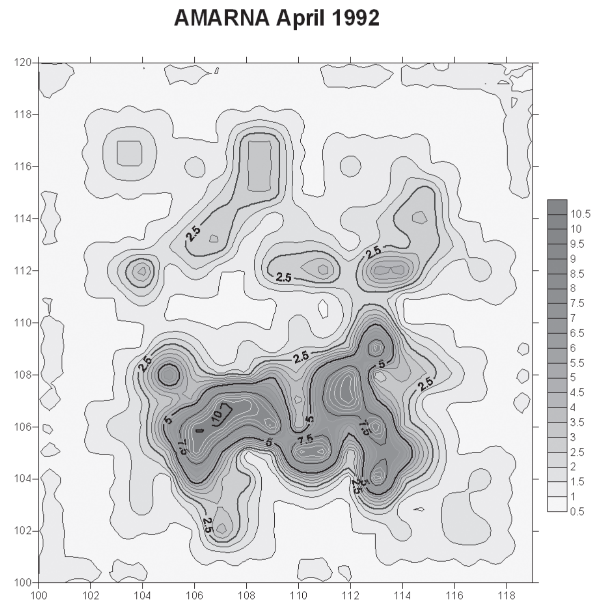


Figure A1.1. **Petrie Kilns Proton Magnetometer Survey April 1992**
High readings indicate strong magnetic anomaly

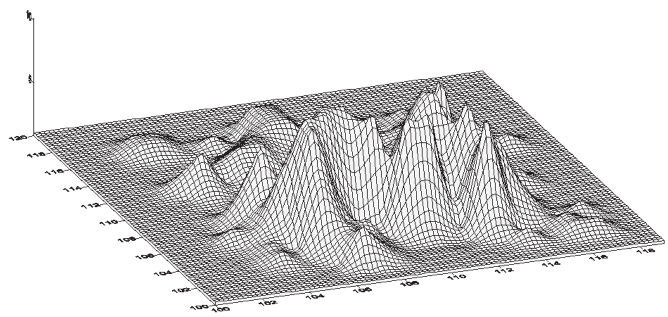


Figure A1.2. **Petrie Kilns Proton Magnetometer Wireframe Plot**

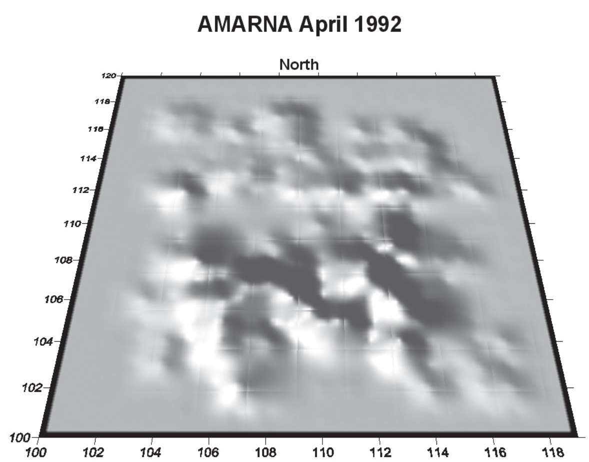


Figure A1.3. **Petrie Kilns Proton Magnetometer Survey**
Perspective shaded plot

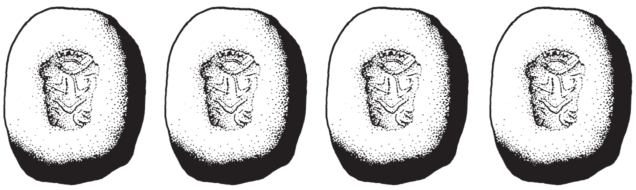
Endnotes

1. Or nanotesla - (nT) = 10^{-9} tesla (T) in the SI system.

Appendix 2

Report of the Faunal Material from Site O45.1

Phillipa Payne
Cambridge University



Introduction

The material included in this report comes from the Main City or "Industrial Area" of the city of *Akhetaten*. The four seasons of excavation (1993, 1994, 1998 and 2003) have produced a total of 2248 animal remains, with a total weight of 9318.9 grams. Of these 29% (656 elements) could be identified with some certainty to species and/or element of the animal represented (Table A2.1.) These animals were all of Ungulates except for *canis* remains from the carnivore group. The bones were collected during excavation using a 5.0mm sieve. The total of 2280 animal remains omits 38 bird bones weighing a total of 29.9 grams and 100 fish bones from all parts of the anatomy weighing 45.7 grams.

Category	Number
Identified mammal	365
Unidentified mammal	58
Identified to animal size group	233
TOTAL	656
Fish	86
Burned fish	14
Bird	33
Burnt bird over 10%	3
Less than 5cm	568
Less than 5cm, burned over 10%	365
Ribs	12
Burned Ribs more than 10%	6
Shaft fragments	113
Non-diagnostic burned	372
Tooth	20
TOTAL	2248

Table A2.1. Total animal remains.

Analysis of identified remains

Excluding the possible gazelle, these categories cover animals all known to have been domesticated in the city at the time of deposition (Table A2.2.). The *Capra/Ovis* may be expected to contain some examples of gazelle but "deer were rare in ancient Egypt" (Osborn and Osbornova 1998:153) and may even have been extinct by the 18th dynasty. The *gazella* category is also likely to be gazelle, as they can graze a natural habitat of semi desert and of desert. Gazelles are also among the fauna depicted in the Middle Kingdom tombs at the nearby site of Beni Hasan. However the reference collection is not extensive enough to rule out other desert dwelling small antelope.

Species	Number of elements
Bos sp.	183
Capra/Ovis sp.	83
Sus sp.	50
Canis sp.	23
Capra sp.	10
Equus sp.	10
Gazella? sp.	4
Ovis sp.	2
TOTAL	365

Table A2.2. Analysis of identified remains

A large number of fish remains have been excavated from the in another part of the city (Payne 2004), making them likely to be an important food group. Work has been done by R. M Luff with regard to the fish remains from the site (Bailey and Luff 2000).

Where a definite identification of animal species was not possible the bones were grouped into size bands (Table A2.3.) with a remainder of 58 that lay between two bands. The "Large Ungulate" group is likely to consist of cattle but the bones were too fragmentary to be certain that they did not belong to an equid or to possibly a large antelope. The "Medium Ungulate" group can probably be assigned to *sus* rather than to ruminants.

Species size	Number of bones
Large ungulate	113
Small ungulate, *Canis sp.*	75
Medium ungulate *Sus sp.*	40
Small carnivore	5
TOTAL	233

Table A2.3. Grouped identities.

Damage

Bone came from 257 contexts across every square of the grid but in 75 of those contexts the bone was too badly damaged to allow further identification. The identified total of 656 also contained many bones that were badly damaged. Over a third (43%) were represented by less than 10% of the whole bone and over half (60%) were less than 50% present. Work remains to be done regarding the ancient and modern damage differences but much of the damage appears to have occurred pre-deposition. From the initial count of 2248, 2 subcategories were identified of elements less than 5cm, divided into pieces not burned and pieces over 10% burned. 578 fragments with an average weight of 1.3 grams each were recorded across the site in the first category and 370 fragments weighing an average of 2.8 grams were burned beyond recognition. The fragmentary nature of the collection means little information is available about a minimum number of individuals at the site, or about how many elements are articulated.

Of the 656 identified remains, 39% had been burned, possibly used as fuel for the several kilns found in the area.

Gnawing marks made by rodents or carnivores were rarely seen in the sample, only four bones exhibited signs of carnivore damage and an additional one may have been gnawed by a rodent.

No bone tools were identified.

The poor state of the assemblage, both in terms of the state in which it was deposited and the weathering from the soil, may account for the lack of visible butchery marks. Only 13 bones show definite signs of cut marks and all in this group had less than ten marks. These marks were drawn to allow the future possibility of identifying either an individual hand in the work or of understanding how the animal was killed (Luff 1994).

Ageing

The age spread of the animals was estimated to neonatal, young, adult or old adult (Table A2.4.). Fusion of epiphysis, where such information was available, was primarily used, as was tooth wear and adult or milk dentition. None of the assemblage preserved enough horn core to use this as an ageing method. Tooth wear stages were recorded using Annie Grant's guide (Grant 1982), where some error is to be anticipated as she was recording modern domestic animals.

Species represented were all domesticates, except the gazelle (?) category, but no work has been done as to whether the elements present did come from domesticated animals.

Catalogue of Individual contexts

The following 5 areas of the site were singled out for individual discussions at the time of excavation. All 5 pre-date building 045.1.

9009 A donkey "burial" square M75

This context contained almost a complete skeleton of a donkey in anatomical position, excavated in 1994. The cranium, inominate and both scapular were unavailable for analysis owing to damage post excavation in the site storage area. Enough material remained to conclude that they had been present at deposition, and excavations photographs show the skull in anatomical position. The mandible was complete with all teeth in occlusion suggesting an age of possibly 5 years old. The vertebral column was also complete (7 cervical, 18 thoracic, 6 lumber, 5 sacral and 11 caudal)

Age	Small ungulate	Medium ungulate/*Sus*	Large ungulate	*Gazella?*	*Canis*	Total
Neonatal	1	2	2	4	0	9
Young	78	47	134	0	0	259
Adult	30	12	42	0	18	102
Old adult	0	4	1	0	0	5

Table A2.4. Age breakdown.

although many of the individual elements had been badly damaged particularly in the lumber and thoracic region. The fore limbs were complete and all long bones fused.

It is possible to estimate the age of the animal at death using a combination of epiphysial evidence and tooth wear. According to both I. A Silver (1969) and to E. Schmid (1972) the humerus proximal epiphysis fuses between the ages of three and three-and-a-half years, as do the tibia and femur proximal epiphysis. This individual therefore must be over this age. The minimal wear on the teeth however suggests that the animal may be somewhat older. The latest of the teeth to erupt are P4 and M3 at three-and-a-half and the canine at four to five years (Schmid 1969).

The limb bone measurements can be used to calculate the height of the animal but this was not done in this case as little remains with which to compare the outcome. The vertebrae did not exhibit any interesting pathologies.

8076 Human Skeleton square L85

This context contained a human skeleton and five animal bones. Two of the animal bones were undiagnostic, one weighing just 0.4 grams. The total weight of the animal elements was 54.1 grams. The three identified elements came from a large bovid of indefinable age. The astragalus was whole but only 10% remained of the vertebrae and of the third phalanax. None of the bones had been burnt or exhibited butchery marks. If the astragalus had come from a joint of meat where the whole leg was buried, the astragalus would be partly protected during butchery by the calcaneus, so may have escaped damage in this way.

Kiln 2 Square L80

This kiln had five separate contexts, and animal bone was found in the lower two and the top fill.

8066

This context contained a total weight of 77.2 grams of bone, one totally calcined rib and 25% of a bovid scapula, which was very badly weathered and despite its position was unlikely to have been burned.

8067

This context contained a total weight of 75.5 grams of animal bone but none of it was burned. An *Ovis* distal epiphysis and the third/fourth metapodial of a bovid point to use as food, as does a rib shaft, but the lumber vertebrae of a caprid sized animal could represent *Canis* and could not be more securely identified.

8071

This context contained just 4 grams of animal bone, none of which was burned. The two bones were *Ovis* or *Capra* femur and were articulated, an unfused proximal epiphysis and the shaft from the same individual. The femur proximal epiphysis and shaft is estimated to fuse between three and three-and-a-half years of age putting this individual under this age bracket (Schmid 1972).

Kiln 3 Square L80/M80

This kiln had three contexts with bone being found in only one.

8991

This context contained two bovid bones that were also not burned. They may have come from the same individual, as both are young. The third and fourth metatarsal had fused together but the distal epiphysis was missing. This is thought to fuse between the ages of two and two-and-a-half. The second phalanx was also unfused and this is thought to fuse at the age of one-and-half to two (Schmid 1972). If they are the same individual, then the lower end of this age range is to be expected.

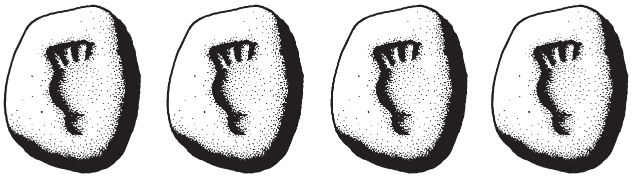
7974 Pit area

This area was a single context that yielded a variety of bones with a total weight of 24.5 grams. Of this two were fish bones and one was possibly lizard skin. A pubis shaft from a large animal of *equus* or *bovid* size had been carbonised over 90% of the surface, and a bovid carpal had been calcined over 100% of the surface. The other eight bones were not burned, and were mostly under 5cm at their greatest measurement.

Appendix 3

Charcoal Remains

Rainer Gerisch
Systematische Botanik und Pflanzengeographie,
Freie Universität Berlin



Introduction

During three seasons of work for the Amarna Spring Expeditions[1] in 1998, 2005 and 2006, wood anatomical research was carried out on behalf of Paul Nicholson's *Amarna Glass Project*. Analyses were conducted on the abundant charcoal material found during the excavations of the industrial area at O45.1, of the Main City. The samples were recovered from the 1993, 1994 and 2003 autumn excavations and are stored in the S.C.A. magazine of the Amarna dig house.

Six kilns/furnaces were uncovered at O45.1, among them two large, roughly circular structures, c.2.0m in diameter. They are characterised by thick heat insulating walls, and a thick filling of slag (Kilns 2, 3) and a lining of "sacrificial render". These kilns were believed to be furnaces capable for the manufacturing of glass from its raw materials. One of three kilns, fairly typical of pottery kilns at Amarna, had an associated workshop with a trampling floor and a clay puddling pit (Kiln 1). The two others may also have been used for the firing of pottery or the making of faience (Kilns 4, 6). Another structure is probably a hearth, and survived to only one course and could have served for working glass or for metallurgy (Kiln 5) (Kemp and Nicholson 1995, 1997, Nicholson 2004, 2005). The industrial area is overlain by a later building leading to the notation of the site; underneath the area human burials were found.

The charcoal material examined comprises 93 samples containing 6,980 pieces (8,104.4 ml) from squares K80, K85, K90, K100, K115, L75, L80, L85, M75, M80 and M85 in grid 8. Of these, 6,122 pieces (7,770.1 ml) are identifiable pieces of wood charcoal, the remaining portion is unidentified wood charcoal as well as bark charcoal. The charcoal was recovered by hand selection and through dry sieving. The largest amount of charcoal was found in feature [8995], compact grey ash with charcoal and burned limestone in the base of Kiln 3, consisting of 2,613 pieces (2,786.5 ml), followed by feature [8071], ashy layer in Kiln 3, with 442 pieces (370.5 ml), feature [9020], rake out material from Kiln 2, 416 pieces (592.2 ml) and feature [8033], a deposit underlying a unit of lime, some mud patches and brick with ash, 408 pieces (598 ml). Additionally to the loose charcoal, charcoal inclusions embedded in larger-sized slag lumps were studied by taking off small pieces for identification from several places of the lumps. Most of the lumps were found in square M80, feature [8068], a slag layer in Kiln 3 at SW corner of L80, one in square L80, feature [7974], a refuse deposit, possibly industrial in origin, and one from surface cleaning in square M75, feature [8976].

Microscopic analysis revealed nine wood taxa (Table A3.1), among which the Nile acacia (*Acacia nilotica*) dominates with about 95%, and occurs with 5,825 pieces (7,391.6 ml) in 92 samples; the percentage of presence amounts to about 99%. All other taxa form only 5% of the total. The tamarisk (*Tamarix* sp.) is represented in 26 samples (130 pieces, 142.8 ml), the percentage of pieces is 2% and the percentage of presence 28%, acacia (*Acacia* sp.) in 20 samples (68 pieces, 83.8 ml). Sycomore fig (*Ficus sycomorus*) is contained in 10 samples (45 pieces, 63.4 ml), white acacia (*Faidherbia albida*) in 5 (30 pieces, 48.2 ml). The remaining taxa, mimusops (*Mimusops* sp.),

TA MC, Industrial area O45.1 Charcoal / Wood taxa	Presence [spls]	Count [pcs]	Volume [ml]	Weight [g]
Acacia nilotica-type	92	5,825	7,391.6	3,412.3
Acacia sp.	20	68	83.8	42.3
Balanites aegyptiaca	4	7	20.5	7.2
Cedrus libani	2	2	3.5	0.8
Faidherbia albida	5	30	48.2	19.4
Ficus sycomorus	10	45	63.4	22.2
Mimusops sp.	6	13	12	6.1
Palmae	2	2	4.3	2.9
Tamarix sp.	26	130	142.8	55.1
	93	6,122	7,770.1	3,568.3

Table A3.1. Anthracological spectrum from the industrial area at O45.1, Main City.

balanos (*Balanites aegyptiaca*), cedar of Lebanon (*Cedrus libani*) and Palmae occur in 2–4 samples with only a few pieces (Figs. 1–3). In the slag lumps, exclusively charcoal from Nile acacia was found. Bark charcoal was present in 27 samples: in 18 of them only in 1–4 pieces; the largest amounts, 556 pieces (201.5 ml) and 90 pieces (31 ml), occurred in features [8995] and [8071] of Kiln 3.

The charcoal composition is rather homogeneous; in half of the samples only 1–2 taxa were identified. This concerns partly samples with a small number of pieces, but also larger samples directly connected with kiln fills, which consist almost exclusively of charcoal from the Nile acacia and to a very small extent of tamarisk, namely from the features [8071], fill inside Kiln 3, [8991], sand top fill of Kiln 3, [8995], grey, ashy deposit in base of Kiln 3, [9010], fill of Kiln 4, [9033], fill of Kiln 5, [10224], industrial waste. The identifications demonstrate that the Nile acacia was practically the only fuel wood used to fire the kilns. A greater taxonomic diversity of the charcoal assemblage can be observed in square M75, feature [8981], deposit, immediately under top soil, stony with pottery and charcoal, and square M85, feature [10214], natural, yellow sand under contexts in L85, with 6 or 7 taxa per sample, respectively (table A3.2). In comparison, other investigated areas of Amarna revealed the following results up to present: Workmen's Village: 22 taxa (140 samples, 24,146 pieces), Main City / workshop area, Q48.4: 21 taxa (59 samples, 14,464 pieces), House of Ranefer: 13 taxa (76 samples, 12,141 pieces), Grid 12 excavations: 13 taxa (55 samples, 9,513 pieces), Central City: 14 taxa (100 samples, 9,441 pieces). Further, the amount of tamarisk charcoal is greater than in the O45.1 material. A survey of woody plants identified in fuel material of Amarna is given in Gerisch (2004).

The trees and shrubs, which have been identified from O45.1, were all available in the country with exception of the cedar. The high frequencies of Nile acacia in the samples can be due both to the importance of the tree in the landscape and to preferential cutting of this wood. The once abundant natural stands along the Nile were important sources for fuel wood as well as for prefabricated charcoal. The wood of the Nile acacia represents an excellent fuel characterised by a strong, heavy heartwood which burns steadily and slow with high calorific value (4,950 kcal/kg) and only little smoke when dry. As timber it was used to a great extent for boat and ship building, furniture, coffins, statues, tools and dowels. The Nile acacia is a 2–14m high tree or shrub with a dark stem, bipinnate leaves and bright, yellow flowers clustered in round heads. The pods with their characteristic indentations are up to 15cm long containing 30% tannin (Germer 1985:90–91). The tree is widely distributed in subtropical and tropical Africa, from Egypt southwards to South Africa and in Asia eastwards to India.

Among other indigenous trees represented in the charcoal spectrum are the tamarisk, the white acacia and the balanos tree. The two most widespread species of tamarisk in Egypt are *T. aphylla* and *T. nilotica*. The halophytic shrubs or small trees with scale leaves and minute flowers in dense racemes grow on saline, sandy soils, edges of salt marshes, coastal sandy plains, along Nile and channel banks. Their wood also represents an important source for fuel in ancient Egypt, however, of less quality in comparison with that of acacia. It burns more quickly and with smoke. The white acacia, a tree of up to 18m height, is distributed in tropical and subtropical Africa, Palestine, Arabia, on the Nile and channel banks in Egypt and the Sudan. In the Egyptian Nile valley it grows only between Aswan and Qena. The balanos tree is a 4–10m high, shrubby tree growing in

Appendix 3

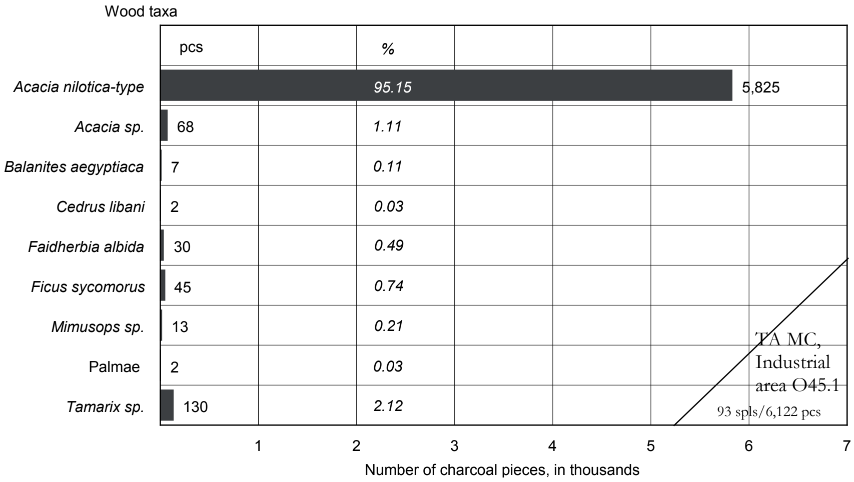


Figure A3.1. Number of pieces and percentage for the identified wood taxa.

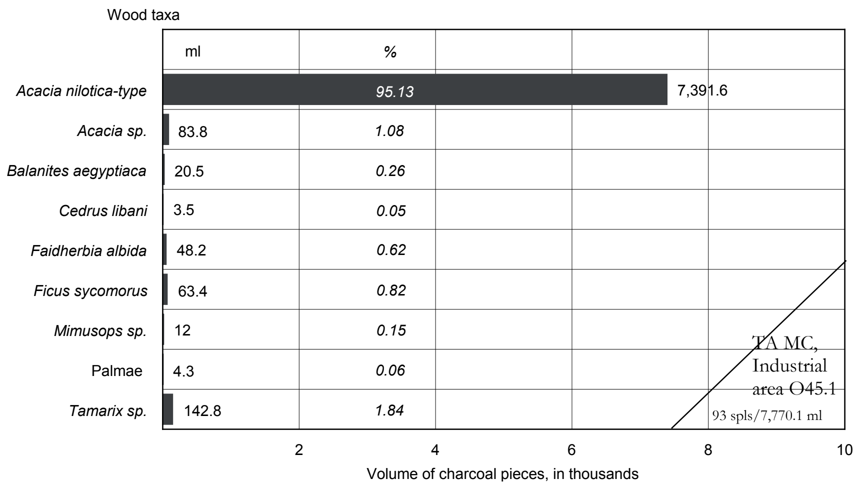


Figure A3.2. Volume of pieces and percentage for the identified wood taxa.

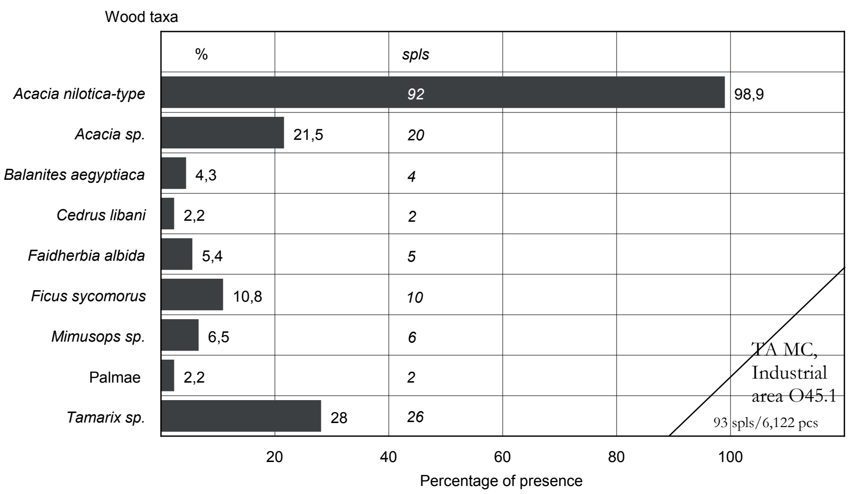


Figure A3.3. Number of samples and percentage of presence for the identified wood taxa.

tropical Africa, Egypt, Palestine and Arabia, nowadays rare and decreased in Egypt; it occurs in desert wadis and plains and only occassionally on the Nile banks. The hard and durable wood of the thin stems mainly served as fire wood. Since Predynastic times, the fruits and the oil obtained from the seeds were used. *Acacia* sp. includes several species which have wood anatomical features in common, among them are *A. ehrenbergiana*, *A. raddiana*, *A. tortilis* growing on sandy plains and in desert wadis, and also *A. nilotica* with indistinct feature characteristics.

The sycomore fig and mimusops have been cultivated on the Nile and channel banks and in gardens. The sycomore fig was one of the most important trees in ancient Egypt valued for its many uses. The fruits developing in clusters around the trunk and branches were eaten fresh or dried, they also were added to bread and cakes. The pale, light wood was used for coffins, sarcophagi, statues and building material. The tree has been introduced to the Nile valley very early. It is found in tropical Africa, the Nile valley, in Palestine and along the eastern coast of the Red Sea to Yemen. The sycomore represented a popular shade tree and was associated with the goddess Hathor. Mimusops was also an important and frequently occurring garden tree with a dense foliage and tough leaves; the fruits contain a sweet edible pulp. Twigs and leaves were often present in tombs. *M. laurifolia* is the most common species; it is assumed that in the New Kingdom also *M. kummel* was cultivated. Both species are growing nowadays in the highlands of Ethiopia and Yemen. Leaves and twigs were used in funeral garlands and bouquets. The tree is uncommon in Egypt today and occurs only occassionally in gardens (Gale *et al*. 2000:340–42, Schoske *et a*l. 1992:8).

The precious timber of the Lebanon cedar, used for boat and ship building, construction work, furniture and coffins, was imported since the Early Dynastic period from the eastern Mediterranean. The tree is native to Lebanon, Syria and southern Turkey. In the mountains of Lebanon extensive forests were found. The cedar is an imposing tree up to 20–35m high with large, widespreading horizontal branches and a broad, flattened crown, in dense stands growing straight and narrow. Some trees can reach an age of more than 1,000 years. Uncontrolled cutting in antiquity led to a widespread deforestation and only relicts of the original forests are still preserved. The two charcoal pieces of this timber probably derived from wooden remnants.

The question of whether fire wood or prefabricated charcoal served as fuel for the kilns cannot be answered easily. Looking at the recovered fuel material, the few remains of uncharred and incompletely charred wood and bark as well as the large volume of loose bark in feature [8995], Kiln 3, could more likely be an argument for the use of wood. Also some charcoal pieces in longer lengths and impressions observed in the slag material point in this direction. In principle both, wood fires and charcoal fires can be used for the production of glass, faience and pottery. Without artificial air supply wood fires can generate temperatures of about 700°C. Fires from charcoal can achieve about 1,000°C. In kilns, furnaces, or hearths, which allow an artificial ventilation, i.e. air supply by blow pipes or bellows, the use of wind or the chimney effect, wood fires and charcoal fires could reach temperatures of about 1,400°C and 1,600°C, respectively (Rehder 2000:7). These temperatures were not sufficient to liquefy silicious sand, the melting temperature of which lies between 1,700°C and 2,000°C. By adding of an alkine flux, e.g. plant ash, these temperatures can be lowered to about 800–900°C. Nicholson and Jackson reconstructed a replica of the best preserved furnace (Kiln 3) (see Chapter 4), which could readily achieve and maintain a temperature of 1,100°C using the prevailing wind from the north. For firing the furnace, a mixture of fuel wood was taken (Nicholson and Jackson 1998, Nicholson 2000). The advantage of charcoal is that it can be lightened relatively easyily and burns then steadily without flame but with concentrated heat producing no smoke. Because of its reduction in size and weight during the carbonisation process, the charcoal can be transported and handled easily. It was required for metallurgical processes for which higher temperatures and the ability of chemical reduction in a carbon monoxide atmosphere are necessary. The conversion of wood into charcoal may be regarded as one of the oldest technological processes invented and used since the early history of mankind. In the procedure of carbonisation under quasi-hermetic seal, where the entry of air is controlled to prevent that, the wood does not burn away to ashes as in a conventional fire, the physical and chemical bounded water and other volatile substances together with pyrolysis gases are driven off, so that more or less pure carbon (81–90%) is obtained. Carbonisation processes occur also as transition stages in the combustion of wood. Because of the remaining water, the temperature of this combustion is connected with lower values. If the combustion process is interrupted or stops by itself, charcoal from wood fires, sometimes with remnants from uncharred wood, and charcoal from charcoal fires are similarly left over. Otherwise the fuel is converted into ashes. From European glass factories of the Middle Ages it is known that wood as well as charcoal from the surrounding forests have served as fuel. The decision between these two kinds of fuel depended on economic factors, the possibilities of transportation, the kind of glass to be produced and other circumstances.

Table A 3.2. Results of charcoal analysis in relation to unit numbers. Listed are the identified wood taxa and their amounts and those for bark charcoal where present. The values in round brackets concern finds of uncharred or slightly charred wood and bark; the last column gives further information on the presence of uncharred and incompletely charred pieces of wood and bark (legend: o-uncharred, x-slightly charred, xx-partly charred, xxx-uncharred traces).

Unit number	Square number(s) / No of samples	Wood taxa and bark	Count [pcs]	Volume [ml]	Weight [g]	Uncharred, incompletely charred
[7961]	8.K80 / 1 sample	*Acacia nilotica*-type *Tamarix* sp.	16 1	44 1	2.8 0.4	-
[7962]	8.K80,85 / 3 samples	*Acacia nilotica*-type *Mimusops* sp. *Tamarix* sp.	37 1 1	31.6 0.5 0.7	16.4 0.3 0.3	-
[7966]	8.K80 / 1 sample	*Acacia nilotica*-type	3	7	3.7	-
[7969]	8.K80 / 2 samples	*Acacia nilotica*-type *Acacia* sp. Palmae	12 2 1	35 3 2.5	19.5 1.6 1.7	-
[7974]	8.L80	*Acacia nilotica*-type	Charcoal inclusions	in slag lump		-
[7976]	8.K80 / 1 sample	*Acacia nilotica*-type	2	4.4	2.6	-
[7982]	8.K80 / 1 sample	*Acacia nilotica*-type	1	7	3.7	-
[7986]	8.L80 / 1 sample	*Acacia nilotica*-type *Acacia* sp.	2 2	7 0.2	3.8 0.1	-
[7991]	8.K85 / 1 sample	*Acacia nilotica*-type bark	9 2	22 1.2	14.3 1.1	-
[7998]	8.K80 / 1 sample	*Acacia nilotica*-type *Mimusops* sp. *Tamarix* sp. bark	27 1 1 27	34 0.7 2 13	15.8 0.4 1.2 9.8	-
[8029]	8.L85 / 1 sample	*Acacia nilotica*-type	3	6.5	3.1	-
[8033]	8.K80 / 1 sample	*Acacia nilotica*-type *Acacia* sp. *Faidherbia albida* bark	379 (1) 5 24 2 (2)	548 (1.5) 7 43 1.2 (1)	252.7 (1.1) 5.3 17.5 0.9 (1.1)	1 - 0 2 - 0
[8036]	8.K85 / 1 sample	*Tamarix* sp.	1	0.8	0.4	-
[8067]	8.L80 / 1 sample	*Acacia nilotica*-type	4 (1)	13 (2.6)	6.4 (1.2)	1 - 0
[8068]	8.L80	*Acacia nilotica*-type	Charcoal inclusions	in slag lump		-
	8.M80	*Acacia nilotica*-type	Charcoal inclusions	in slag lump	No 3	-
	8.M80	*Acacia nilotica*-type	Charcoal inclusions	in slag lump	No 4	-
	8.M80	*Acacia nilotica*-type	Charcoal inclusions	in slag lump	No 5	-
[8071]	8.L80 / 2 samples	*Acacia nilotica*-type *Acacia* sp. bark	441 1 90	370 0.5 31	150.9 0.2 20.7	1 - xx
	8.L80	*Acacia nilotica*-type	Charcoal inclusions	in slag lump		-
[8976]	8.M75	*Acacia nilotica*-type	Charcoal inclusions	in slag lump		-
[8981]	8.M75 / 3 samples	*Acacia nilotica*-type *Acacia* sp. *Cedrus libani* *Ficus sycomorus* *Mimusops* sp. Palmae *Tamarix* sp. bark	288 20 1 22 7 1 67 1	376.1 20 1 29 6 1.8 63 0.5	188.7 8.1 0.2 8.7 3.4 1.2 26.4 0.7	-
[8991]	8.M80 / 1 sample	*Acacia nilotica*-type *Acacia* sp.	33 2	57.3 3.5	26.3 1.4	-
[8992]	8.M80 / 1 sample	*Acacia nilotica*-type *Acacia* sp. *Faidherbia albida* *Ficus sycomorus* *Tamarix* sp.	78 2 1 1 3	113 7 0.4 0.6 3	59.2 5.2 0.1 0.2 1.2	-
[8994]	8.M80 / 1 sample	*Acacia nilotica*-type	1	17	10.3	-
[9001]	8.L80 / 1 sample	*Acacia nilotica*-type *Acacia* sp.	33 1	50 0.6	26.1 0.3	-

Unit number	Square number(s) / No of samples	Wood taxa and bark	Count [pcs]	Volume [ml]	Weight [g]	Uncharred, incompletely charred
[8995]	8.L80,M75,80 / 4 samples	*Acacia nilotica*-type *Acacia* sp. *Tamarix* sp. bark	2,601 9 3 556 (1)	2,779 5.5 2 201.5 (0.3)	1,150.7 2.1 0.8 132.3 (0.3)	10 - XXX 1 - 0, 5 - XXX
[9002]	8.L75 / 1 sample	*Acacia nilotica*-type *Cedrus libani* *Mimusops* sp.	2 1 1	1 2.5 1.8	0.5 0.6 0.7	-
[9006]	8.M80 / 1 sample	*Acacia nilotica*-type *Acacia* sp. *Ficus sycomorus* *Tamarix* sp. bark	277 (1) 8 2 10 2 (1)	182 (0.3) 2.9 0.6 4.6 0.5 (0.6)	94.7 (0.3) 1.6 0.2 1.7 0.4 (0.6)	1 - 0 1 - 0
[9010]	8.L75 / 1 sample	*Acacia nilotica*-type	1	6.5	3.4	-
[9012]	8.M80 / 1 sample	*Acacia nilotica*-type	4	9.5	5.2	-
[9014]	8.L75 / 1 sample	*Acacia nilotica*-type	1	3.7	2.3	-
[9019]	8.L75 / 2 samples	*Acacia nilotica*-type *Tamarix* sp. bark	107 3 20	172 4.5 10	86.6 2.2 5.7	-
[9020]	8.L75,80 / 3 samples	*Acacia nilotica*-type *Ficus sycomorus* *Tamarix* sp. bark	411 (1) 2 3 43	588.5 (1.3) 0.7 3 32	276.1 (0.8) 0.2 1.3 22.4	1 - o
[9021]	8.L75 / 1 sample	*Acacia nilotica*-type	5	5	2.2	-
[9022]	8.M80 / 1 sample	*Acacia nilotica*-type *Tamarix* sp. bark	54 1 1	73 3.4 0.5	33 1.5 0.3	-
[9022] [9023]	8.M80 / 1 sample	*Acacia nilotica*-type	4	20	11.6	-
[9025]	8.M80 / 1 sample	*Acacia nilotica*-type	3	6	3.4	-
[9026]	8.L75 / 1 sample	*Acacia nilotica*-type	9	5.9	2.3	-
[9028]	8.L75 / 2 samples	*Acacia nilotica*-type	12	18.6	7.7	-
[9033]	8.M80 / 1 sample	*Acacia nilotica*-type *Tamarix* sp.	10 3	18 3	10.5 1.2	-
[9035]	8.L75 / 1 sample	*Acacia nilotica*-type bark	8 1	10.5 2	5.5 1.3	-
[10174]	8.M85 / 2 samples	*Acacia nilotica*-type	23	83.5	48.1	-
[10175]	8.M85 / 1 sample	*Acacia nilotica*-type bark	30 1	25 0.2	12.2 0.3	-
[10178]	8.K100 / 1 sample	*Acacia nilotica*-type	1	0.5	0.2	-
[10179]	8.M85 / 1 sample	*Acacia nilotica*-type	2	4.5	2.3	-
[10184]	8.K90 / 1 sample	*Acacia nilotica*-type *Tamarix* sp.	2 1	6.5 2.5	4.3 0.6	 1 - XX
[10185]	8.K90 / 3 samples	*Acacia nilotica*-type *Acacia* sp. *Ficus sycomorus* *Tamarix* sp.	11 1 2 1	27 0.8 4.5 1.5	13 0.4 1.3 0.5	1 - xx
[10187]	8.M75 / 1 sample	*Acacia nilotica*-type *Ficus sycomorus* *Tamarix* sp.	6 1 1	10 5 5	6.8 0.9 1.6	-
[10189]	8.M85 / 3 samples	*Acacia nilotica*-type *Acacia* sp. *Mimusops* sp. bark	36 1 1 1	75.5 0.7 1 0.6	40.9 0.4 0.5 0.5	-
[10191]	8.L85 / 2 samples	*Acacia nilotica*-type	7	32	20.6	-
[10192]	8.L85 / 1 sample	*Acacia nilotica*-type	8	11	5.1	-
[10194]	8.L85 / 1 sample	*Acacia nilotica*-type *Balanites aegyptiaca* *Tamarix* sp.	29 2 1	61 6 2	32.6 2.3 0.7	-

Appendix 3

Unit number	Square number(s) / No of samples	Wood taxa and bark	Count [pcs]	Volume [ml]	Weight [g]	Uncharred, incompletely charred
[10196]	8.M85 / 1 sample	*Acacia nilotica*-type	4	5	2.2	-
[10199]	8.L85 / 1 sample	*Acacia nilotica*-type *Balanites aegyptiaca* *Tamarix* sp. bark	33 1 2 1	80 8 2 1	42.7 2.3 0.9 1.3	-
[10202]	8.K,L,M85 / 5 samples	*Acacia nilotica*-type *Acacia* sp. *Tamarix* sp. bark	102 1 5 2	141.5 3.5 1.9 1.5	75.4 1.4 0.7 1.1	-
[10207]	8.K115 / 2 samples	*Acacia nilotica*-type *Acacia* sp. *Balanites aegyptiaca* *Tamarix* sp. bark	52 1 1 2 1	123.5 2 3 3 1.5	73.5 1 1.3 1 1.1	-
[10210]	8.K85 / 1 sample	*Acacia nilotica*-type	9	16	8.1	-
[10214]	8.L,M85 / 3 samples	*Acacia nilotica*-type *Acacia* sp. *Balanites aegyptiaca* *Faidherbia albida* *Ficus sycomorus* *Tamarix* sp. bark	261 6 3 1 8 9 8 (1)	426 8.1 3.5 0.8 9 18.5 5 (1.5)	205.7 4.6 1.3 0.3 5.9 4.2 4 (1.2)	1 - X
[10215]	8.L85 / 1 sample	*Acacia nilotica*-type	10	24	10.5	-
[10219]	8.L85 / 1 sample	*Acacia nilotica*-type	1	2.5	0.9	-
[10221]	8.M85 / 3 samples	*Acacia nilotica*-type	20	37	20.1	-
[10223]	8.M85 / 1 sample	*Acacia nilotica*-type *Acacia* sp. *Faidherbia albida* *Tamarix* sp. bark	9 1 1 1 (1)	15 12 1.5 1 (1)	7.5 5 0.4 0.4 (1.1)	1 - 0
[10224]	8.M85 / 3 samples	*Acacia nilotica*-type *Acacia* sp. *Tamarix* sp. bark	92 2 1 4	184.5 3 0.4 2.2	98 1.9 0.2 1.7	-
[10225]	8.K85 / 1 sample	*Acacia nilotica*-type *Acacia* sp. *Faidherbia albida* *Tamarix* sp.	62 3 3 3	92 3.5 2.5 3.5	46.4 1.7 1.1 1.5	-
[10227]	8.L85 / 2 samples	*Acacia nilotica*-type	27	54	23	-
[10231]	8.M85 / 1 sample	*Acacia nilotica*-type	43	57	30.7	-
[10234]	8.L85 / 1 sample	*Acacia nilotica*-type	2	16	6.6	-
[10236]	8.L85 / 1 sample	*Acacia nilotica*-type *Ficus sycomorus* *Mimusops* sp. *Tamarix* sp. bark	65 7 2 6 2 (2)	139 14 2 10.5 1 (1.5)	72.9 4.8 0.8 4.2 0.6 (1.8)	1 - XX 2 - 0

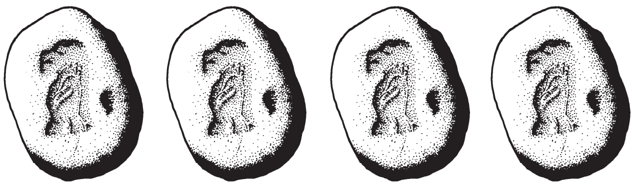
Endnotes

1. Directed by Professor Kemp, who kindly allowed the work on Nicholson's samples to be carried out.

Appendix 4

Human Remains

Information provided by Jerome Carl Rose



The identifications below were made by Dr. Jerome Rose in 2006 and noted by Mr. Boris Trivan. I am indebted to both of these for their efforts.

J80 [9472]

- Older male (between 35 and 50 years of age)
- major artritis of the hip
- the skull matches the skeleton from the same box

L85 [8076] and [10232]

- female (probably) (between 30 and 40 years of age)
- artritis
- skull missing

L80 [9037]

- most likely female (between 15 and 20 years of age)
- skeleton missing
- this skull does not belong to the skeleton from L75 [8076]

Appendix 5

Data Tables

Caroline M. Jackson and Paul T. Nicholson

Appendix 5 data tables

Sample Number	Sample description	Method	SiO_2	Na_2O	CaO	K_2O	MgO	Al_2O_3	Fe_2O_3	TiO_2	Sb_2O_3	MnO	CuO	CoO	SnO_2/ SnO*	PbO	ZnO	SO_3/ SO_2*	Cl	P_2O_5	NiO	Na_2O/ K_2O	$CaO+MgO$/ Na_2O+K_2O	Total
VITREOUS MATERIAL ON YELLOW PLASTER																								
TA24	Yellow plaster with blue-green layer	SEM	46.04	2.01	9.97	1.67	12.25	7.74	17.41	0.53		0.62	0.43	0.16										
MAN 1967B	Blue glass on yellow plaster	EPMA	62.29	15.49	6.35	2.78	4.01	1.17	0.49	0.07	0.00	2.93	3.72	0.01	0.22	0.03	0.06	0.41						
VITREOUS MATERIAL ON BANDED SANDSTONE																								
MAN1967A	Blue glass with banded sandstone layer	SEM	71.42	19.86	2.96	0.60	1.45	2.47	0.60	0.28				0.17				0.49	1.13					101.43
TA137	Vitrified layer, banded sandstone	SEM	59.15	9.25	7.04	1.64	2.14	5.29	2.92	0.61			10.35						0.11					98.48
TA94	Glazed banded sandstone	SEM	64.88	1.71	4.29	8.53	1.70	9.19	5.87	1.10			2.87											
TA95	Glazed banded sandstone	SEM	72.19	6.44	7.11	3.29	2.57	3.96	1.63	0.53			0.66					0.36	0.12					
GLASS ON CERAMICS																								
MAN1967F	Blue glass on ceramic		66.16	14.55	8.34	2.47	3.30	0.97	0.38			2.01	1.65					0.47	0.61					100.91
MAN1967G	Blue glass, ?ceramic on surface	SEM	69.53	17.51	5.38	1.44	2.71	1.75	0.42					0.22				0.30	1.14					100.40
MAN1967L	Turquoise blue glass with ceramic	SEM	65.02	13.53	7.69	3.41	4.19	0.69	0.45				1.97	0.07				0.38	0.67					98.06
MAN2609	Rim, cylindrical vessel. Lt green glass	SEM	66.67	16.87	8.71	2.02	3.51	1.23	0.45									0.61	0.67					100.74
MAN2611	Opaque dark blue glass on cream ceramic	SEM	63.93	15.00	9.01	0.78	2.98	2.38	0.72	0.29		0.21		0.10				0.32	1.23					96.94
TA69	Translucent blue/turquoise glass on ceramic	SEM	61.22	17.96	11.49	2.05	3.46	1.05	0.60	0.15			2.43	0.02				0.44	0.87					101.74
TA98	Raw glass, turquoise and ceramic	SEM	65.79	15.85	10.77	1.86	3.84	0.76	0.64	0.27			1.38	0.00				0.41	0.78					102.34
UC 22922E^	Dk blue glass on ceramic	EPMA	74.95	14.19	3.60	0.34	2.13	2.56	0.62	0.16	0.05	0.15	0.02	0.26	0.00	0.01	0.38	0.11	1.02	0.04	0.16			100.75
TA97^	raw glass green/red and ceramic	EPMA	62.94	15.45	10.64	2.22	3.73	1.03	0.82	0.14	0.00	0.13	1.19	0.00	0.03	0.01	0.01	0.40	0.75	0.17	0.00			99.67
TA102^	Blue glass, ceramic with parting layer	EPMA	62.78	16.81	9.67	2.63	3.91	0.57	0.31	0.08	0.00	0.02	1.55	0.00	0.14	0.00	0.01	0.42	0.85	0.15	0.00			99.88
TA105^	/glass lump/red/turquoise, ceramic	EPMA	65.14	16.08	9.15	2.87	3.60	0.64	0.50	0.09	0.00	0.03	1.91	0.00	0.02	0.00	0.00	0.19	0.68	0.19	0.01			101.10
TA143^	Blue glass from cylindrical vessel	EPMA	63.07	17.09	10.42	1.96	3.79	0.67	0.45	0.09	0.00	0.02	1.76	0.00	0.04	0.00	0.02	0.45	0.83	0.14	0.01			100.79
MCR 1966A^	Dark blue glass, white coating	EPMA	62.03	19.28	7.88	1.97	3.73	0.55	0.34	0.08	1.64	0.02	0.98	0.00	0.08	0.00	0.01	0.41	1.12	0.21	0.00			100.34
TA131	Fritting pan base with green glass	SEM	61.52	11.92	11.28	2.25	4.84	1.53	1.14	0.22	0.77		0.76	0.03				0.29	0.09					96.63
TA132	Fritting pan with blue glass	SEM	47.44	19.24	2.24	0.33	2.36	1.63	0.15									0.20	0.82					74.39
TA133	Rim of fritting pan with adhering glass	SEM	74.28	12.10	1.18	0.83	1.95	6.79	0.49			0.42		0.48			0.63	0.28	0.43					99.85
TA141	Turquoise glass from fritting pan	SEM	61.96	10.88	6.87	3.32	3.34	3.46	2.34	0.84			2.64	0.08				0.51	0.65					96.89
FRIT - RAW GLASS																								
TA125	Blue frit adhering to sherd	SEM	68.46	11.52	6.81	0.49	1.37	5.41	3.39			0.34		0.33			0.52		0.82					99.43
TA20	Blue frit on sherd	SEM	69.02	7.77	1.50	1.04	2.28	6.87	4.33	0.60		0.52				0.38		0.19						
TA22	Glass in "slag" (Co)	SEM	67.97	18.03	0.63	6.41	3.07	2.14	0.41	0.10	0.00	0.14	0.01	0.14	0.00	0.00	0.18	0.24	1.18	0.05				100.71
TA55	"Frit" (Cu)	SEM	63.90	15.26	1.73	11.64	3.84	0.60	0.39	0.08	0.00	0.01	1.56	0.01	0.03	0.01	0.01	0.43	0.69	0.14				100.33
TA64	Green/blue raw glass	SEM	66.36	9.47	5.42	6.92	2.55	1.80	1.38	0.32			3.23					0.30	0.19					97.93
TA73	Vesicular turquoise glass	SEM	65.53	15.38	6.76	3.40	4.65	1.10	0.39				2.45	0.00				0.49	0.91					
TA104	"Frit" Turquoise with sandstone	EPMA	70.81	7.76	3.76	3.68	1.47	8.23	1.71	1.34	0.00	0.03	0.47	0.00	0.03	0.01	0.01	0.11	0.18	0.10				99.72
TA64	Ceramic	SEM	54.70	3.43	6.93	2.74	2.71	20.12	8.18	0.99														99.80

Sample Number	Sample description	Method	SiO_2	Na_2O	CaO	K_2O	MgO	Al_2O_3	Fe_2O_3	TiO_2	Sb_2O_3	MnO	CuO	CoO	SnO_2/ SnO*	PbO	ZnO	SO_3/ SO_2*	Cl	P_2O_5	NiO	Na_2O/ K_2O	CaO+MgO/ Na_2O+K_2O	Total
GLASS																								
Blue																								
MAN1466	Fragment of blue footed vessel	SEM	67.94	15.63	6.62	0.46	2.62	1.77	0.26					0.19			0.49	0.33	1.12			34.13	0.57	97.41
MAN1967H	Blue glass, original edge	SEM	62.39	19.14	8.90	0.42	4.80	3.70	0.84	0.23		0.27		0.16				0.34	1.00			45.78	0.70	102.18
MAN2634	Dark blue glass ribbon	SEM	59.17	23.76	4.87	0.85	5.26	4.77	0.78			0.27		0.20			0.45	0.35	1.19			28.12	0.41	101.92
MAN2639	Blue glass rod with central hole	SEM	74.01	17.99	3.18	0.30	1.72	2.48	0.74				0.73	0.13					0.96			60.37	0.27	102.24
TA99	Glass from ''runnel''	EPMA	68.72	20.53	3.89	0.65	2.07	2.26	0.48	0.111	0.000	0.141	0.021	0.113	0.000	0.011	0.128	0.308	1.423	0.075	0.061	31.62	0.28	100.99
TA107	Glass chip	EPMA	54.52	24.24	8.35	0.33	4.62	5.00	0.91	0.180	0.590	0.307	0.085	0.298	0.001	0.005	0.316	0.377	1.043	0.077	0.199	74.30	0.53	101.46
TA22	Glass in slaggy matrix	EPMA	67.97	18.03	6.41	0.63	3.07	2.14	0.45	0.096	0.000	0.141	0.014	0.144	0.000	0.004	0.183	0.244	1.182	0.050	0.066	28.69	0.51	100.83
TA32a	Glass in slaggy matrix	EPMA	60.47	20.57	6.13	0.56	4.73	3.57	1.29	0.222	0.000	0.179	0.020	0.126	0.001	0.026	0.208	0.373	1.321	0.222	0.062	36.99	0.51	100.07
MCR 1967c	Dark blue glass	EPMA	64.22	18.52	6.26	0.94	2.52	3.95	2.14	0.466	0.000	0.129	0.038	0.100	0.009	0.006	0.154	0.226	1.264	0.217	0.063	19.78	0.45	101.22
MCR 2624	Dark blue glass chunk	EPMA	69.69	20.16	3.42	0.28	1.64	2.06	0.50	0.123	0.346	0.112	0.154	0.086	0.007	0.015	0.054	0.263	1.552	0.040	0.043	72.66	0.25	100.54
MCR 2625	Dark blue melted glass fragment	EPMA	65.06	18.42	7.09	1.46	4.43	1.62	0.50	0.094	0.072	0.120	0.390	0.086	0.021	0.025	0.093	0.334	1.010	0.116	0.077	12.59	0.58	101.02
UC 6524	Turquoise rod	EPMA	66.56	16.38	8.47	1.24	3.96	1.72	0.43	0.082	0.002	0.137	0.136	0.114	0.003	0.038	0.104	0.341	0.922	0.100	0.070	13.21	0.70	100.80
UC 22910b	Turquoise rod	EPMA	64.24	19.19	7.09	0.99	3.70	1.95	0.38	0.076	0.497	0.161	0.053	0.166	0.002	0.006	0.231	0.409	1.050	0.112	0.092	19.36	0.53	100.40
UC 22912a	Turquoise glass chip	EPMA	62.00	19.50	9.87	0.53	2.35	3.64	0.63	0.144	0.000	0.164	0.020	0.312	0.000	0.004	0.400	0.519	0.902	0.059	0.129	36.77	0.61	101.19
MCR 2661	Turquoise blue glass rod	EPMA	61.58	19.25	8.45	1.36	3.73	1.77	0.57	0.115	0.167	0.209	1.287	0.078	0.062	0.063	0.099	0.392	1.060	0.178	0.049	14.17	0.59	100.47
UC 22937D	Dark blue glass with ?ceramic core	EPMA	66.81	18.79	7.65	1.25	2.96	0.91	0.31	0.070	0.000	0.021	0.026	0.064	0.000	0.002	0.048	0.286	1.269	0.092	0.031	15.09	0.53	100.58
MAN2616	Opaque, light blue glass fragment	SEM	62.92	16.50	9.87	1.76	4.17	1.16	0.60		1.32		0.94	0.00				0.32	1.06			9.40	0.77	100.62
MAN1546	GUROB - blue vessel	SEM	65.53	16.57	5.43	1.92	2.64	0.83	0.42				2.05	0.06		0.01			1.06			8.62	0.44	96.50
MAN1544	GUROB - vessel fragment turquoise	SEM	62.71	17.15	5.29	1.84	2.34	0.66	0.37		0.57		0.44	0.03		5.28		0.58	0.96			9.30	0.40	98.22
MAN2617	Dark blue glass lump	SEM	62.10	14.63	8.59	2.78	4.63	0.88	0.44				2.01	0.03				0.39	0.66			5.27	0.76	97.13
UC22922F	Turquoise/blue bubbly glass frag poorly heated	SEM	63.96	16.38	7.38	2.69	3.91	0.50	0.25				2.32	0.07				0.49	0.77			6.10	0.59	98.72
MAN2633	Turquoise/blue triangular chunk	SEM	64.09	15.82	7.66	3.17	4.13	0.66	0.31				1.87	0.06				0.56	0.56			4.99	0.62	98.89
TA112	Thin turquoise blue glass rod	SEM	66.36	16.47	6.29	1.61	2.48	0.73	0.45				1.69	0.02				0.34	1.17			10.22	0.49	97.61
MAN2665	Blue glass cane	SEM	64.25	16.36	11.38	1.31	2.88	0.80	0.38				1.86	0.14				0.42	0.86			12.50	0.81	100.62
MAN1967O	Opaque light green drip	SEM	64.22	16.66	7.09	2.92	3.98	0.38	0.25				2.00	0.01				0.54	0.43			5.72	0.57	98.47
TA45	Tubular glass/faience bead	SEM	62.58	16.07	8.05	2.48	4.76	0.61					2.12	0.12				0.46	0.89			6.49	0.69	98.14
MAN1521B	Opaque light blue glass	SEM	63.13	19.52	7.83	1.45	3.77	0.67	0.32		0.94		2.01	0.00				0.44	1.10			13.49	0.55	101.16
MAN2622	Opaque light blue fragment	SEM	62.08	19.08	7.48	2.05	3.88	0.88	0.42		0.69		1.17	0.12				0.61	0.60			9.30	0.54	99.05
MAN2637	Opaque turq blue glass ribbon	SEM	63.15	19.65	7.93	1.81	3.74	0.53	0.31				1.14	0.02				0.42	1.01			10.88	0.54	99.70
TA23	Khorfush with glass	EPMA	63.18	16.80	10.26	1.88	3.86	0.60	0.44	0.079	0.000	0.016	1.828	0.004	0.035	0.019	0.011	0.458	0.870	0.149	0.009	8.92	0.76	100.50
TA46	Blue bead	EPMA	60.90	18.93	7.66	2.28	4.18	0.86	0.62	0.112	0.000	0.024	3.372	0.001	0.020	0.003	0.007	0.361	1.130	0.232	0.003	8.30	0.56	100.70
TA55	Blue ''Frit''/glass	EPMA	63.90	15.26	11.64	1.73	3.84	0.60	0.43	0.080	0.000	0.009	1.560	0.008	0.028	0.012	0.012	0.428	0.691	0.143	0.004	8.82	0.91	100.38
TA61b	Blue chip/part of rod	EPMA	60.51	18.70	8.74	2.72	4.45	0.56	0.40	0.091	1.339	0.018	1.259	0.003	0.170	0.005	0.009	0.403	0.898	0.254	0.002	6.88	0.62	100.52
TA65	Dark blue opaque glass	EPMA	63.21	16.62	10.59	1.84	3.78	0.69	0.64	0.095	0.000	0.035	1.838	0.004	0.029	0.005	0.011	0.446	0.812	0.156	0.004	9.01	0.78	100.81
TA68	Bluechip	EPMA	63.51	17.57	8.73	2.35	3.68	0.49	0.30	0.070	0.762	0.007	0.883	0.002	0.037	0.015	0.012	0.405	0.894	0.167	0.001	7.49	0.62	99.87
TA70	Blue glass fragment	EPMA	62.00	18.34	8.19	2.32	3.77	0.44	0.32	0.055	0.298	0.004	1.376	0.003	1.658	0.004	0.007	0.384	0.973	0.294	0.005	7.90	0.58	100.44
TA100	Blue glass ''flake''	EPMA	67.20	17.25	5.56	3.01	2.79	0.91	0.55	0.129	0.020	0.062	1.213	0.003	0.050	0.015	0.014	0.341	1.047	0.167	0.004	5.74	0.41	100.33
TA111	Blue glass rod	EPMA	61.57	18.29	5.59	2.82	4.47	1.43	0.82	0.116	0.000	0.011	3.689	0.001	0.008	0.004	0.009	0.328	1.114	0.293	0.005	6.48	0.48	100.58
TA113	Blue glass rod	EPMA	63.09	16.41	10.12	3.06	3.70	0.68	0.52	0.100	0.000	0.042	1.344	0.003	0.029	0.003	0.009	0.443	0.810	0.177	0.003	5.37	0.71	100.53
TA136	Blue glass fragment	EPMA	63.07	16.98	9.13	2.72	3.79	0.75	0.51	0.105	0.000	0.008	1.577	0.002	0.216	0.002	0.006	0.277	1.063	0.288	0.002	6.24	0.66	100.49
MCR 1967J	Dark blue drip	EPMA	62.92	18.67	8.49	1.75	4.49	0.67	0.42	0.084	0.474	0.015	0.965	0.000	0.048	0.003	0.007	0.393	1.044	0.107	0.005	10.66	0.64	100.55
MCR 2648	Dark blue rod	EPMA	62.06	17.00	7.98	2.03	3.41	0.62	0.62	0.081	0.000	2.535	2.244	0.002	0.178	0.014	0.015	0.357	0.851	0.253	0.009	8.39	0.60	100.25
MCR 2667	Opaque dark blue drip	EPMA	67.00	14.53	8.54	2.56	3.73	1.01	0.57	0.131	0.114	0.010	1.184	0.002	0.087	0.001	0.013	0.296	0.857	0.147	0.002	5.68	0.72	100.79
UC 22937C	Dark blue ''core-formed'' vessel	EPMA	66.22	16.52	8.09	1.83	3.84	0.93	0.57	0.119	0.000	0.010	0.991	0.001	0.074	0.003	0.008	0.217	1.202	0.156	0.003	9.04	0.65	100.77

Sample Number	Sample description	Method	SiO_2	Na_2O	CaO	K_2O	MgO	Al_2O_3	Fe_2O_3	TiO_2	Sb_2O_3	MnO	CuO	CoO	SnO_2/SnO*	PbO	ZnO	SO_3/SO_2*	Cl	P_2O_5	NiO	Na_2O/K_2O	CaO+MgO/ Na_2O+K_2O	Total
Blue/green, green																								
UC22918bB	Translucent green rod	SEM	63.47	16.47	7.85	2.00	3.67	0.90	0.50				0.98	0.02		0.38		0.42	0.81			8.24	0.62	97.46
MAN1967I	Green glass drip, tooled	SEM	67.72	17.86	7.22	1.19	2.83	0.82	0.45				0.57	0.00				0.37	1.05			15.02	0.53	100.08
MAN1967N	Opaque light green drip	SEM	56.63	17.10	3.62	2.51	3.88	0.58	0.34				2.17	0.00		2.03		0.52	1.01			6.82	0.38	90.39
MAN2632	Green glass rod with central hole	SEM	64.56	16.56	7.33	3.12	4.15	0.63	0.34		0.69		1.84	0.09		0.66		0.56	0.73			5.31	0.58	101.25
MAN2635	Opaque green glass ribbon	SEM	62.98	16.45	9.28	1.78	3.70	0.81	0.37				1.47	0.05		0.95		0.32	1.09			9.24	0.71	99.24
TA60	Green glass rod	SEM	64.70	14.60	6.74	1.25	2.54	0.64	0.41				1.36	0.00		2.70		0.37	1.02			11.66	0.59	96.33
UC22918bA	Opaque lime green rod	SEM	61.42	18.01	7.89	1.98	3.62	0.67	0.36		1.11		0.83	0.05				0.50	0.98			9.12	0.58	97.40
Opaque White and colourless																								
MAN2614	Opaque white glass in "slag"	SEM	64.03	16.31	7.40	2.19	3.75	1.87	0.95		0.73							0.30	0.56			7.45	0.60	98.09
MAN1546	GUROB - blue vessel with yellow and whitedecoration	SEM	55.81	15.22	5.39	1.77	3.61	0.71	0.27		1.01		0.44	0.03		15.11		0.55	0.68			8.59	0.53	100.59
UC22919bB	Colourless/white rod	SEM	62.84	17.47	7.56	1.78	5.22	0.75	0.43					0.04					1.04			9.81	0.66	97.14
Opaque Red																								
MAN1521A	GUROB—Opaque red glass	SEM	60.01	17.40	7.74	1.62	3.71	0.76	0.29				5.12					0.44	0.82			10.74	0.60	97.91
UC22917b	Opaque red glass rod	SEM	63.86	14.79	7.50	1.31	2.65	1.09	0.61				4.34	0.01				0.27	0.94			11.28	0.63	97.37
MAN2660	Opaque brown glass rod	SEM	64.10	17.65	6.51	0.93	3.53	0.91	0.43				5.19						1.31			18.98	0.54	100.56
Yellow																								
MAN2647	Yellow cane	SEM	65.22	14.17	6.96	2.92	3.75	0.60	0.33					0.03		2.03		0.46	0.60			4.86	0.63	97.06
MAN2664	Lt brown/yellow trail	SEM	63.67	15.76	6.29	2.71	3.62	0.59	0.36				0.83	0.01		2.64		0.37	0.68			5.81	0.54	97.53
UC22916b	Opaque yellow rod	SEM	70.84	19.57	7.11	2.74	4.02	0.70	0.36				1.07			2.56		0.46	1.01			7.14	0.50	110.43
UC22937A	Opaque yellow frag	SEM	60.46	19.08	5.37	3.52	3.84	1.73	1.18							4.73		0.11	0.80			5.42	0.41	100.82
Purple, Brown and variations																								
MAN1967D	Brown glass,bubbly chip	SEM	67.03	17.67	7.77	2.58	3.81	0.93	0.35									0.56	0.76			6.85	0.57	101.46
MAN1967E	Brown glass adher to ceramic	SEM	69.58	13.90	6.56	2.03	2.97	1.67	1.47	0.22									0.83			6.85	0.60	99.23
UC22915b	Brown glass rod	SEM	70.10	18.46	9.30	1.99	4.39	0.92	0.54									0.49	0.95			9.28	0.67	107.14
UC22914B	Purple glass rod	SEM	63.48	16.62	9.36	2.74	4.15	0.63	0.23			0.97		0.00				0.48	0.81			6.07	0.70	99.43
UC22920B	Translucent dk blue/black rod	SEM	61.62	15.34	8.11	1.95	3.91	0.84	0.48			2.46	1.32	0.23				0.42	0.65			7.88	0.70	97.34
Uluburun Ingots																								
LOT4110	Dark blue ingot	SEM	69.49	16.99	6.94	0.46	2.46	1.99	0.56	0.16		0.11			0	0.28	0.02	0.27	1.12	0		36.93	0.54	100.85
KW1422	Dark blue ingot	SEM	67.17	17.76	5.95	0.83	2.86	1.98	0.62	0.15		0.12		0.11	0		0.12	0.25	1.01	0.05		21.40	0.47	98.98
Uluburun	Turquoise ingot	SEM	67.69	19	5.74	0.8	2.63	0.69	0.39	0.04					0	0.59	0.09	0.28	1.38	0.03		23.75	0.42	99.35

*SnO_2=SEM/SnO=EPMA
*SO_3=SEM/SO_2=EPMA
^Some of glasses analysed under the heading "glass from ceramics" are included in some of the figures in Chapter 5.
Omissions in the table denote elements below detection using the technique specified.

Appendix 6

Scientific Examination Of Vitreous Materials And Associated Ceramics

A. J. Shortland[1], G. D. Hatton And M. S. Tite[2]

Introduction

The chemical compositions and, where appropriate, the microstructures of the following groups of samples collected during the 1993 and 1994 excavations, have been investigated:

1) cobalt blue frit
2) copper and cobalt blue glass
3) Egyptian blue and turquoise frits
4) ceramics to which cobalt blue frit and glass adhered, wall fragments from Kiln 3 and *khorfush* (ie fused clay).

Tables of analyses together with a brief discussion of the results are presented below. However, for a full discussion and interpretation of the results, and for details of the analytical techniques used, readers are referred to both published works (Shortland 2000, Tite and Shortland 2003, Shortland and Eremin 2006), and an unpublished DPhil thesis (Hatton 2005).

Cobalt blue frit (Shortland 2000, Tite and Shortland 2003)

The fragments of cobalt blue frit were found adhering both to ceramics and fused clay, in some cases with a white lime-rich clay slip separating the frit from the ceramic. Examination in polished section in an analytical scanning electron microscope (SEM) showed that these frits consist of unreacted quartz particles in a glass matrix, with varying amounts of porosity (Plate A6.1). The chemical compositions of the glass matrices of the frits as determined by wavelength dispersive spectrometry (WDS) are given in Table A6.1, together with the percentages of unreacted quartz in the bulk frit as determined by image analysis.

The high alumina contents of the frits, together with the presence of manganese, nickel and zinc, indicate that the source of the cobalt colourant was the cobaltiferous alums from the Dakhla and Kharga Oases in the Western Desert of Egypt (Kaczmarczyk 1986, Shortland *et al.* 2006). The low potash and, after correction for the magnesia contribution by the

Number	Association	Vitrification[1]	SiO_2	Al_2O_3	CaO	MgO	Na_2O	K_2O	FeO	TiO_2	CoO	CuO	MnO	% Quartz [2]
AM23	fused clay	CV	81.0	5.7	0.8	1.0	9.5	1.1	0.2	0.1	0.19	0.01	0.20	28
AM28	white slip		76.0	2.7	4.3	2.2	13.2	0.3	0.7	0.1	0.23	0.04	0.20	10
AM31	white slip + ceramic	EV	71.6	4.1	8.1	1.1	13.5	0.2	0.6	0.2	0.21	0.04	0.27	32
AM32	(fragment)		78.3	5.3	1.2	1.8	10.6	0.8	0.6	0.2	0.38	0.03	0.44	33
AM33	white slip + ceramic	EV-CV	76.5	4.8	2.4	3.1	9.4	1.0	1.2	0.5	0.40	0.03	0.63	29
AM34	(fragment)		75.3	7.3	1.2	2.4	11.5	0.7	0.6	0.1	0.43	0.02	0.39	36

Table A6.1. Chemical compositions of the glass matrices of cobalt blue frits (SEM-WDS)

All analyses normalised to 100%
1 EV-extensive vitrification; CV- continuous vitrification
2 Percentage of unreacted quartz in the bulk frit, as determined by image analysis (% SiO2 refers to glass matrix only, and does not include the unreacted quartz particles)

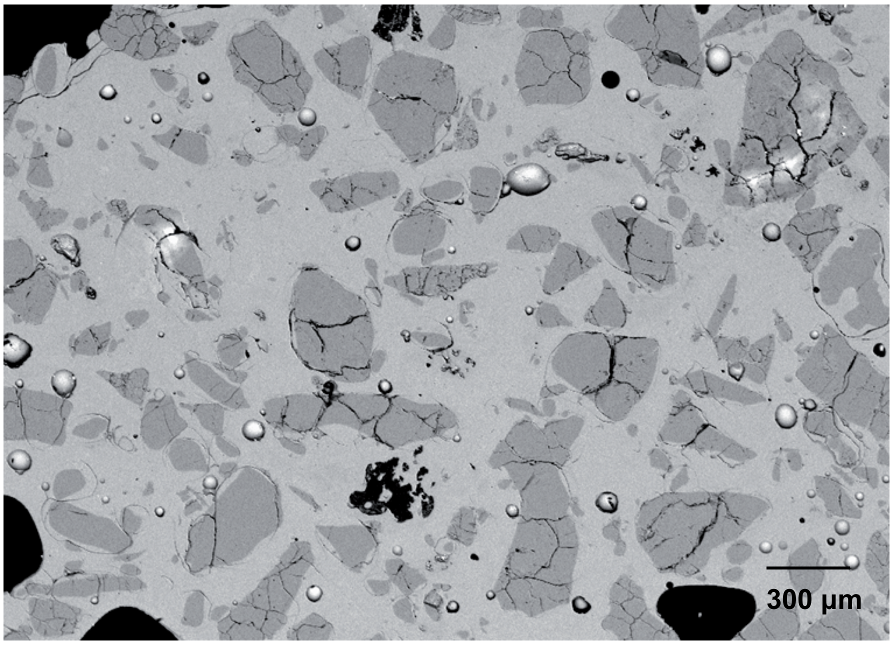


Plate A6.1. SEM photomicrograph of section through cobalt blue frit (AM32) showing unreacted quartz particles (darker grey) in a glass matrix (lighter grey) with occasional pores (black).

cobaltiferous alum, low magnesia contents of the frits strongly suggest that natron from the natural evaporitic deposit at Wadi Natrun in Egypt was the predominant source of the alkali flux. Thus the frits were most probably produced by firing a mixture of crushed quartz pebbles, natron, and cobalt colourant in the form of hydroxides precipitated from a cobalt alum solution by the addition of natron. No finished objects made of frit are known, so it would appear that it is an intermediate material to another product. The bulk composition of the frits is too high in silica and cobalt for it to be possible to melt it alone and create glass, however, it may be involved in this process, as discussed below.

Rare examples of copper blue frits were also identified, but they were too few in number to present a coherent pattern for interpretation.

Copper and cobalt blue glass (Shortland 2000, Tite and Shortland 2003, Shortland and Eremin 2006)

The fragments of glass were similarly found adhering both to ceramics, some of which were probably sherds from cylindrical vessels, and fused clay. Again, a white lime-rich clay slip separated the glass from the ceramic in some cases. The chemical compositions of the glass as determined in polished sections by WDS in an analytical SEM are given in Table A6.2.

The presence of up to 0.2% tin oxide in some of the copper blue glass suggests that bronze, perhaps in the form of scale from metalworking scrap was sometimes used as the source of the copper colourant. Once again the high alumina content of the cobalt blue glass indicates that cobaltiferous alum from the Western Desert of Egypt provided the cobalt colourant. The presence of few percent each of potash and magnesia indicate that the ashes obtained from burning halophytic desert or coastal plants provided the source of the alkali flux in the copper blue glass, whereas the lower potash content of the cobalt blue glass suggests that the flux used may have included some natron. Too little is known about the chemical composition and variability of relevant plant ashes to make any conclusions certain, but from the comparison of the composition of the cobalt blue glass and frit, Tite and Shortland (2003) have suggested that the cobalt blue glass could have been produced by firing a mixture of crushed cobalt blue frit, plant ash and additional quartz.

Egyptian blue and turquoise frits (Hatton 2005)

The Egyptian blue and turquoise frits, which would probably have been used as pigments, consisted of powdery residues adhering to small ceramic fragments. Examination in polished section in an analytical SEM showed that the Egyptian blue frit is made up of isolated areas of copper-calcium silicate crystals ($CuCaSi_4O_{10}$), which are the source of the blue colour, and unreacted quartz bonded together by small amounts of glass (Plate A.6.2). In contrast, the turquoise frit is made up of isolated areas of copper-rich glass containing unreacted quartz together with high concentrations of small crystals of cristobalite (high temperature form

Appendix 6

Number	Association	Vitrification [2]	SiO_2	Al_2O_3	CaO	MgO	Na_2O	K_2O	FeO	TiO_2	CoO	CuO	MnO	NiO	ZnO	SnO_2	P_2O_5	SO_3	C1
Copper blue glass																			
AM16	ceramic		62.4	0.7	10.4	4.0	16.9	1.9	0.4	0.1	0.00	1.66	0.01	0.00	0.02	0.05	0.12	0.42	0.80
AM29	fused clay	PV-EV	67.2	1.0	5.6	3.1	16.6	3.0	0.5	0.1	0.03	1.18	0.11	0.02	0.00	0.01	0.17	0.27	0.99
AM30	fused clay		65.5	1.4	8.8	3.8	14.7	2.8	0.8	0.1	0.02	0.75	0.03	0.00	0.05	0.03	0.17	0.12	0.79
AM35	ceramic		63.5	1.4	14.5	4.2	9.8	2.8	0.9	0.1	0.03	1.14	0.10	0.05	0.01	0.19	0.38	0.41	0.47
AM36[1]	white slip + ceramic	EV	64.2	5.2	7.4	3.2	11.2	3.8	3.1	0.4	0.00	0.49	0.03	0.03	0.00	0.07	0.35	0.32	0.14
AM38[1]	ceramic	EV	63.1	2.5	10.5	5.5	12.0	2.5	2.0	0.2	0.01	0.79	0.09	0.02	0.01	0.01	0.35	0.20	0.13
Cobalt blue glass																			
AM22	white slip + ceramic	EV	65.9	2.1	7.1	2.9	18.4	0.8	0.5	0.1	0.20	0.10	0.18	0.02	0.00	0.00	0.05	0.27	1.34
AM37	white slip + ceramic	EV-CV	67.9	2.0	4.6	2.6	21.2	0.6	0.4	0.1	0.16	0.10	0.16	na	na	0.07	0.10	na	na

Table A6.2. Chemical compositions of copper and cobalt blue glasses (SEM-WDS)

All analyses normalised to 100%; na—not analysed
1 High alumina contents are due to contamination from the adhering ceramic
2 PV—partial vitrification; EV—extensive vitrification; CV—continuous vitrification

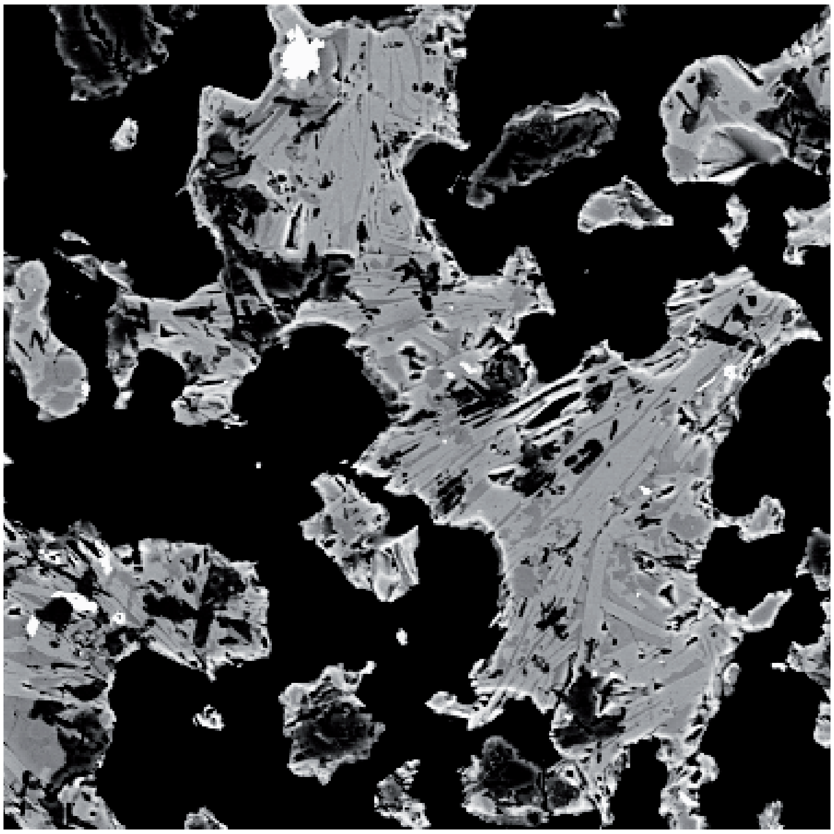


Plate A6.2. SEM photomicrograph of section through powdery residue of Egyptian blue frit (AM4) showing isolated particles consisting of Egyptian blue crystals (light grey) and unreacted quartz (dark grey) bonded together by small amounts of glass (mid grey).

of quartz) and wollastonite ($CaSiO_3$) (Plate A6.3). The bulk chemical compositions of the frits as determined in polished section by energy dispersive spectroscopy (EDS) in an analytical SEM are given in Table A6.3.

The Egyptian blue and turquoise frits were produced by firing a mixture of quartz, calcium carbonate, a copper compound and alkali flux to a temperature in the range 900–1000°C (Tite *et al.* 1984). The quartz was probably in the form of quartz sand. Since many sands, including those from Amarna (AM43 and AM44 in Table A6.3) contain significant amounts of calcium carbonate, the sand could also have been the source of the calcium carbonate used in the production of the frits. Alternatively, the calcium carbonate was added separately either as crushed limestone or shell. The source of the copper was either scale from copper metal or bronze, or a copper ore such as malachite, and the source of the flux was plant ash. Whether Egyptian blue or turquoise frits are produced depends primarily on the ratio of lime to copper oxide in the mixture, higher ratios being required for the production of turquoise frits. In both cases, the primary frits thus produced would have been ground to a fine powder for use as pigments.

	SiO_2	Na_2O [2]	K_2O	CaO	MgO	Al_2O_3	FeO	TiO_2	CuO	SnO_2	PbO
Egyptian blue frit											
AM4	63.0	3.4	1.2	16.7	0.8	1.7	0.9	0.1	11.2	0.7	0.2
Turquoise frit											
AM9[1]	66.6	4.7	1.9	14.0	1.0	1.8	1.3	0.2	7.6	0.8	0.2
AM5	76.3	4.7	<0.1	10.5	<0.1	2.5	0.3	<0.1	5.3	0.2	0.1
AM6	80.3	3.1	0.2	8.1	0.2	3.0	0.3	<0.1	4.3	0.3	0.2
AM7	73.9	6.0	<0.1	11.8	<0.1	2.2	0.3	<0.1	5.1	0.4	0.4
AM8	75.9	2.1	0.1	17.8	<0.1	0.7	0.7	<0.1	2.2	0.3	0.1
AM10	70.1	2.2	0.6	18.3	0.5	0.3	0.6	0.1	6.5	0.7	0.1
Amarna sands											
AM44 surface	93.55	0.26	0.29	3.68	0.21	1.23	0.57	0.15			
AM43 sub-surface	76.64	0.81	0.45	17.26	0.61	2.37	1.36	0.32			

Table A6.3. Chemical compositions of bulk Egyptian blue and turquoise frits (SEM-EDS) and Amarna sands (ICP).

All analyses normalised to 100%
1 AM9 includes area with the Egyptian blue microstructure
2 Because of overlapping Na_2O and CuO peaks, the Na_2O contents are too high

Ceramics, kiln wall fragments and khorfush (Shortland 2000)

The chemical compositions of the ceramics, wall fragments from Kiln 3 and *khorfush* (i.e. fused clay), as determined either in polished section by EDS in an analytical SEM or by inductively coupled plasma spectroscopy (ICP), are given in Table A6.4. Comparison of these compositions with that of Nile silt (AM45 in Table A6.4) indicates that the Nile silt was most probably the source of the clay used in all cases.

The temperatures to which the ceramic and other clay-based fragments were fired were estimated by comparison of the nature and extent of the glass phase as observed in polished section in an SEM (Maniatis and Tite 1981, Tite *et al.* 1982) with those of a series of Nile silt samples fired in a laboratory furnace at temperatures in the range 650–1250°C. For Nile silt, partial vitrification (PV) of the clay had started by 950°C. Subsequently, the extent of the glass phase increased progressively becoming extensive (EV) by about 1100°C and more-or-less continuous (EV-CV) by about 1150°C, at which point the sample had begun to sag. By 1200°C, the glass phase was continuous with spherical rather than elongated pores (CV). By this temperature, the sample had started to flow, and by 1250°C, it had completely melted and was flowing freely.

Therefore, the vitrification observed in the ceramics and fused clay adhering to the cobalt blue frits (Table A6.1) suggests that the temperatures used in the production of these frits were in the range 1050–1200°C. Similarly, the majority of the ceramics to which the glass fragments adhere (Table A6.2) were fired in the range 1100–1150°C. On the basis of the three samples collected from Kiln 3, the temperatures reached at the front surfaces of the walls varied from about 1100°C for AM 42B, through 1150°C for AM42A, up to 1250°C for AM 42C, the highest temperature reached being comparable to those reached by the *khorfush* (1200–1250°C) (Table A6.4).

Number	Material	Vitrification1	Method	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	TiO_2
AM23	fused clay	CV	SEM-EDS	59.2	15.9	10.8	8.6	1.5	0.0	1.7	2.4
AM31	ceramic	EV	SEM-EDS	60.5	17.4	11.2	2.8	1.0	5.2	0.8	1.0
AM33	ceramic	EV-CV	SEM-EDS	57.6	12.6	8.9	8.9	1.7	6.9	1.4	2.0
AM22	ceramic	EV	SEM-EDS	56.4	15.6	9.2	10.6	0.3	3.4	2.7	1.8
AM29	fused clay	PV-EV	SEM-EDS	58.5	15.7	10.4	5.7	0.9	1.2	3.5	4.1
AM42A	Kiln 3 wall	EV-CV	ICP	62.90	14.27	10.20	4.62	3.03	1.54	1.56	1.89
AM42B	Kiln 3 wall	EV	ICP	63.13	13.61	9.54	6.15	2.87	1.52	1.36	1.82
AM42C	Kiln 3 wall	CV	ICP	60.02	15.67	11.28	4.93	3.18	1.59	1.29	2.04
AM24	khorfush	CV	SEM-EDS	59.6	16.4	12.9	4.9	2.0	0.0	1.7	2.5
AM25	khorfush	CV	SEM-EDS	64.2	15.1	10.4	5.0	1.5	0.0	1.7	2.1
AM26	khorfush	CV	SEM-EDS	60.3	17.6	10.8	5.6	1.6	0.0	1.7	2.3
AM45	Nile silt		ICP	57.09	16.70	11.88	6.53	3.31	1.13	1.38	1.99

Table A6.4. Chemical compositions of ceramics, kiln wall fragments and khorfush.
All analyses normalised to 100%
1 PV—partial vitrification; EV—extensive vitrification; CV—continuous vitrification

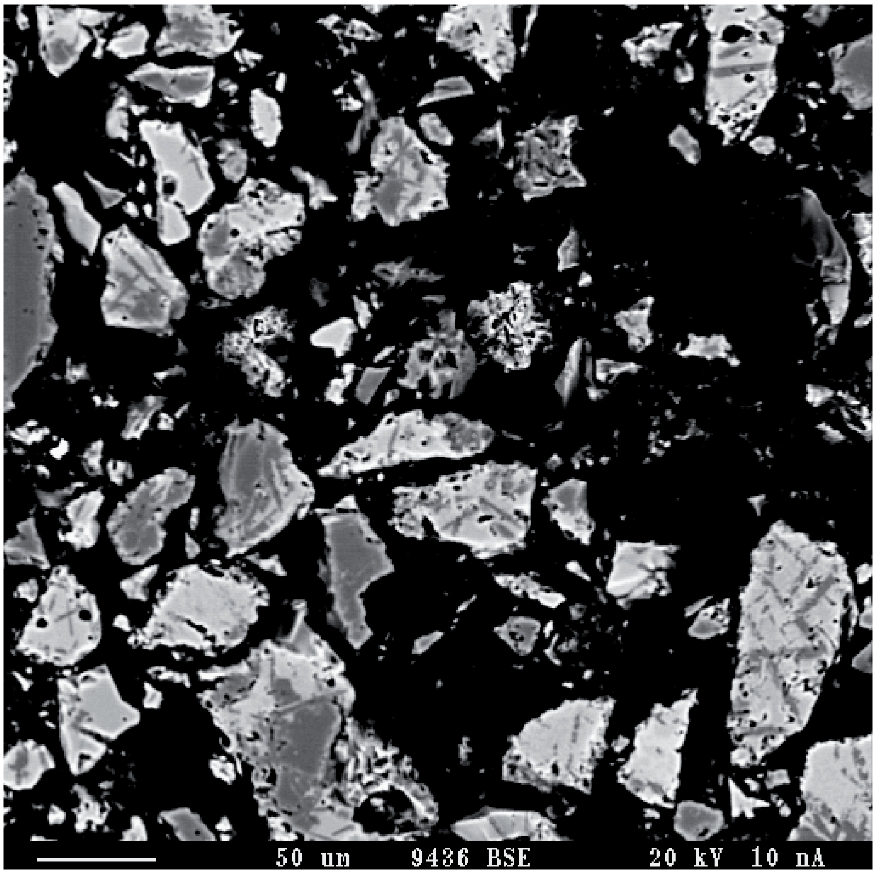


Plate A6.3. SEM photomicrograph of section through powdery residue of turquoise frit (AM7) showing isolated particles consisting of copper rich glass (lighter grey) containing both unreacted quartz and acicular cristobalite crystals (darker grey). The wollastonite crystals also present in the glass are not visible at this magnification.

Endnotes

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2. Research Laboratory for Archaeology and the History of Art, Dyson Perrins Building, South Parks Road, Oxford OX1 3QY, UK.

Section II

Finds Catalogue

Section II

Finds Catalogue

Finds Processing

All artefacts, soil samples and organic remains were examined during the course of the work.

Pottery

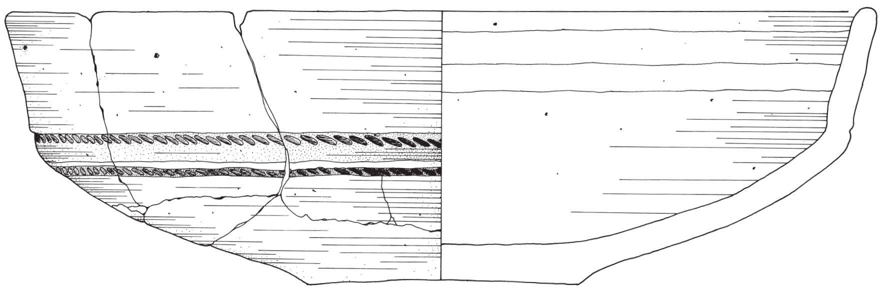
The most common find was pottery. The sherds from each context were examined together at the site. They were separated by broad fabric groups, such that silt, marl and imported fabrics were differentiated. These categories were then sorted into diagnostic and undiagnostic pieces. Diagnostic sherds comprised those with the remains of rims, bases, handles or decoration. Undiagnostic sherds were undecorated body sherds. Sherds of both diagnostic and undiagnostic types were counted and weighed. The undiagnostic material was then discarded. It was re-buried at the end of each excavation season.

The diagnostic material, bagged by context, was taken to the excavation house where it was later processed on a sherd-by-sherd basis, recording the fabric sub-type, ware, diameter and percentage of diameter, rim, handle or base type, vessel group and any additional comments relating to the piece. As is usual, this has been the most time consuming part of the work. It should be noted that fragments of cylindrical vessels were removed from the pottery sample and treated as small finds when the pottery was initially sorted on site. Any which were missed at this time were then collected during the more detailed processing of the pottery at the house. The pottery will be the subject of a separate study.

There were a number of unfired sherds from the work, and these two will be published separately. However, it is clear that the pottery workshop was producing a range of vessel types, including hearths (118000 reconstructed from unfired sherds; Fig. II.1).

"Slag"

The site also produced very large quantities of vitrified material which, for want of a better term, has been called "slag". This is not true slag (see Bachmann 1982:20) and seems to have no connection with metallurgy, rather it is the melted remains of the lining of the furnaces, of bricks and sometimes of ceramic vessels. All of the slag was also examined on site and weighed. A sample of this material was taken whenever it seemed to offer good evidence for the structure of the furnace or conditions therein. These samples were generally treated as small finds.



118000

0 10cm

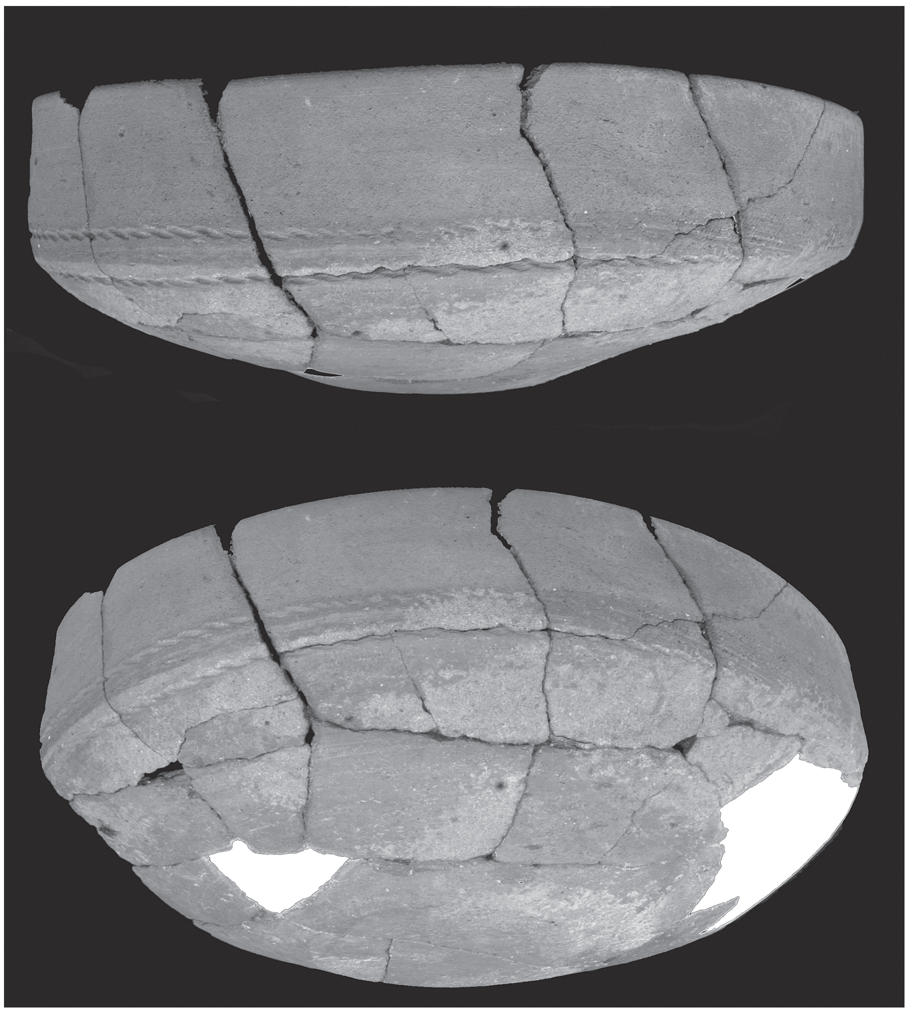


Figure II:1. Unfired hearth vessel (118000) reconstructed from sherds. (Photo: A. Stagg/E.E.S.).

Finds Catalogue

Small Finds

The small finds comprised all other artefacts, and presumed artefacts, from the site. These were bagged by square and context and returned to the excavation house for finds registration. The objects registrar then assigned a unique number to the object. Like the context numbers used on site there are gaps in the sequence, where succeeding finds numbers were assigned to material discovered in other excavations directed by Mr. Kemp in the winter season. In the same way as with context sheets there are occasional examples of a find being assigned a much higher number than others found in the same year, because it was for some reason recorded later.

Finds were recorded onto cards, the front of which has space for a description of the object along with its dimensions and other information. The reverse is blank and reserved for a drawing of the object. These drawings provide a useful record of the piece, and can often be traced for publication. However, any artefact recognised at the time as being something which would feature in publication was drawn by the illustrator in readiness for publication. Certain finds, for example amorphous pieces of plaster etc. were not drawn.

As might be expected it is difficult, over the course of several years and with different finds registrars whose field experience varies, to record all material consistently. It is also inevitable that as information grows so the nature of finds may be reinterpreted. This practice inevitably causes difficulties when sorting finds into categories. Furthermore, with a large volume of finds it would be a very time consuming task to sort through every individual card to find the required categories. As a result it was decided that the finds cards should be recorded onto an ACCESS database.

The ACCESS Database

The database, written in Microsoft ACCESS™, was devised by Rowena Hart and was modified by her on several occasions as the project continued. Paul McGeoghan of Cardiff University's Information Services Division assisted with the report format necessary for the database. The formatting of the database into a form suitable for transfer to Microsoft Word was undertaken by Cerian Whitehurst who also undertook much of the correcting of the format of the entries when transferred.

The database essentially mimics the cards, except that it does not have any illustrations included in it. It was obvious at an early stage that the inconsistencies in recording would be a difficulty, and it was possible to correct many of these on the basis of the description, illustration and photographs on the cards. However, it was known that the final season of work would be a study season during which it was intended that every find would be re-examined, and where necessary re-described at which point it could be corrected on the database.

A major study season took place in August–September 2004. At this time all finds were re-examined and any corrections/additions to their description made on the database. This work was carried out by Nicholson, in discussion with Hart who entered the details onto the database. As a result the database offers the most up-to-date and consistent record of the finds. It has been used in compiling the present publication.

Database Definitions

Certain materials can cause difficulties in describing them consistently for use in a database. One of these is glass. The problem stems from what exactly should be considered glass. For example, a glaze is actually a thin layer of glass. Should it therefore be classified as glass or glaze, or as part of the object it glazes? This is a particular problem for work on materials at the industrial site at Amarna because the glaze on faience has a different composition to that of deliberately produced glass. It can be hard to tell whether a tiny fragment of glass is *actually* glass or faience glaze which has become detached from an object. The problem is exacerbated in the case of tiny faience beads. These are so small that in firing, any core which they might have possessed is entirely fused into the glaze and what is left is actually a glass bead, though with the composition of faience (which is what the material should actually be classified as).

For the purpose of the finds database, "glass" has been defined as anything, whatever its thickness, which was probably intended to be a deliberate glass. It does not include granular material, which has been described as frit, and is probably to be related to pigment making—either for use in painting or in colouring faience. Where fragments of flat "glaze"' are found and are clearly from tiles or inlays they are recorded as "tile or inlay" fragment—rather than glass or glaze. This is because they would have the composition of faience glaze rather than that of true glass, and to include them as glass in the database would be misleading.

The Grouping of Objects

The objects unearthed from the excavation can be grouped in numerous ways—by material, by object type, by function etc. The nature of the excavations at O45.1, an industrial complex, leads to peculiar difficulties of interpretation. Thus, is a piece of broken faience the result of being discarded at the workshop, and so likely to be "industrial" in nature, or is it the result of breaking an item of "personal adornment" which was being worn as such? The problem is, perhaps, further complicated by the infilling of the complex before it was built over. Thus tile fragments have mostly been regarded as 'architectural' but could well be discards from the workshop if there is no evidence to suggest otherwise.

The scheme adopted here is by no means perfect, and is certainly open to criticism. However, the objects have been grouped according to their most likely setting. Thus a perfect faience bead is an item of "personal adornment" whilst a bead of the same type which is fused to a piece of pottery is "industrial". Since items are grouped by material within the broad categories it should not be difficult for anyone wishing to order the material in a different way to do so. In addition a list of finds ordered by material and another by finds number has also been provided.

After discussion with the Egypt Exploration Society it was decided that only a selection of finds would be produced in hard copy for this publication, with the complete list being given on an accompanying DVD. Thus all the finds are included though only a selection in print.

Objects Catalogue

Introduction

This catalogue contains only selected items, representing about 20% of the overall finds. The complete list with descriptions is given on the accompanying CD-ROM, and lists by finds number, by material, by object type and by unit are provided at the end of this selection.

The selection has been made for two reasons. First, the cost of producing a catalogue of over 2000 finds, many of which comprise industrial waste (slag, pieces of plaster lining, unworked stone fragments etc.) is prohibitively high. Second, the nature of the finds means that most of them do not require descriptions nor extensive literature review linking them to similar pieces, they are the waste products from an industrial estate, essential as a group for the study of the technologies taking place at O45.1, but most of them of little individual significance. What is provided here, therefore, are a selection of those finds which throw some light on the industrial processes as well as those finds of most interest within conventional Egyptology. Certain classes of find are covered in full, so that all jar sealings and all moulds for faience objects are given, whilst others receive only limited paper-publications, as is the case with many of the fragments of faience tile.

Where colours are described they are based on the Pantone colour system. Where no dimensions are given in the header for the find number they are given in greater detail in the description. Occasionally a small group of related objects have been listed under a single number and in these instances the dimensions generally accompany the individual descriptions.

Faience amulets have been typed to Brunton and Englebach's (1927) work on Gurob and are listed here as "Gurob" followed by the plate number.

Industrial

The items listed here comprise those which seem to me to be most relevant to the industrial processes carried out at site O45.1. As a result there are items of personal adornment which are in some way defective and as such have been discarded, never having been used. Whilst these could have been grouped as items of adornment, they have more relevance for what they reveal about technology and industrial practice at O45.1 than they do about personal dress.

Object 30668 Square M75 Unit 9004
Material 1 Faience Material 2 Charcoal.
Length 14.60 Breadth 13.60 Thickness 9.00
Object type Bead
Colour 3115C
Figure II.2.
Whitish cream, very friable cement-like material, into which a turquoise blue wafer bead (faience?) is set, edge inwards, revealing approximately two-thirds of its rim. On one surface of the bead there is a reddish brown lump of finer grained friable material. Just below this, and at right angles to the bead, a thin strip of charcoal is visible —about 5.2mm long.

Object 30693 Square M80 Unit 9006
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Bead
Colour Yellow
Figure II.2.
1. D 2.0mm T 1.0mm
Yellow faience (?) disc bead. Similar to Gurob Pl. xlii: 92C.
2. D 2.8mm T 1.1mm
Yellow faience ring bead. Thin protrusion to one side. Break in circumference, but no gap. Slight misalignment at ends of break. Part of glaze missing to reveal core. Similar to Gurob Pl. xlv: 85Q.
3. D 2.1mm T 2.1mm
Glass/faience (?) ring bead. Similar to Gurob Pl. xlv: 85Q.
4. D 1.8mm T 1.1mm
D 2.0mm T 1.0mm
Two yellow faience disc beads. Stuck together on edges of circumference. Similar to Gurob Pl. xlii: 92C.
5. D 2.0mm T 1.0mm
D 1.8mm T 1.1mm
Faience (?) disc beads x 2. Stuck on top of the thin sides and at right angles to each other. Similar to 92C.
6. D 2.1mm T 1.0mm
D 1.9mm T 0.9mm
Faience (?) disc beads x2. Stuck on edges of circumferences. Similar to 92C.
7. D 2.2mm (largest) 1.4mm (smallest) T 1.0mm
Cluster of 5 violet ring beads partly surrounding 1 yellow ring bead. Varying sizes.
85-T

Object 30779 Square M80 Unit 9012
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Bead
Colour 3115C
Figure II.1. & Plate 7.7.
Waster beads:
1. Flattish cluster of beads. Resembles collapsed and flattened piles (max. 4 beads) of beads (form 2 rows). Turquoise blue. Buff-coloured, friable concretions. 9 beads?
L 9.0mm B 5.0mm T 1.5mm
2. Chaotic cluster of beads. No clear orientation. Nine beads? Turquoise blue.
L 6.3mm B 4.0mm T 3.0mm

Object 31545 Square L80 Unit 8031
Material 1 Faience Material 2 Clay (unfired)
Length 7.00 Breadth 6.50 Thickness 3.50 Diameter 2.00
Object type Bead
Colour 295C
Four faience beads have been pushed into a small clay ball. Beads are a dull turquoise in colour. Impressions remain from three others.
Length, breadth and thickness are given for the clay ball, the diameter measurement is for the beads.

Object 31581 Square L80 Unit 8031
Material 1 Faience
Length 7.10 Breadth 5.50 Thickness 1.00 Diameter 5.10
Object type Bead
Colour 314C
Wafer bead that has not been cut properly. Its intended outline is visible.
Slightly larger Pl. XLV: 87F.

Object 31583 Square L80 Unit 8031
Material 1 Faience Material 2 Clay (unfired)
Length 5.00 Breadth 4.20 Thickness 4.00 Diameter 2.00
Object type Bead
Colour 325C
Small unfired clay ball with a possible disc bead pressed into it. Bead is a bright light turquoise green.

Crucible Fragments

The fragments described here as of "crucibles" are generally thick walled and contain traces of copper or copper alloy. There are relatively few finds indicating metallurgy at site O45.1, and it is possible that these small traces of metallurgical activity are in some way related to the production of colourants for glass and faience, or to the fashioning of small items for use in the workshops.

Object 31731 Square J85 Unit 9432
Material 1 Ceramic Material 2 Slag
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Crucible fragment
Two fragments of dark slag material attached to (silt) ceramic. 1. Ceramic has been burned black apart from one side which is red, there is a thin layer of greyish slag on the top which is dull and which has traces of green pigment on. 2. Ceramic fragment covered with a layer of glassy slag, dark green/black colour which in turn has a layer of green pigment on it.
1. L 27.0mm; B 21.0mm; T 16.0mm
2. L 24.0mm; B 22.5mm; T 12.5mm

Object 31774 Square J80 Unit 9438
Material 1 Ceramic Material 2 Metal (copper/ copper alloy)
Length 22.50 Breadth 19.50 Thickness 12.00
Object type Crucible fragment
Fragment of ceramic crucible with layer of slag or vitrified ceramic surface with areas of bright green copper corrosion on the interior of the fragment.

Object 31843 Square J85 Unit 9443
Material 1 Ceramic Material 2 Slag
Length 28.00 Breadth 25.50 Thickness 13.50
Object type Crucible fragment
Rim fragment of ceramic crucible—black from burning and coated on the inside with a slag, probably from metallurgy.

Object 31847 Square J85 Unit 9434
Material 1 Ceramic Material 2 Metal (copper/ copper alloy)
Length 36.50 Breadth 26.00 Thickness 15.00
Object type Crucible fragment
Fragment of vitrified ceramic (silt) which is covered with a thin layer of green copper corrosion product.

Object 32335 Square K80 Unit 7982
Material 1 Ceramic Material 2 Slag
Length 67.50 Breadth 29.00 Thickness 24.00
Object type Crucible fragment
Figure II.2.
Rim fragment of a crucible. Ceramic is fairly coarse with small stones and lime inclusions as well as impressions left by organic inclusions. Inner surface is covered in a layer of vesicular slag which has a green colouration to surface suggesting it is a copper corrosion product.

Object 32344 Square L75 Unit 9019
Material 1 Ceramic
Length 26.00 Breadth 36.50 Thickness 14.00
Object type Crucible fragment
Rim fragment from a ceramic crucible; edges, rim and inner surface appear burnt/blackened. Inner surface has a layer of rough slag covering it. No metal visible.

Object 32345 Square M75 Unit 8979
Material 1 Ceramic Material 2 Slag
Length 105.00 Breadth 85.00 Thickness 50.50
Object type Crucible fragment
Figure II.2.
Fragment of crucible with the interior of the ceramic slagged. The interior surface comprises metal working slag and/or copper corrosion product.

Object 32348 Square M80 Unit 9022/9023
Material 1 Ceramic Material 2 Slag
Length 105.00 Breadth 78.50 Thickness 48.00
Object type Crucible fragment
Figure II.2.
Fragment of crucible with thick layer of slag on the interior. On the surface of this there are traces of copper working slag and copper corrosion products up to 6mm thick.

Cylindrical Vessels

All the fragments of cylindrical vessel from the site are listed here, as they seem to be fundamental to the identification of sites producing vitreous materials. All are of similar silt fabric and of similar form.

Object 30550 Square M75 Unit 8979
Material 1 Ceramic Material 2 Frit
Length 70.00 Breadth 65.20 Thickness 24.00
Object type Cylindrical Vessel
Figure II.3.
Cylindrical vessel base with blue frit showing granules of unreacted quartz, adhering to bottom. The ceramic is distorted (not flat) by heat. Calcareous coating adheres to the ceramic and frit on one surface and overlies ceramic but underlies patches of frit on other surface. Ceramic matrix appears fine grained, quite dense, and is dark grey. Surface with thickest frit layer has frit in peaks with evidence of sizeable air bubbles in the frit.

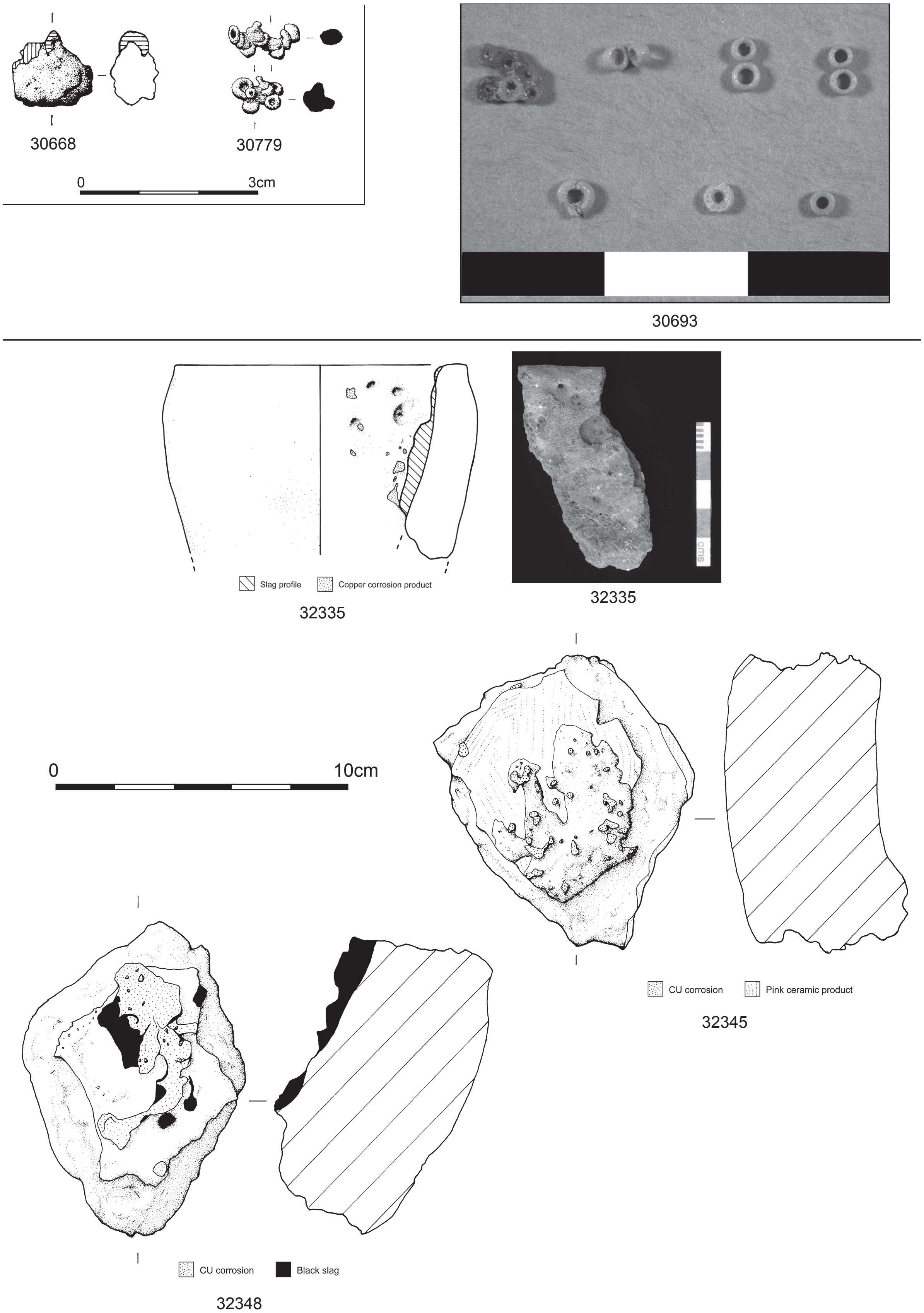


Figure II.2. Beads in matrix and adhering to one another (top) and crucibles (bottom).

Object 30655 Square M75 Unit 8979
Material 1 Ceramic Material 2 Glass
Length 43.20 Breadth 27.30 Thickness 13.20
Object type Cylindrical Vessel
Fragment of vessel rim covered in interior and part of exterior with turquoise-blue glass. Blue vitreous material covers top of rim and one run is seen on outer external surface of ceramic. Red silt ceramic with lime inclusions in fabric. Possibly fabric I:4. On interior both underlying and overlying the glaze are patches of lime.

Object 31650 Square J80 Unit 9440
Material 1 Ceramic
Length 46.20 Breadth 50.00 Thickness 21.00 Diameter 180.00
Object type Cylindrical Vessel
Fragment of cylindrical vessel—the interior base can be seen whilst on the exterior bottom is attached a large area of pale green/blue glass. Interior has white calcareous slip. 6% of the diameter is preserved.

Object 31661 Square K75 Unit 9431
Material 1 Ceramic
Length 124.00 Breadth 84.50 Thickness 60.00 Diameter 200.00
Object type Cylindrical Vessel
Fragment of cylindrical vessel with calcareos lining still semi-intact on the interior. Base and lower wall of vessel preserve a calcareous slip inside. Traces of copper blue glass and also very pale green/white are adhering to the underside of the vessel. Traces of glass on the interior. 20% of diameter preserved.

Object 31679 Square J80 Unit 9438
Material 1 Ceramic Material 2 Glass
Length 67.00 Breadth 33.90 Thickness 12.00 Diameter 160.00
Object type Cylindrical Vessel
Rim sherd of silt ceramic which is coated on the inside with a top layer of green blue glass. 6% of diameter preserved.

Object 31682 Square J80 Unit 9438
Material 1 Ceramic Material 2 Glass
Length 31.20 Breadth 35.90 Thickness 11.00 Diameter 180.00
Object type Cylindrical Vessel
Figure II.3.
Fragment of the rim of a cylindrical vessel which has turquoise blue glass running down either side, but only near the top. Thick glass, up to 5mm, forming a thin ridge than runs along the inside of the rim. 9% of diameter preserved.

Object 31691 Square J85 Unit 9438
Material 1 Ceramic Material 2 Glass
Length 53.00 Breadth 28.5 Thickness 16.5 Diameter 180.00
Object type Cylindrical Vessel
Fragment from the base of silt ceramic cylindrical vessel. No original surfaces survive.
9% of diameter preserved.

Object 31817 Square J80 Unit 9459
Material 1 Ceramic
Length 85.40 Breadth 73.80 Thickness 28.80 Diameter 200.00
Object type Cylindrical Vessel
Vitrified ceramic fragment from a cylindrical vessel. Very blackened and full of air holes; very hard (probably fabric I:4). On its interior surface it still has a very thin layer of slip. 15% of diameter preserved.

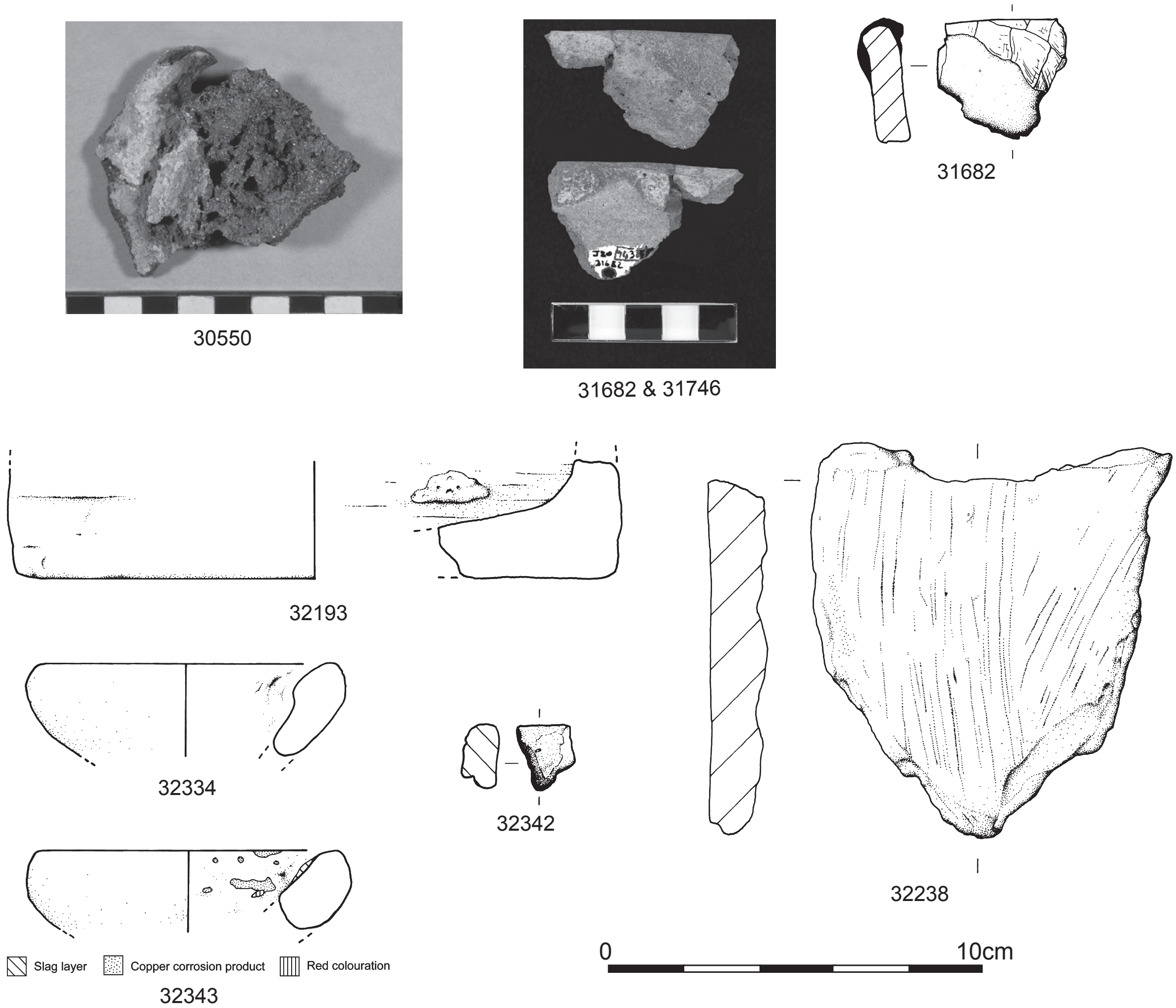


Figure II.3. Cylindrical vessel fragments.

Object 31853 Square J85 Unit 9443
Material 1 Ceramic
Length 70.50 Breadth 90.90 Thickness 26.50 Diameter 180.00
Object type Cylindrical Vessel
Five joining fragments from the base and side of one cylindrical vessel made of silt ceramic. Now re-adhered to form one larger fragment.
The thickness measurement given is that of the base. The thickness of the wall is 15.5mm. 16% of diameter preserved.

Object 31869 Square Surface Unit Surface
Material 1 Ceramic
Length 75.50 Breadth 51.00 Thickness 23.80
Object type Cylindrical Vessel
Fragment of silt ceramic cylindrical vessel base, under the yellow layer of calcareous slip the ceramic looks very burnt (black), gradually changing to purple towards the exterior of the base. Over fired.

Object 31882 Square J80 Unit 9440
Material 1 Ceramic
Length 49.50 Breadth 42.00 Thickness 27.50 Diameter 180.00
Object type Cylindrical Vessel
Ceramic fragment of part of the base of a cylindrical vessel. String cut. 8% of diameter preserved.

Object 31889 Square J85 Unit 9434
Material 1 Ceramic
Length 88.90 Breadth 54.00 Thickness 13.00 Diameter 160.00
Object type Cylindrical Vessel
Three fragments from the wall and part of the base of a cylindrical vessel. Ceramic is very black as if burnt. Overlying the calcareous slip on the inside is a thick layer of hard, chalky-looking material rich in lime and silica. This could be the remains of unreacted batch materials. Three fragments have been joined together to form one piece. 14% of diameter preserved.

Object 31894 Square J80 Unit 9459
Material 1 Ceramic
Length 93.00 Breadth 58.50 Thickness 32.50 Diameter 160.00
Object type Cylindrical Vessel
Base of cylindrical vessel which has become vitrified. Bloated and over-fired. Calcareous slip survives inside. 18% of diameter preserved though the inside of the vessel base and the wall has broken away.

Object 31943 Square J85 Unit 9449
Material 1 Ceramic Material 2 Glass
Length 26.10 Breadth 14.60 Thickness 18.90
Object type Cylindrical Vessel
Fragment of silt ceramic cylindrical vessel with a layer of weathered copper green/blue glass on one surface.

Object 31963 Square J80 Unit 9438
Material 1 Ceramic Material 2 Glass
Length 26.90 Breadth 24.00 Thickness 12.00
Object type Cylindrical vessel
Silt ceramic rim of a cylindrical vessel. One side has copper green/blue glass adhering to it.

Object 32193 Square K85 Unit 7962
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 180.00
Object type Cylindrical Vessel
Figure II.3.
Fragment of base and wall of a silt ceramic cylindrical vessel. The inner surface appears to have a patch of devitrified glass adhering to it at the base of the wall. The fragment is overfired. 5% of diameter preserved.

Object 32202 Square K75 Unit 9481
Material 1 Ceramic
Length 55.00 Breadth 47.00 Thickness 18.00
Object type Cylindrical Vessel
Fragment of silt ceramic (fabric I:1) cylindrical vessel which has been over fired. Brick red one side, yellow grey the other. One edge has a patch of hard white substance adhering to it. Purple patches on yellow grey side.

Object 32203 Square K75 Unit 9481
Material 1 Ceramic
Length 37.00 Breadth 37.00 Thickness 11.00 Diameter 180.00
Object type Cylindrical Vessel
Rim fragment of silt ceramic cylindrical vessel. Inner surface has a hard white substance adhering to it and possibly also a lump of devitrified glass. Slight traces of blue glass and lime on the interior. 5% of diameter preserved.

Object 32238 Square L75 Unit 9002
Material 1 Ceramic
Length 112.00 Breadth 106.00 Thickness 15.00 Diameter 180.00
Object type Cylindrical Vessel
Figure II.3.
Base of a cylindrical vessel. Underside has been scraped and shows striations and has a slightly white firing surface. The surface of the inside of the base and the walls has been lost, perhaps as a result of removing glass, no traces of glass remain. Vessel fabric is hard and contains particles of limestone—probably fabric I:4. 20% of diameter preserved.

Object 32334 Square K80 Unit 7966
Material 1 Ceramic
Length 97.50 Breadth 73.00 Thickness 14.50
Object type Cylindrical Vessel
Figure II.3.
Fragment of a silt ceramic potters bat (fabric I:4). It has one finished edge which along with the two surfaces are covered with impressions left by organic material probably chaff. The upper surface has a white bloom. 15% of 180mm diameter preserved.

Object 32341 Square L75 Unit 8979
Material 1 Ceramic
Length 48.00 Breadth 28.00 Thickness 13.00
Object type Cylindrical Vessel
Fragment of ceramic cylindrical vessel, covered in white slip on both sides. The inside has begun to fuse. Clear circular grooves on inside and outside from wheel forming process.

Object 32342 Square L75 Unit 8979
Material 1 Ceramic Material 2 Glass
Length 17.00 Breadth 15.00 Thickness 11.50
Object type Cylindrical Vessel
Figure II.3.
Tiny fragment of cylindrical vessel rim, coarse silt fabric. Pinkish white one side. Top of rim and interior covered in a layer of turquoise blue glass, opaque.

Object 32343 Square L75 Unit 9010
Material 1 Ceramic Material 2 Slag
Length 22.50 Breadth 35.00 Thickness 14.50
Object type Crucible
Figure II.3.
Fragment of rim from a crucible. Fragment is heavily slagged on interior. Inner surface and edge of rim covered in a layer of black slag which in turn has patches of green and red colouration on—possibly copper and iron present in slag.

Object 32346 Square K80 Unit 7998
Material 1 Ceramic Material 2 Glass
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 160.00
Object type Cylindrical Vessel
Figure II.4.
Large fragment of ceramic cylindrical vessel base. Patches of grey colouration with a slight blue tinge—possibly from glass. The edges are covered in lime. Exterior has blue glass running down it. Underside has an area of thin dark copper blue glass, also a layer of yellow plaster stuck to it which shows clear organic material impressions from decayed inclusions and dark brown inclusions. 45% of diameter preserved.
L 155.0mm; B 142.0mm; T 20.0mm

Object 32347 Square L75 Unit 9026
Material 1 Ceramic
Length 133.00 Breadth 81.00 Thickness 23.00 Diameter 160.00

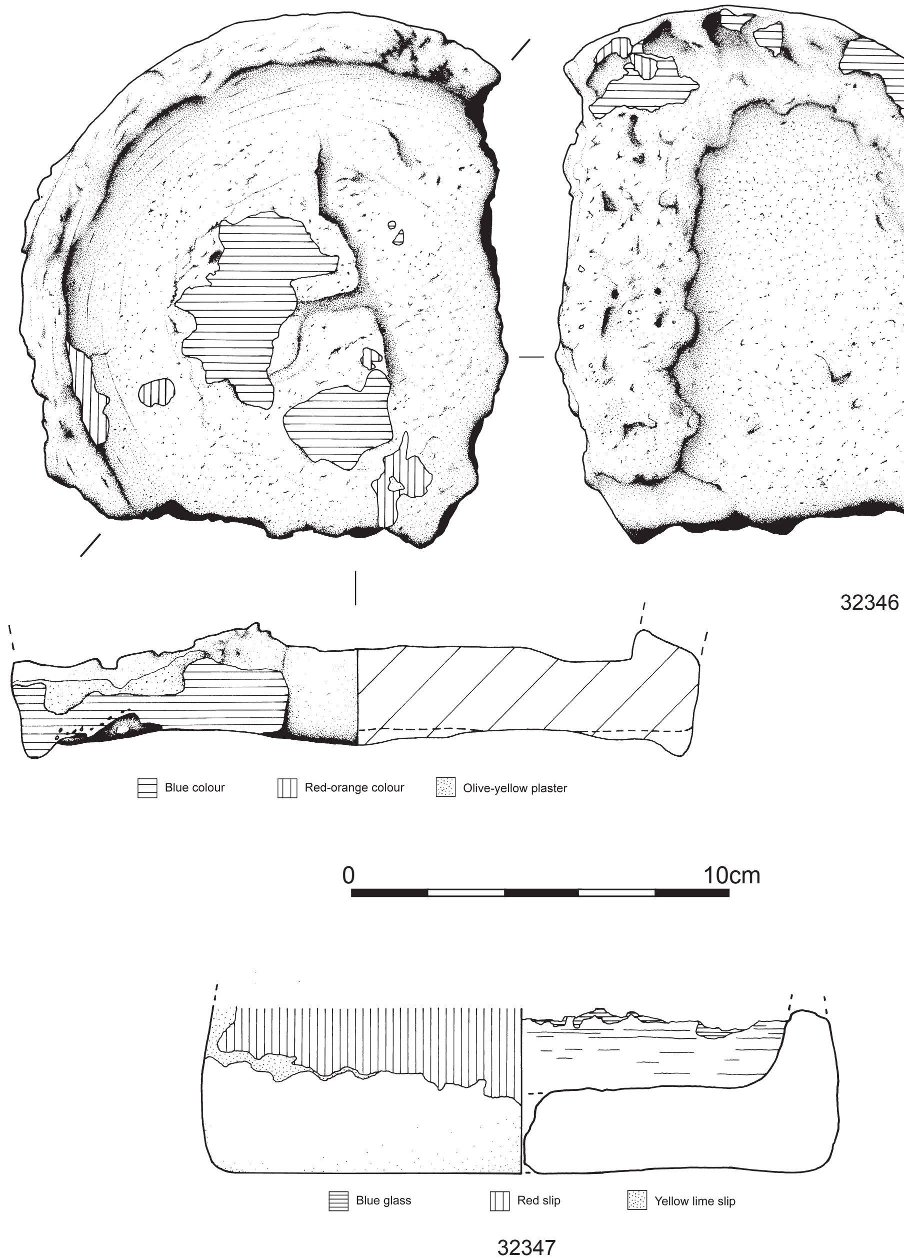


Figure II.4. Cylindrical vessel fragments.

Object type Cylindrical Vessel
Figure II.4.
Vitrified fragment of cylindrical vessel base. Blackened on the top edge and down inside vessel. Calcareous slip on interior mostly lost. Exterior surface is covered by a thin layer of clay. This lays above the original surface. Traces of glass remain on the interior. The thickness given is that of the base, the thickness of the wall = 17mm. 27% of diameter preserved.

Object 32350 Square K80 Unit 7966
Material 1 Ceramic Material 2 Slag
Length 47.00 Breadth 52.00 Thickness 12.00 Diameter 180.00
Object type Cylindrical Vessel
Silt ceramic rim fragment from a cylindrical vessel, surface on exterior has flaked off in patches. The interior has white calcareous slip. Rim edge covered in a thin layer of blue opaque glass. 8% of diameter preserved.

Object 32351 Square L80 Unit 7974
Material 1 Ceramic Material 2 Glass
Length 57.00 Breadth 46.00 Thickness 12.50
Object type Cylindrical Vessel
Coarse silt ceramic fragment of cylindrical vessel, yellow slip outside, lime patches on interior surface in rough surface also has a patch of copper turquoise blue glass—some on surface and some in a ridge running through the middle of the patch. The fragment may be from very near the base of the vessel.

Object 32427 Square K85 Unit 8036
Material 1 Ceramic
Length 100.00 Breadth 95.50 Thickness 11.50 Diameter 180.00
Object type Cylindrical Vessel
Fragment of cylindrical vessel in silt fabric—inside has blue frit on the bottom which has eaten into the slip on the interior vessel wall. The rim is uneven, perhaps from wear. 16% of diameter preserved.
Thickness varies 11.5mm to 19.5mm.

Object 33394 Unit 10171
Material 1 Ceramic Material 2 Glass
Length 72.00 Breadth 71.00 Thickness 15.00 Diameter 180.00
Object type Cylindrical Vessel
Rim sherd of a cylindrical vessel. White calcareous coating on the inside (hardly any glaze). On the inside some wheel marks visible. On the outside there is turquoise and dark-green glass on the rim and running down the walls. Some limestone inclusions in fabric, probably I:4. 9% of diameter preserved.

Object 33460 Square K100 Unit 10173
Material 1 Ceramic Material 2 Glass
Length 92.00 Breadth 68.00 Thickness 26.00 Diameter 190.00
Object type Cylindrical Vessel
Base fragment of a cylindrical vessel. Exterior on one edge slightly vitrified. White coating on the interior, slight traces of green glass. String cut base.

Object 33461 Square K100 Unit 10173
Material 1 Ceramic
Length 60.00 Breadth 53.00 Thickness 23.00 Diameter 190.00
Object type Cylindrical Vessel
Base fragment of a cylindrical vessel. White coating on the inside.

Object 33462 Square K100 Unit 10173
Material 1 Ceramic
Length 80.00 Breadth 42.00 Thickness 25.00 Diameter 180.00
Object type Cylindrical Vessel
Base fragment of a cylindrical vessel. White coating on the inside.
15% of diameter preserved.

Object 33497 Square K100 Unit 10178
Material 1 Ceramic Material 2 Glass
Length 64.00 Breadth 54.00 Thickness 11.50 Diameter 240.00
Object type Cylindrical Vessel
Rim sherd of a cylindrical vessel. White lining on the inside (hardly any glaze), dark-green glass on the interior of the rim. 7% of diameter preserved.

Object 33546 Square M75 Unit 10187
Material 1 Ceramic Material 2 Glass
Length 68.00 Breadth 39.00 Thickness 17.00
Object type Cylindrical Vessel
Rim fragment of a cylindrical vessel. Coarse silt fabric with white coating on the interior up to the rim. Remnants of light copper green glass overlie the white coating and show many “air bubbles”. Too small to diameter.

Object 33653 Square M75 Unit 10187
Material 1 Ceramic Material 2 Glass
Length 54.00 Breadth 39.00 Thickness 13.00 Diameter 200.00
Object type Cylindrical Vessel
Rim sherd of a cylindrical vessel. White coating layer on the interior, some remnants of greyish/white glass near the rim on the inside. Two specks of glaze on the exterior.
5% of diameter preserved.

Object 33838 Square K90 Unit 10185
Material 1 Ceramic Material 2 Glass
Length 48.00 Breadth 38.00 Thickness 14.00
Object type Cylindrical Vessel
Roughly square fragment of a cylindrical vessel. Cobalt -blue glass on one surface, c.1.5mm thick. Too small to diameter.

Object 33839 Square K90 Unit 10185
Material 1 Ceramic Material 2 Glass
Length 39.00 Breadth 29.00 Thickness 13.00
Object type Cylindrical Vessel
Fragment of a cylindrical vessel, cracked and the glaze penetrating through the crack.
Too small to diameter.

Object 33981 Square K115 Unit 10207
Material 1 Ceramic
Length 32.00 Breadth 38.00 Thickness 8.00 Diameter 180.00
Object type Cylindrical Vessel
Rim sherd of a thin cylindrical vessel. Traces of dark copper blue glass extend from the interior over the rim and become more extensive on exterior.
6% of diameter preserved.

Object 34077 Square M85 Unit 10179
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 170.00
Object type Cylindrical Vessel
Base of a cylindrical vessel. Wheel marks visible.
20% of diameter preserved.

Object 34191 Square K80 Unit 7998
Material 1 Ceramic Material 2 Glass
Length 155.0 Breadth 142.0 Thickness 20.0
Object type Cylindrical Vessel
Figure II.5.
Fragment of cylindrical vessel. Exterior is yellow/white and is probably a firing surface. This surface extends to the underside of the base. There is a run of deep copper blue glass on the exterior. On the interior only the angle between the wall and base remains. This has a white calcareous slip. Adhering to it is a patch of copper blue glass

Object 34208 Square J85 Unit 9438
Material 1 Ceramic
Length 48.00 Breadth 30.00 Thickness 19.00
Object type Cylindrical Vessel
Fragment of a base of a cylindrical vessel with traces of dark blue glass to the underside of the vessel.

Object 34218 Unit Surface
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 180.00
Object type Cylindrical Vessel
Base of a cylindrical vessel. White coated on interior. String cut base. 12% of diameter preserved.

Object 34219 Square Surface Unit Surface
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 180.00
Object type Cylindrical Vessel
Base of a cylindrical vessel. White coated inside. Base has a layer of dark copper (possibly cobalt-) blue glass. Finger print on exterior. 16% of diameter preserved.

Object 34220 Unit Surface
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 180.00
Object type Cylindrical vessel
Possibly the base of a cylindrical vessel. Base has adhering dark copper blue glass.

Object 34241 Square WT Unit Western spoil heap
Material 1 Ceramic Material 2 Slag
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 180.00
Object type Cylindrical Vessel
Rim fragment of cylindrical vessel. The vessel wall has over-vitrified to slag. Interior surface is missing. 7% of diameter preserved.

Object 34242 Square WT Unit Western spoil heap
Material 1 Ceramic Material 2 Lime
Length 46.72 Breadth 25.68 Thickness 19.46
Object type Cylindrical Vessel
Fragment of cylindrical vessel with lime adhering.

Object 34243 Square WT Unit Eastern spoil heap
Material 1 Ceramic Material 2 Glass
Length 83.81 Breadth 46.74 Thickness 27.14
Object type Cylindrical Vessel
Fragment of slagged cylindrical vessel. Some of the white coating on the interior survives. The exterior has some adhering glass.

Object 34261 Square L75 Unit 9019
Material 1 Ceramic
Length 64.00 Breadth 46.00 Thickness 9.00 Diameter 180.00
Object type Cylindrical Vessel
Rim of cylindrical vessel. White coating on interior and white firing surface on exterior. Slightly pinkish on all surfaces—including broken edges—perhaps from contact with pigment perhaps post breakage. 11% of diameter preserved.

Object 30656 Square M75 Unit 8981
Material 1 Ceramic—silt Material 2 Glass
Length 40.10 Breadth 28.20 Thickness 13.00 Diameter
Object type Cylindrical Vessel
Rim fragment of silt fabric cylindrical vessel. Calcareous slip on interior. Outer surface and top of rim covered in turquoise blue glass. One horizontal line of thicker turquoise glaze running almost perpendicular to rim top. Small white specks of calcareous material interspersed within glaze.

Object 31681 Square J80 Unit 9438
Material 1 Ceramic—silt Material 2 Frit
Length 42.00 Breadth 25.00 Thickness 18.20
Object type Cylindrical Vessel
Figure II.5.
Fragment of silt ceramic, apparently part of a cylindrical vessel which has a piece of blue frit attached to it on one side.

Object 31777 Square J85 Unit 9432
Material 1 Ceramic—silt
Length 39.50 Breadth 31.40 Thickness 15.50
Object type Cylindrical Vessel
Silt ceramic fragment from a cylindrical vessel. The interior has a layer of yellow overlain by white, but as these grade together it is likely that the change in colour is the effect of heating on the calcareous lining.

Object 31792 Square J85 Unit 9431
Material 1 Ceramic—silt
Length 43.20 Breadth 34.50 Thickness 20.50
Object type Cylindrical Vessel
Fragment of cylindrical vessel base—ceramic silt. Pale green/blue glass approx. 1mm thick on the interior of the vessel.

Object 31816 Square J85 Unit 9433
Material 1 Ceramic—silt
Length 53.90 Breadth 28.30 Thickness 16.50 Diameter 170.00
Object type Cylindrical Vessel
Fragment of silt ceramic cylindrical vessel base. The interior retains a thin layer of yellow-coloured calcareous slip.
8% of diameter preserved.

Calcarous Matrix

Object 30742 Square M80 Unit 9006
Material 1 Calcareous matrix Material 2 Faience
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Figure II.5 & Plate 7.4.
Eighteen angular fragments of calcareous matrix, fairly fine-grained material with inclusions of charcoal, ceramic, lime and quartz sand. Colour range from creamy white to greyish brown. All fragments have dark copper blue or turquoise faience beads embedded in them. In some cases, beads are sandwiched between layers of calcareous material; in others, the beads sit on the surface of the fragment. One fragment (the darkest colour) appears to have been overheated and the beads have melted/become slaggy. Bead types range from ring/disc to wafer through multiple beads (both flat and cylinder multi-section). There are two examples of a bead has been pressed into unfired clay pad and this has then been covered by the calcareous matrix.
Size range: L 3.0 --26.4mm; B 2.7 -- 20.6mm; T 2.0 -- 12mm

Object 32174 Square M75 Unit 8976
Material 1 Calcareous Matrix
Length 105.50 Breadth 58.00 Thickness 52.50
Object type Fragment
Large lump of lime plaster of the type used to make trays but containing ceramic, glazed red sandstone, charcoal and quartz pebbles. One surface (top) has 2 balls of the lime plaster material adhering to it. Each c.1cm diameter. This same surface is also covered in thin grainy mud and has small flecks of charcoal, ceramic and quartz.

Object 32244 Square M80 Unit 9006
Material 1 Calcareous matrix
Length 35.00 Breadth 30.00 Thickness 38.00
Object type Fragment
Eight fragments of lime plaster material. Containing fragments of ceramic, mudbrick, charcoal and quartz pebbles. The largest piece has faience beads/bead fragments. One surface has a grey muddy layer with fine fragments of charcoal and ceramic embedded in it. Other fragments are smaller examples of the same material. Dimensions for largest fragment. Weight of group 54g.

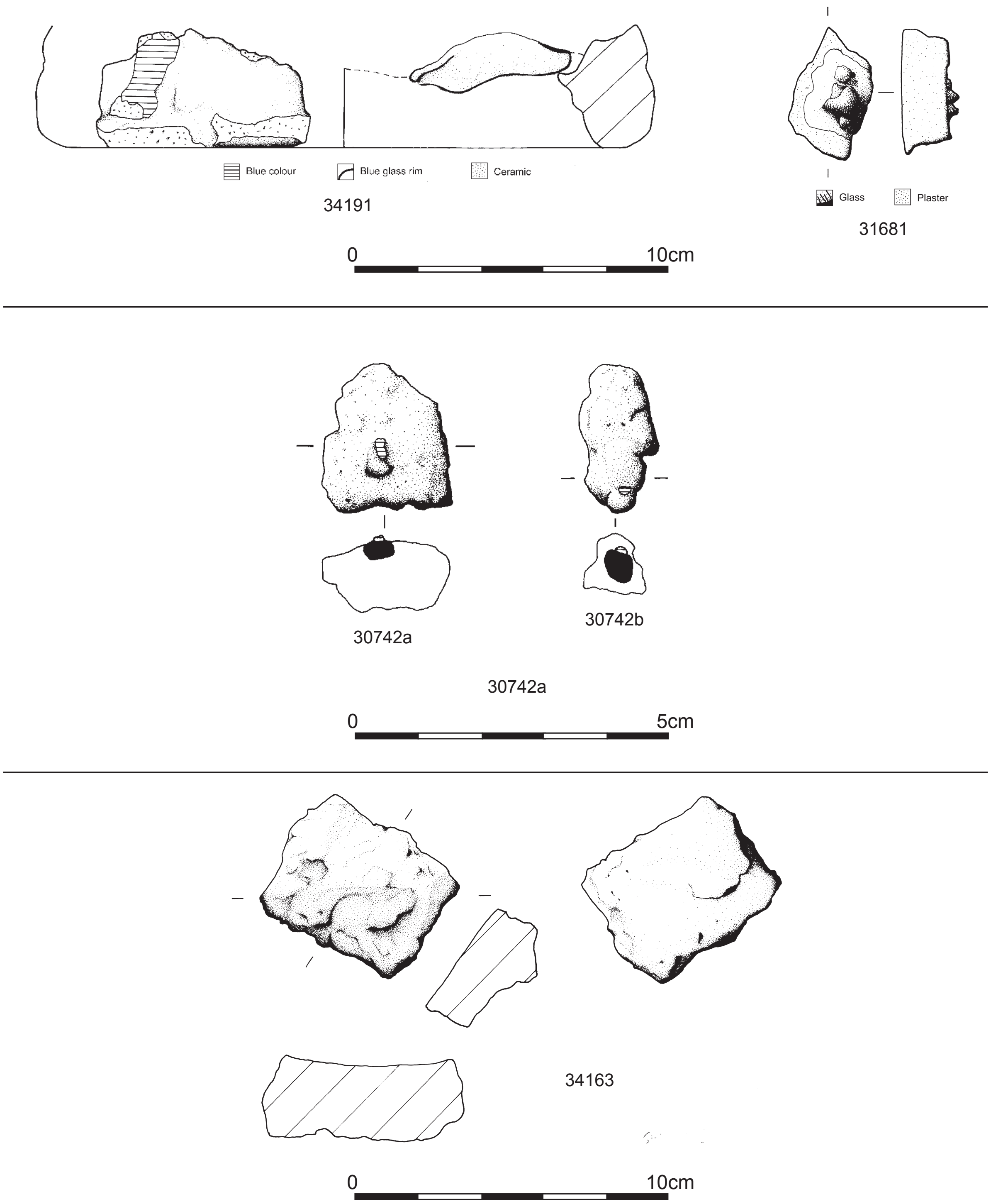


Figure II.5. Cylindrical vessel fragments (top), beads in matrix (centre) and clay (bottom).

Ceramic

Object 32239 Square L75 Unit 8979
Material 1 Ceramic Material 2 Pigment
Length 105.50 Breadth 93.50 Thickness 14.50
Object type Fragment
Six joined fragments which go to make up a section of the body of a hearth bowl. Covered in pink and yellow powdery pigment inside and out and also on the outer side has impressions left by rope tied round bowl. Fabric is I;1/I:4 with reaction rims from burned limestone. Adhering red and yellow pigment on both surfaces. It is possible that this pigment is in fact the mixture for a fugitive slip as used by contemporary potters at Deir Mawas.

Object 33500 Square K100 Unit 10178
Material 1 Ceramic
Length 105.00 Breadth 62.00 Thickness 35.00
Object type Fragment
Part of a thick walled industrial vessel. Red ceramic with black core, white lining as on cylindrical vessel, on interior. Coarse fabric.

Clay

Object 30822 Square M80 Unit 9006
Material 1 Clay Material 2 Glass
Length 5.90 Breadth 4.00 Thickness 2.90
Object type Fragment
Tiny sphere of glass, on brown, fine-grained clay fragment. The glass is green; damaged portion shows darker green, unweathered, interior.
Copper: approx 1.2mm of the sphere visible.<1g weight.

Object 34155 Square M75 Unit 9005
Material 1 Clay
Length 83.37 Breadth 67.70 Thickness 19.94
Object type Fragment
Fragment of clay smoothed on the interior where it was pressed against the exterior of a vessel wall. Tiny flecks of charcoal, sand and quartz pebbles adhere to the lower half of its slightly rough exterior. Voids from decayed organic material.

Object 34163 Square M75 Unit 9014
Material 1 Clay
Length 57.49 Breadth 42.53 Thickness 23.08
Object type Fragment
Figure II.5.
Fragment of clay that has been adhered to the exterior of a vessel. The interior surface of the clay is smooth and the exterior quite rough. Fabric is closely similar to the unfired sherds from O45.1 but a bit finer. Distinct from the fabric of the other jar sealings which tends to be coarser with many voids.

Variant D Faience

Object 31953 Square J85 Unit 9454
Material 1 Faience
Length 13.20 Breadth 12.50 Thickness 8.30
Object type Fragment
Colour 295C
Fragment of variant D faience (Lucas 1962:163–64) with Variant A slip, as confirmed by Andrew Shortland. The fragment has a pale blue colour to its core and areas of dark blue fired surface which underlies a layer of the blue turquoise faience glaze, which is quite fragmented though the remaining areas still retain a sheen.

Frit

Object 31653 Square J85 Unit 9439
Material 1 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Two fragments of Egyptian greenish pigment - one piece is dense and sandy looking. The other more porous and friable.
1. L 14.5mm; B 10.9mm; T 7.2mm
2. L 13.9mm; B 8.9mm; T 5.5mm

Object 33557 Square M85 Unit 10179
Material 1 Frit
Length 10.00 Breadth 8.00 Thickness 2.00
Object type Fragment
Fragment of blue frit, light blue in colour with some dark blue spots on one surface. Straw inclusions stuck to the underside.

Object 33606 Square M85 Unit 10179
Material 1 Frit
Length 15.00 Breadth 11.00 Thickness 4.00
Object type Fragment
Fragment of green frit, granular surfaces. On one surface some white inclusions.

Object 33692 Square M85 Unit 10189
Material 1 Frit
Length 16.00 Breadth 11.00 Thickness 10.00
Object type Fragment
Figure II.6.
Coarse, dark blue frit with unreacted silica. Probably the first stage in making Egyptian blue frit.

Object 33951 Square M85 Unit 10202
Material 1 Frit
Length 37.00 Breadth 22.00 Thickness 19.00
Object type Fragment
Fragment of green frit, light blue in colour, irregular in shape, some buff-coloured encrustations.

Object 30352 Square M80 Unit 7961
Material 1 Glass
Length 22.70 Breadth 15.50 Thickness 8.60
Object type Drip
Colour Copper Blue
Figure II.6.
Transparent dark blue glass. V-shaped drip of waste glass—tapers toward bottom of V-shape. Pitted exterior surface due to weathering. Colour possibly due to copper.

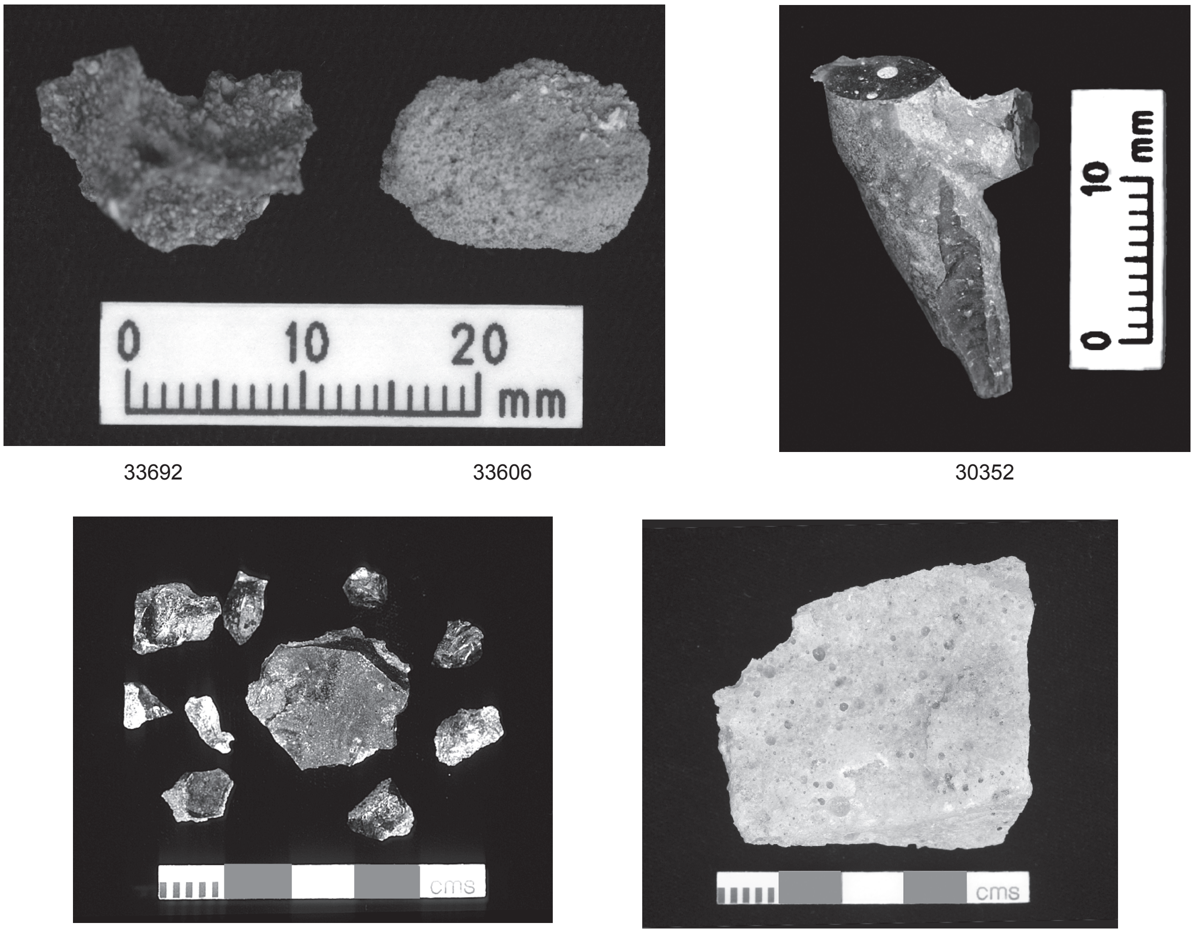
Object 30736 Square L80 Unit 7974
Material 1 Glass
Length 38.00 Breadth 20.50 Thickness 13.00
Object type Drip
Colour Copper Blue
Copper blue glass drip/run in 2 sections (broken to reveal shiny, bright blue interior). Weathered and slightly rounded and nodular exterior. Buff friable material adheres, in varying thicknesses, to all surfaces. Oxidised to red patches within the glass. Lime adhering.

Object 30643 Square M80 Unit 8992
Material 1 Glass
Length 7.30 Breadth 5.80 Thickness 1.80
Object type Fragment
Colour Turquoise
Flat fragment of light turquoise opaque glass. Triangular with concave sides and blunt points. All sides are broken. Signs of air bubbles. Fine, buff-coloured material adheres to flat surfaces. Possibly remains of glass strip.

Object 30665 Square M75 Unit 9004
Material 1 Glass Material 2 Ceramic
Length 11.55 Breadth 7.38 Thickness 3.65
Object type Fragment
Colour Copper Blue
Fragment of translucent copper blue glass adhering to ceramic.

Object 30737 Square L80 Unit 7974
Material 1 Glass Material 2 Stone (sandstone)
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Colour Copper Blue
Figure II.6.
Fifteen fragments (all angular) of shiny translucent copper blue glass of varying thickness. Some with weathered upper edges. Some have a layer of friable sandstone—like material adhering. These have probably flaked off pieces of glazed sandstone.
1. 25 x 22.5 x 11mm
Largest. Curved weathered surface (follows contours of sandstone originally underneath??)
2. 14.3 x 12.2 x 11mm
3. 14.8 x 8.8 x 9mm
4. 15 x 11.5 x 3mm
5. 14 x 12.9 x 9.5mm
6. 10 x 9.5 x 9.5mm
7. 10.2 x 8 x 6mm
8. 12 x 7.8 x 5.7mm
9. 11.2 x 9.4 x 6.5mm
10. 11.2 x 6.3 x 5.1mm
11. 7.1 x 7.6 x 7.9mm
12. 9 x 7.5 x 6.9mm
13. 11.5 x 6.4 x 4mm
14. 7.1 x 6.5 x 5.2mm
15. 10 x 5 x 1mm

Object 30824 Square M80 Unit 9006
Material 1 Glass
Length 11.80 Breadth 10.00 Thickness 4.70
Object type Fragment
Colour Blue
Opaque light blue glass perhaps from mould. One surface is flat and suggests that it was the overspill from pressing a mould over a piece of glass. However, the surface is smooth and shows no sign of contact with a ceramic mould, it is therefore possible that this piece has formed fortuitously from glass dripping onto a flat surface.
L 8.9mm B 4.5mm T 4.7mm



33692 33606 30352

30737 33992

Figure II.6. Frit and glass.

Object 33610 Square M85 Unit 10179
Material 1 Glass
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 6.00
Object type Drip
Colour Blue
Dark blue opaque glass hemisphere, probably a drip. (It is possible, but unlikely that this is the end of an applicator for kohl or part of a bead).

Object 30792 Square M80 Unit 8987
Material 1 Glass
Length 6.40 Breadth 3.10 Thickness 2.80
Object type Droplet
Colour Blue
Pear shaped droplet of bright blue opaque glass. Flattened on one surface with whitish "concretion line" which shows the remains of whatever it dripped down and stuck to. Broken at narrowest, elongated point.

Glass

Object 30600 Square M75 Unit 8981
Material 1 Glass
Length 22.80 Breadth 10.80 Thickness 9.20
Object type Fragment
Colour Green
Opaque pale (copper) green glass with many bubbles in fabric. Lime is visible in some voids.

Object 31565 Square L80 Unit 7961
Material 1 Glass
Length 9.20 Breadth 7.00 Thickness 1.90
Object type Fragment
Colour Turquoise
Fragment of opaque turquoise glass. One edge is rounded and thus finished as opposed to broken, suggesting that it is either a piece from a rim or, more likely, a piece of inlay.

Object 31577 Square L80 Unit 7974
Material 1 Glass
Length 8.00 Breadth 8.00 Thickness 7.60
Object type Fragment
Colour Cobalt Blue
Fragment of cobalt blue glass. Also has an area of red in it. Rounded on all edges. The red here suggests that the colour may actually be from copper rather than cobalt, and such an intense blue could be formed using that material. However, the original designation has been retained here.

Object 31714 Square J85 Unit 9431
Material 1 Glass
Length 20.50 Breadth 13.50 Thickness 12.50
Object type Fragment
Colour Cobalt Blue
A lump/fragment of dark cobalt blue glass with swirls of light blue and dark blue. Two sides are covered in sand and dirt, though that on one side could be plaster surface (very thin layer) which the molten glass became adhered to.

Object 33432 Unit 10171
Material 1 Glass
Length 18.00 Breadth 14.00 Thickness 5.00
Object type Fragment
Colour Blue
Opaque bright-blue fragment of glass, triangular in shape, broken at all edges, breaks reveal small air bubbles, partly infilled with buff-coloured material. One surface quite rough, greyish in colour. The fragment might be part of a core formed vessel and one side is still dull from contact with the core, though this cannot be said with certainty.

Object 33517 Square K90 Unit 10185
Material 1 Glass
Length 11.00 Breadth 9.00 Thickness 6.00
Object type Fragment
Colour Red
Fragment of opaque red glass, now discoloured to green with only two spots of original red colour visible.

Object 33992 Square M85 Unit 10202
Material 1 Glass
Length 49.00 Breadth 41.00 Thickness 21.00
Object type Fragment
Colour Green
Figure II.6.
Large "lump" of glass, greyish/green in colour. One flat surface. Many air bubbles are visible, some infilled with buff-coloured material. This might have been intended as colourless glass. Appears to have been chipped out of the vessel in which it was prepared.

Metal

Object 30767 Square L75 Unit 9021
Material 1 Metal—copper/copper alloy
Length 14.40 Breadth 12.30 Thickness 2.60
Object type Fragment
Flat "D" shaped piece of copper. One straight (cut?) edge. The curved edge is less smooth and regular and shows evidence of fragment being composed of 2 fused plates. Greyish with fine, powdery copper corrosion product. Faint evidence of exfoliation.

Object 32150 Square K80 Unit 7981
Material 1 Metal—copper/copper alloy
Length 31.00 Breadth 11.50 Thickness 2.00
Object type Fragment
Fragment of copper/copper alloy sheet/plate. One long edge is quite straight while the other long edge curves slightly, joining the other long edge in a point. The short edge is jagged as if broken off from the rest of the original object, perhaps suggesting a blade of some sort. Along the straight edge on one side, about 1mm down is a slight groove, perhaps suggesting that it is the rim of a copper vessel of some description. Copper suggested by the bright green surface of fragment—the colour of copper corrosion. Broken through a rivet hole.

Object 33859 Square M85 Unit 10202
Material 1 Metal—copper/copper alloy
Length 13.00 Breadth 12.00 Thickness 3.00
Object type Fragment
Folded strip of copper alloy. Green to light green in colour.

Object 33970 Square M85 Unit 10221
Material 1 Metal—copper/copper alloy
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 7.00
Object type Fragment
Small "nodule" of copper alloy, green in colour.

Object 34066 Square M85 Unit 10231
Material 1 Metal—copper/copper alloy
Length 14.00 Breadth 11.00 Thickness 2.00
Object type Fragment
Green fragment of copper alloy, granular surface. Some cream encrustations.

Object 34212 Square J80 Unit 9461
Material 1 Metal—copper/copper alloy
Length 18.90 Breadth 6.80 Thickness 3.20
Object type Fragment
Small fragment of folded copper sheet.

Object 30730 Square L80 Unit 7974
Material 1 Metal—silver
Length 23.20 Breadth 20.00 Thickness 1.00
Object type Fragment
Roughly triangular, flat fragment of silver (?) sheet. Dark grey/black. No green corrosion product, but raised bubbles to one surface. Some brown friable material adheres in clumps. Conservator Mark Lewis has suggested that the silver may be allowyed with copper. <1g weight.

Pigment

Object 33767 Square M85 Unit 10196
Material 1 Orpiment
Length 13.50 Breadth 8.00 Thickness 3.00
Object type Fragment
Fragment of orpiment. Bright yellow, shiny, layered appearance. This mineral is sometimes used as a pigment, though is not a common find.

Object 32373 Square K80 Unit 7984
Material 1 Pigment
Length 34.00 Breadth 30.00 Thickness 30.00
Object type Fragment
Fragment of red ochre pigment. Surface dulled by dust/dirt apart from where broken—there it is a vibrant red orange colour, powdery on the surfaces though hard as a whole. Flat bottom has a patch of darker red to orange where it has been heated. Colour differences due to exposure to different temperatures.

Object 32374 Square K80 Unit 7981
Material 1 Pigment
Length 44.00 Breadth 27.50 Thickness 16.00
Object type Fragment
Fragment of red ochre pigment. Mottled shades of red orange from dark wine to light red orange, possibly from exposure to different temperatures. Very similar in all resepects to find 32373.

Yellow Plaster

The many fragments, sometimes bagged by the kilo, of coarse yellow plaster are characteristic of the site. The texture of the plaster is open, and it is highly fired such that it is very dense. The surface of the plaster is frequently covered with a thin layer (usually <1mm thick) of blue or greenish blue frit or pigment. Occasionally there seems to be more than one layer of such frit, and it has not been possible to determine with certainty to what process it belongs. It may be that the plaster was the lining from the dome of the kilns and the frit is the remains of glazing materials carried upward by the heat and partly fused to the dome. Against this view is the fact that we also have drips of slag, suggesting that the dome was used until it was so covered by slag that it had to be demolished. It is, of course, possible that sometimes the dome had to be demolished for reasons other than excess of slag, and that it is to this time that the yellow plaster belongs.

Another possibility is that the coarse plaster was used in the refinement of cobalt and was fired *in situ* as a trough and then used to collect residue from a refinement process. Some of the plaster contains fragments of faience. However, it is impossible to know if this is simply waste material which was accidentally incorporated or whether the plaster is in some way connected with faience manufacture. For the moment the function of the plaster must remain uncertain.

Object 30510 Square K80 Unit 7984
Material 1 Plaster—yellow Material 2 Frit
Length 21.50 Breadth 17.50 Thickness 10.50
Object type Fragment
Yellowish/cream, very friable, open textured plaster. Uneven surfaces. One surface has traces of mid-blue pigment (or possibly even frit) which is quite hard and grainy. Smaller patch to one side is of a slightly more turquoise hue and is not raised like the larger (which is c.1mm thick). Plaster body has impressions possibly left by organics (straw?) and has traces of red grains in areas.

Object 30516 Square K85 Unit 7962
Material 1 Plaster—yellow Material 2 Frit
Length 44.20 Breadth 31.50 Thickness 15.10
Object type Fragment
Creamy-yellow fragment of open textured plaster. Flattish with uneven upper and lower surfaces and broken edges. Surface shows evidence of organic inclusions or impressions left by the same organic (straw?). One quartz pebble c.2mm visible. Upper surface shows traces of mid-blue pigment—approx. 0.5mm where section visible. Pigment covered in brown powdery material.

Object 30546 Square K85 Unit 7962
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Seven fragments of yellowish cream, very friable plaster, 3 with traces of pigment. All are open textured, show evidence of inclusions and some have impressions from organics (e.g. straw) to underside. All fragments angular/broken. Where pigment exists, it is on one surface.
1. L 40.1mm; B 25.7mm; T 11.1mm Turquoise and dark blue frit like pigment traces.
2. L 27.6mm; B 22mm; T 10.9mm Turquoise and dark blue pigment.
3. L 18.4mm; B 12mm; T 13mm Thick turquoise patch, overlain by friable buff coloured material.
4. L 12.0mm; B 10.5mm; T 8.0mm Some dark blue frit-like too.
5. L c.7.1mm; B 7.0mm; T 5.8mm
6. L 6.3mm; B 5.0mm; T 4.3mm
7. L 2.5mm ; B 2.5mm; T 1.1mm

Object 30752 Square M80 Unit 9022/3
Material 1 Plaster—yellow Material 2 Frit
Length 21.00 Breadth 16.70 Thickness 9.50
Object type Fragment
Fragment of cream/yellow plaster. Porous/layered with voids left by inclusions. Bluish grey thin pigment layer to both unbroken, parallel, flattish surfaces.

Object 31486 Square K85 Unit 7991
Material 1 Plaster—yellow
Length 18.00 Breadth 13.00 Thickness 9.50
Object type Fragment
Light red/brown plaster fragment—porous with large inclusions. Inclusions appear to have a thin covering of blue/green copper corrosion product, whilst middle core of inclusions are white/light grey. Also some possible organic plant impressions.Inclusions possibly small broken faience beads embedded in plaster.

Object 31506 Square L80 Unit 7974
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Twenty fragments of dirty, yellow plaster, porous and relatively hard with inclusions—of black, and chalky white stoney fragments. Plant material impressions are visible. Blue pigment on one side only of each piece, though the shade of blue varies from bright light blue (turquoise/blue) to a dark cornflower blue. Slight curvature on some fragments.

Object 31531 Square L80 Unit 7986
Material 1 Plaster—yellow Material 2 Frit
Length 35.80 Breadth 27.50 Thickness 10.00
Object type Fragment
Fragment of yellow, porous plaster with visible plant impressions, chalky patches and a small opaque stone. The flatter surface has a dark turquoise green pigment on it.
Embedded within the plaster on the underside is the fragment of a light turquoise faience.

Object 31533 Square L80 Unit 7986
Material 1 Plaster—yellow Material 2 Frit
Length 50.50 Breadth 41.00 Thickness 9.50
Object type Fragment
Fragment of vitrified yellow plaster. It has a glassy appearance in places. The flattest surface has a dark green colouration with one small area of bright turquoise green. The underside also has a dark green to black speckled appearance. It is very hard with chalky white inclusions and plant impressions.

Object 31600 Square L85 Unit 8029
Material 1 Plaster—yellow Material 2 Frit
Length 29.80 Breadth 23.50 Thickness 11.20
Object type Fragment
Fragment of yellow, porous plaster—quite hard. One surface has pigment on it. Pigment varies from patches of cobalt blue to green turquoise and penetrates into the matrix. Plaster inclusions- plant impressions left by organic inclusions.

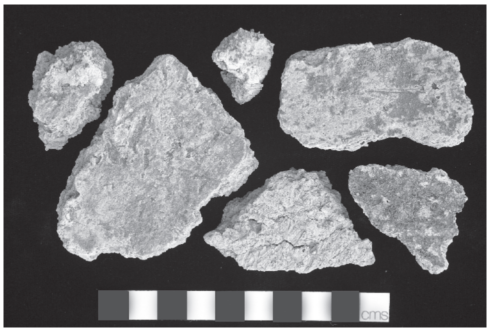
Object 31694 Square J85 Unit 9439
Material 1 Plaster—yellow Material 2 Frit
Length 47.00 Breadth 38.00 Thickness 6.00
Object type Fragment
Fragment of yellow, porous, friable plaster. The smooth surface has an area of dark blue/green pigment on and appears to have begun to vitrify. Inclusions—impressions left by organic inclusions, grains of sand and also 2 pieces of faience. Only a powdery looking green pigment remains of the glaze on the outside of the pieces exposing the white core.

Object 31789 Square J85 Unit 9431
Material 1 Plaster—yellow Material 2 Frit
Length 17.00 Breadth 14.20 Thickness 9.00
Object type Fragment
Fragment of yellow porous plaster with areas of green pigment adhering. Faience in the matrix.

Object 31799 Square J85 Unit 9443
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Figure II.7.
Fragments of yellow, porous plaster, most pieces with pigment—green, blue, and turquoise. One piece is slightly vitrified with a distinctly granular look to the surface. Several pieces have a curvature. Where the pigment is thickest it is Egyptian blue in colour, then light blue and dark green/blue when it is thinnest i.e. 2mm.

Object 31801 Square J85 Unit 9434
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Fragments of yellow porous plaster. All fragments retain traces of pigment: green, blue-green.

Object 31820 Square J80 Unit 9459
Material 1 Plaster—yellow Material 2 Frit
Length 18.00 Breadth 10.30 Thickness 9.10
Object type Fragment
Fragment of yellow porous plaster. Inclusions of organic plant material visible as impressions. Surface has green pigment on. On underside is a fleck of grainy bright green turquoise pigment/substance.



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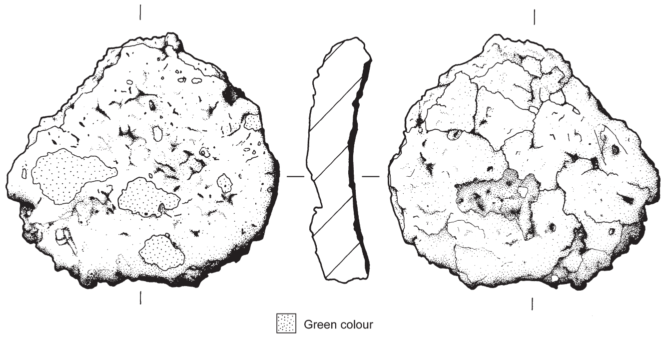


32336

0 10cm

Figure II.7. Yellow plaster.

Object 31862 Square J85 Unit 9453
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Eight fragments of yellow, porous plaster. One piece is slightly vitrified. All but three of the remaining pieces have traces of green/blue pigment. All but the vitrified piece have impressions left by organic inclusions, the largest also contains an opaque greyish stone. One piece has faience in the matrix.

Object 31959 Square J80 Unit 9438
Material 1 Plaster—yellow Material 2 Frit
Length 45.00 Breadth 44.30 Thickness 22.00
Object type Fragment
Fragment of yellow, porous, friable plaster. Impressions left by organic plant inclusions. One surface has areas of blue/turquoise pigment adhering to it.

Object 31993 Square J85 Unit 9502
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Fragments of yellow, porous, friable plaster, most fragments have traces of pigment on one side. Colour of pigment ranges from pale green turquoise to blue green turquoise. Organic plant impressions are also visible with the plaster. Faience in matrix.

Object 32129 Square L75 Unit 9026
Material 1 Plaster—yellow Material 2 Frit
Length 47.00 Breadth 37.00 Thickness 18.00
Object type Fragment
Fragment of yellow plaster—appears to have been exposed to heat, judging by its grey/yellow/white colour. Unevenly layered profile and friable nature, porous. One surface has a glassy surface with visible sheen. Some faience in the matrix.

Object 32146 Square M80 Unit 9012
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Seventeen fragments of yellow plaster—porous, friable. Evidence of organic inclusions, some have small white chalky inclusions too. Most appear burnt on one surface, whilst the other surface has traces of blue and green pigment. Four pieces have a slight curve to their surface, especially the largest piece. One small piece is partially vitrified with the surface covered in patches by an opaque glassy light greenish material, probably the fused frit material.

Object 32311 Square M80 Unit 9006
Material 1 Plaster—yellow Material 2 Frit
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Approximately forty fragments of yellow, porous plaster. Many have impressions from organic matter. Many have, on one surface, a covering, usually patchy, of pigment in bright blue or green. One piece has a lump of quartz stuck in it and can see where plaster shrunk away from it during drying/firing. One piece has faience in the matrix. Three pieces are a pinkish brown colour rather than yellow. One piece is much darker brown with hollow white inclusions (perhaps calcined limestone), yellow inclusions and burned patches. Two pieces appear to have had their surfaces either burnt/exposed to heat or covered in a hot substance. This has given a hard rough feel to the surface. One of these in particular has a sparkly sheen to this surface.

Object 32336 Square K85 Unit 8036
Material 1 Plaster—yellow Material 2 Frit
Length 72.50 Breadth 67.50 Thickness 11.50
Object type Fragment
Figure II.7.
Fragment of yellow, porous, friable plaster. Large stone, small lumps of gypsum organic impressions visible. Surface is covered in a burnt layer of green colour—sparkles in light. In some places the green is lighter and more dense and sandy/crystalline. Other surface has patches of brown. Fragment also has slight curve through the shortest length.

Object 33659 Square L85 Unit 10191
Material 1 Plaster—yellow Material 2 Frit
Length 14.00 Breadth 10.00 Thickness 5.00
Object type Fragment
Fragment of yellow plaster with blue frit on one surface. Some white and brown inclusions in the plaster body.

Object 33765 Square L85 Unit 10192
Material 1 Plaster—yellow
Length 20.00 Breadth 12.00 Thickness 10.00
Object type Fragment
Fragment of yellow plaster. Layered, open texture with some voids and straw impressions, yellowish in colour.

Object 34000 Square M85 Unit 10231
Material 1 Plaster—yellow Material 2 Frit
Length 30.00 Breadth 19.00 Thickness 9.00
Object type Fragment
Fragment of yellow plaster with blue frit on one surface. Layered in appearance, impressions of straw.

Slag

Object 31854 Square J85 Unit 9443
Material 1 Slag Material 2 Metal (copper/ copper alloy)
Length 16.00 Breadth 13.50 Thickness 9.50
Object type Fragment
Amorphous fragment of metal slag (?) with a green layer which looks like copper corrosion, and which covers its surface. Sand adheres to its surface.

Object 32097 Square K80 Unit 7984
Material 1 Slag
Length 18.50 Breadth 17.00 Thickness 10.00
Object type Fragment
Fragment of slag—dark grey with lime inclusions. Surface is a dark red colour in places and has a shine to it.

Object 33804 Square M85 Unit 10189
Material 1 Slag
Length 250.00 Breadth 190.00 Thickness 130.00
Object type Fragment
Slightly curving amorphous lump of slag. Some large voids, some red patches. Kept as a sample. On its upper surface there are lots of solidified drips and runs of slag. On the broken edge there is a large lump of lime 110mm long. This might have been thrown in as a lump of limestone and become calcined. Vesicular with flecks of lime. Pieces of charcoal are trapped in the section all the way through it. On the underside of the piece there are lobes of slag where it may have run between lumps of charcoal or other material.

Object 34257 Square M75 Unit 8981
Material 1 Slag Material 2 Stone (sandstone)
Length 25.00 Breadth 22.00 Thickness 4.00
Object type Fragment
Fragment of sandstone that has cracked and become glazed in between the bands and then over vitrified to slag on what is now the surface.

Stone

Object 33502 Square K100 Unit 10178
Material 1 Stone—quartzite
Length 85.00 Breadth 84.00 Thickness 42.00
Object type Fragment
Fragment of stone, reddish in colour with grooves on back and front. Possibly for sharpening tools (?)

Glazed Sandstone

Most of the sandstone with traces of glaze is banded sandstone, though there is also some red. Where there is no glaze the surface is often yellow, apparently affected by heat. Most of the sandstone is very friable.
Analysis of the glaze is inconclusive, as only a limited number of samples have been examined. The evidence suggests that the stone may have been used in the production of glass rather than faience, but this must remain uncertain for the moment.

Object 30358 Square M80 Unit 7961
Material 1 Stone—sandstone Material 2 Glass
Length 10.20 Breadth 9.90 Thickness 8.20
Object type Fragment
Colour Green
Glazed banded sandstone with light green translucent glass. Triangular shape in section. All fractures at edges are angular.

Object 30415 Square L80 Unit 7974
Material 1 Stone—sandstone Material 2 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Figure II.8.
Eleven fragments of glazed banded sandstone. All fragments show some trace of glaze to one surface. Pale green/white in colour. One fragment has a very shiny glazed surface, and two small specks of deeper colour (copper colouration?). One fragment has glass to two sides, two largest fragments join.
Joins 30422. One piece is adhered to 30374.
Size range: L 12.5-100mm; B 10.2-51.0mm; T 2.8-25.9mm

Object 30422 Square L80 Unit 7974
Material 1 Stone—sandstone Material 2 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Five fragments of glazed banded sandstone. All fragments have one surface glazed. Two fragments have a shiny

glazed surface. One of which has a reddish-orange deposit on top of decayed faience layer.
Joins 30415
Size range: L 18.0-47.6mm; B 10.0-25.5mm; T 9.0-20.3mm

Object 30530 Square K85 Unit 8036
Material 1 Stone—sandstone Material 2 Slag
Length 20.80 Breadth 17.90 Thickness 14.00
Object type Fragment
Greyish-black, shiny surfaced slag fragment. Breaks in this reveal quite a dense composition with air bubbles. Green friable material is the breaking down of sandstone. Buff-coloured grains also adhere, plus some finer grained material/sand to one surface.

Object 30571 Square M75 Unit 8979
Material 1 Stone—sandstone
Length 34.10 Breadth 25.80 Thickness 30.50
Object type Fragment
Fragment of banded sandstone, similar to type commonly found with glaze (see 30572) and /or slag (see 30573). Brownish grey with fine grey bands. Triangular in section.

Object 30590 Square M75 Unit 8981
Material 1 Stone—sandstone
Length 19.00 Breadth 13.50 Thickness 9.40
Object type Fragment
Piece of banded sandstone. One surface has turned white and ashy where the glaze has either racked off or was just starting to form.

Object 30646 Square M75 Unit 8979
Material 1 Stone—sandstone Material 2 Glass
Length 32.40 Breadth 32.00 Thickness 15.10
Object type Fragment
Brownish grey sandstone fragments with light greenish blue glass (slightly shiny and streaky). Grey slag residue to one surface adjoining the curved surface with glass residue.

Object 30653 Square L75 Unit 8980
Material 1 Stone—sandstone Material 2 Glass
Length 28.70 Breadth 21.20 Thickness 16.90
Object type Fragment
Irregular lump of sandstone covered in blue-green glass/glaze. Streaks of red are visible in the glass suggesting that it was copper based. Lime encrustations on surface. Sandstone is very friable from heating.

Object 30662 Square M75 Unit 9004
Material 1 Stone— andstone Material 2 Slag
Length 63.00 Breadth 50.00 Thickness 49.60
Object type Fragment
Fragment of sandstone that has glazed. This glaze has over-vitrified to slag on the surface. In cracks the glaze remains as a copper green glass.

Object 30663 Square M75 Unit 8981
Material 1 Stone—sandstone Material 2 Frit
Length 15.70 Breadth 12.50 Thickness 7.80
Object type Fragment
Red sandstone with light green glaze forming on the surface. Glaze is not fully formed and quite granular.

Object 30676 Square M75 Unit 9005
Material 1 Stone—sandstone Material 2 Glass
Length 50.50 Breadth 31.70 Thickness 22.80
Object type Fragment
Fragment of sandstone with glaze on surface. Broken surfaces on sides reveal layers of black/dark green, shiny, glass.

Object 30685 Square M75 Unit 9015
Material 1 Stone—sandstone Material 2 Glass
Length 38.80 Breadth 31.10 Thickness 37.40
Object type Fragment
Fragment of banded sandstone. Upper surface has glass (granular through to smooth in texture). Whitish/green. Residue <1mm thick.

Object 30851 Square M75 Unit 8981
Material 1 Stone—sandstone Material 2 Slag and glass
Length 22.60 Breadth 19.10 Thickness 10.00
Object type Fragment
Fragment of buff sandstone with black bubbly slag adhering. Turquoise blue glassy layer on one edge grading to buff, frothy layer.

Object 31497 Square Surface Unit Find
Material 1 Stone—sandstone Material 2 Slag
Length 54.20 Breadth 42.00 Thickness 24.80
Object type Fragment
Sandstone fragment partially covered with glass and this has over-vitrified in places to become slag. One section of the sandstone surface has vitrified to glass with an area of light blue colouration within white/green suggests sandstone exposed to high temperatures.

Object 31560 Square L80 Unit 7986
Material 1 Stone—sandstone
Length 37.90 Breadth 18.50 Thickness 16.00
Object type Fragment
Fragment of banded sandstone with a patch of glass forming on one surface on top of a layer of lime (tested with HCl). The granules of silica are visible within the glass suggesting the temperature to which the piece was heated was not very high i.e. the silica did not fuse.

Object 32126 Square M75 Unit 9005
Material 1 Stone—sandstone
Length 36.50 Breadth 39.00 Thickness 12.00
Object type Fragment
Fragment of sandstone—layers of the stone visible and a very visible fault shows that it is liable to break into pieces. It appears to have been shaped with a curved top, sides which curve down to a flat edge. Appears to have been partially burnt and has a thin layer of lime (tested with HCl+).

Object 32159 Square L80 Unit 7974
Material 1 Stone—sandstone Material 2 Slag
Length 15.50 Breadth 11.00 Thickness 8.50
Object type Fragment
Small fragment of light grey banded sandstone with a fragment of slag adhering to it. The slag has small air holes in it, white chalky inclusions and powdery beige inclusions are inside some of these, probably lime, discoloured lime and fine sand.

Object 32195 Square M75 Unit 9015
Material 1 Stone—sandstone Material 2 Glass
Length 45.50 Breadth 25.50 Thickness 46.00
Object type Fragment

Two joined fragments of red banded sandstone which on one surface have a thick layer of dark green/black glass which has begun to slag. Patches of yellow/green can be seen in the slag especially where the slag is quite thin. The edges of the glass are light white/green what would have been the glass colour before it became over-vitrified. (see 32196) At the edges the individual grains can be seen whereas where the glass is thicker they have melted to form the glass proper.

Object 33410 Unit 10171
Material 1 Stone—sandstone Material 2 Glass
Length 26.00 Breadth 22.00 Thickness 29.00
Object type Fragment
Figure II.8.
Fragment of banded sandstone, grey/brownish in colour with darker bands, irregular fractures, one surface with white/pale green glass layer with granular surface c.1mm thick.

Object 33411 Unit 10171
Material 1 Stone—sandstone Material 2 Glass
Length 27.00 Breadth 23.00 Thickness 34.00
Object type Fragment
Figure II.8.
Fragment of banded sandstone, greyish-brown in colour, with darker bands, light-green glassy layer on two surfaces, some dripped nodules of slag. Irregular fractures.

Object 33623 Square M85 Unit 10179
Material 1 Stone—sandstone Material 2 Glass
Length 16.00 Breadth 11.00 Thickness 9.00
Object type Fragment
Fragment of banded sandstone with deep and dark blue/green glass on several surfaces.

Object 33636 Square M75 Unit 10187
Material 1 Stone—sandstone Material 2 Glass
Length 72.00 Breadth 36.00 Thickness 26.00
Object type Fragment
Fragment of banded sandstone, quite hard on one side, but of more soft, sandy composition on the other side. Small fragment of glass adhering, white/light green in colour.

Object 33654 Square M85 Unit 10174
Material 1 Stone—sandstone Material 2 Glass
Length 51.00 Breadth 41.00 Thickness 15.00
Object type Fragment
Fragment of banded sandstone, clearly layered in appearance, brown-greyish in colour. Glass on one surface and edge light green in colour, grading to copper blue.

Object 33697 Square M85 Unit 10189
Material 1 Stone—sandstone Material 2 Glass
Length 31.00 Breadth 23.00 Thickness 44.00
Object type Fragment
A fragment of banded sandstone, greyish and red in colour, fused together, corner to corner, by a layer of glaze. The glass is mainly turquoise to grey in colour, except for the glaze that runs down between the two fragments of stone, where the glaze is red. The glaze varies from frit-like to fully vitrified glass.

Object 33805 Square K90 Unit 10195
Material 1 Stone—sandstone Material 2 Glass
Length 54.00 Breadth 24.00 Thickness 35.00
Object type Fragment
Dark-grey to purple fragment of coarse sandstone (quartzite) with large angular grains. Greyish glass on flat surface and worked edge. Unusually coarse stone to be found with this type of glaze.

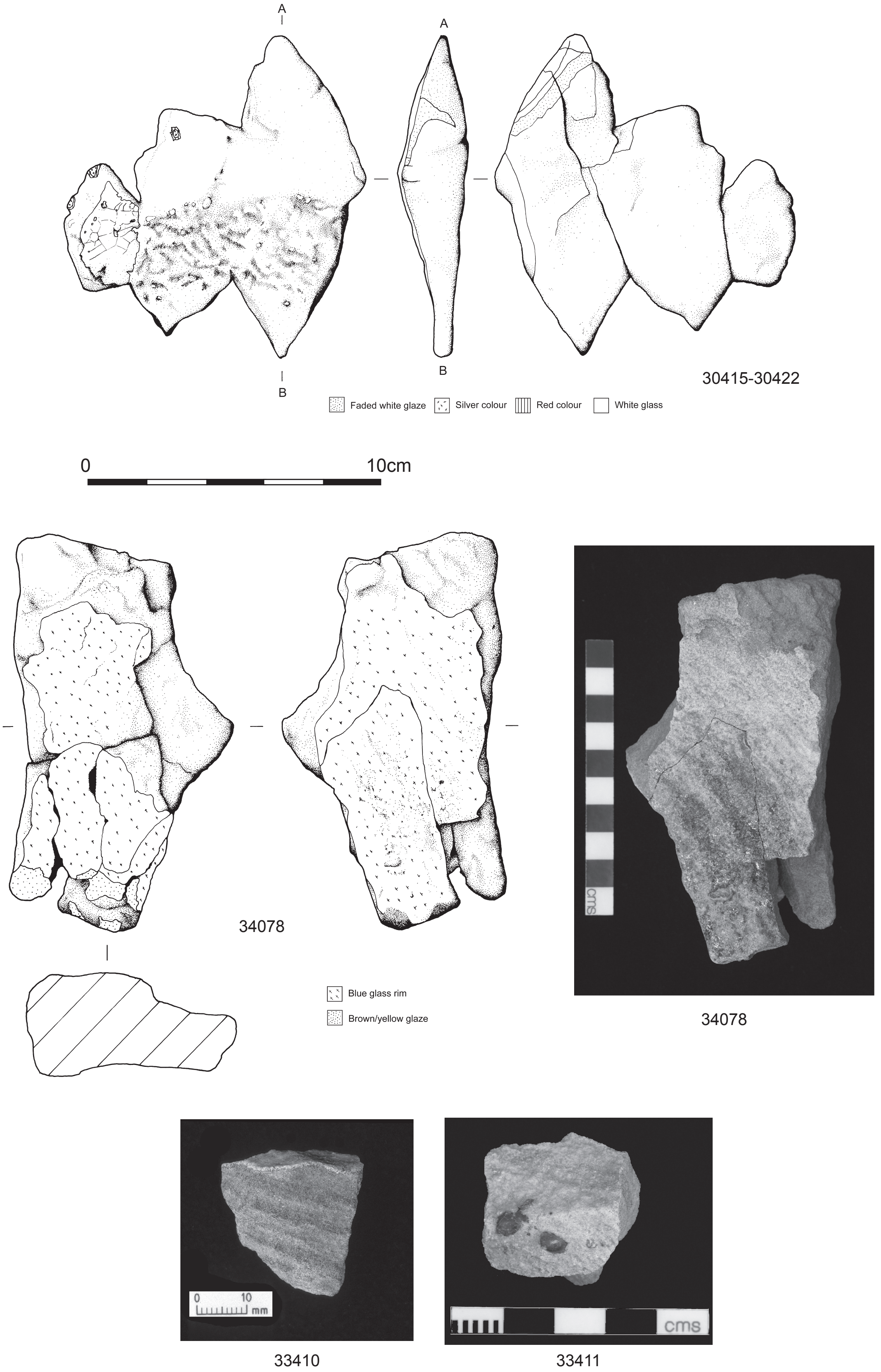


Figure II.8. Glazed sandstone.

Object 33865 Square M85 Unit 10196
Material 1 Stone—sandstone Material 2 Glass
Length 17.00 Breadth 14.00 Thickness 19.00
Object type Fragment
Fragment of brown-red banded sandstone with dark grey bands. White/light green glass on flattish surface.

Object 34019 Square M85 Unit 10233
Material 1 Stone—sandstone Material 2 Glass
Length 26.00 Breadth 19.00 Thickness 11.00
Object type Fragment
Fragment of sandstone, with greyish glass, granular surface where the silica has not fused.

Object 34078 Square M85 Unit 10189
Material 1 Stone—sandstone Material 2 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Figure II.8.
Big fragment of banded sandstone. Brownish in colour with dark grey bands. Glass on both sides and on one edge. The glaze is grey/light green in colour; some darker bands of glass on one side. 324.9 gr. One smaller fragment sandstone, with greyish layer on one and mustard yellow layer on other surface. 9.8 gr.

Object 34086 Square L85 Unit 10202
Material 1 Stone—sandstone Material 2 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Fragment
Fragment of red-brown banded sandstone with glaze around. The colour of glaze varies from black to light green (white in cross section). Some of the glass has over-vitrified to slag. Similar in profile to 34164.

Object 34164 Square WT Unit Spoil heap
Material 1 Stone—sandstone Material 2 Glass
Length 40.79 Breadth 40.04 Thickness 27.19
Object type Fragment
Figure II.9.
Glazed banded sandstone.

Object 32194 Square M75 Unit 9015
Material 1 Stone—sandstone Material 2 Glass
Length 62.50 Breadth 62.00 Thickness 37.50
Object type Fragments
Figure II.9.
Three joining fragments of red banded sandstone. One surface of the pieces has been covered with a glassy slag which is dark, with patches of mustard yellow. These have only a thin layer of slag covering whilst others in the same context have a deeper layer. Thickness taken at the thickest point and measured when all 3 joined. On the side of the piece the glass is thinnest and whitish/green. The fragment looks as though it has become self glazed from the reaction between fly-ash and the silica.

Glass Vessel Fragments

Object 30604 Square L75 Unit 9001
Material 1 Glass
Length 12.00 Breadth 6.20 Thickness 3.10
Object type Fragment
Colour Cobalt Blue
Figure II.9.
Cobalt blue body fragment with yellow cane rim with swags of turquoise blue, yellow and white. Possibly part of a perfume bottle.

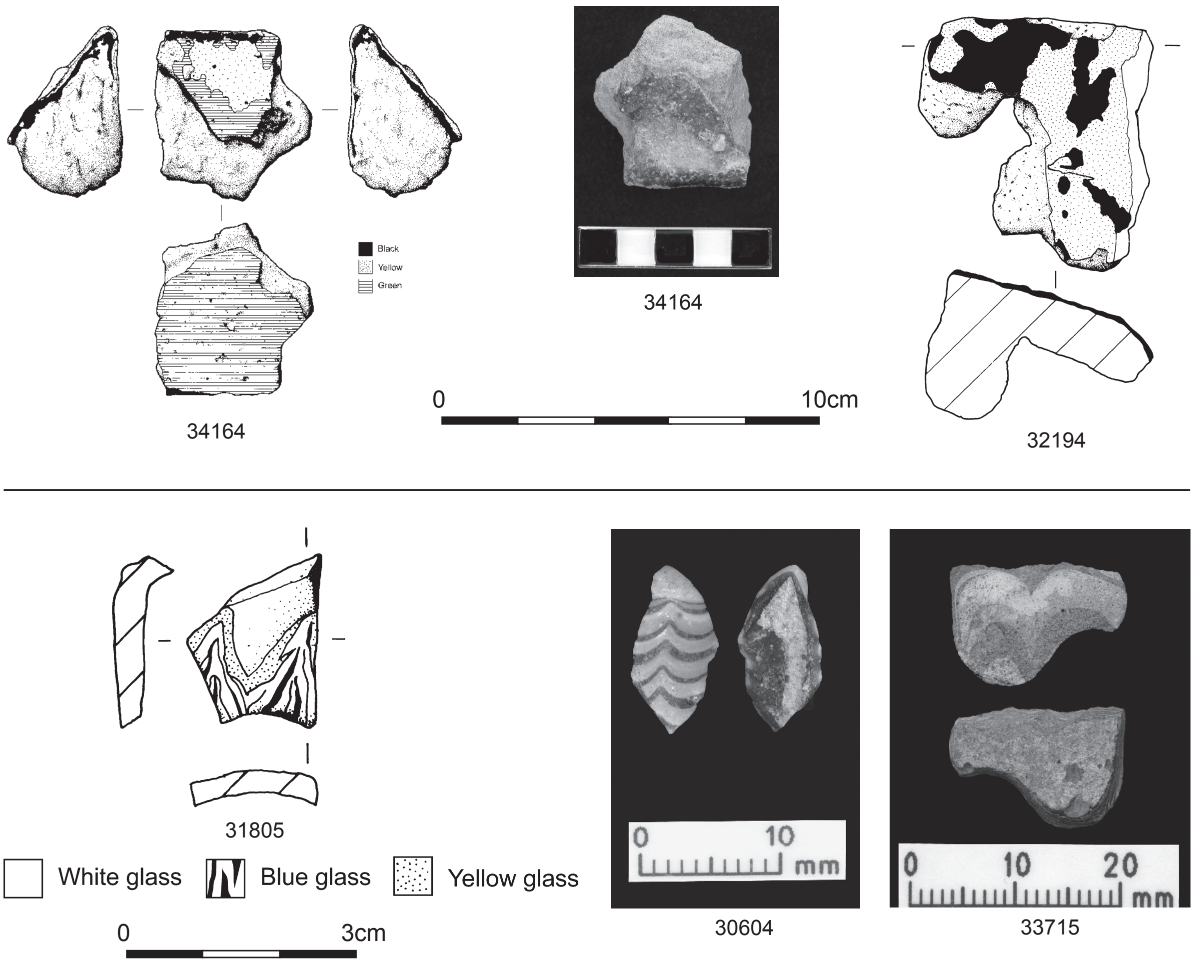


Figure II.9. Glazed sandstone (top) and glass vessel fragments (bottom).

Object 31805 Square J85 Unit 9434
Material 1 Glass
Length 21.10 Breadth 16.90 Thickness 3.00
Object type Glass Vessel
Colour Cobalt Blue
Figure II.9.
Fragment of opaque cobalt blue glass with white and yellow glass added to form chevron design. The blue dragged through the white for a marble type effect though in a regular way following the triangular shape outlined by the yellow.

Object 33608 Square M85 Unit 10179
Material 1 Glass
Length 14.00 Breadth 12.00 Thickness 2.00
Object type Glass Vessel
Colour Copper Blue
Opaque dark copper blue fragment of glass, a vessel fragment from a core formed vessel (light brown material stuck to the glass on one surface). It might also be a fragment of glass stuck to lime from a cylindrical vessel. The fragment is broken on all edges, slightly curved. Same shade as 33731.

Object 33715 Square L85 Unit 10192
Material 1 Glass
Length 16.50 Breadth 11.00 Thickness 3.00
Object type Fragment
Colour Blue

Figure II.9.
Opaque blue glass. Weathered and discoloured glass fragment from vessel. Angular, broken on all edges. Originally a decoration in swag pattern in yellow/white, now only vague white colours visible. At fresh breaks/ in cross section white lines in the blue body glass are clearly visible.

Inlay Fragments

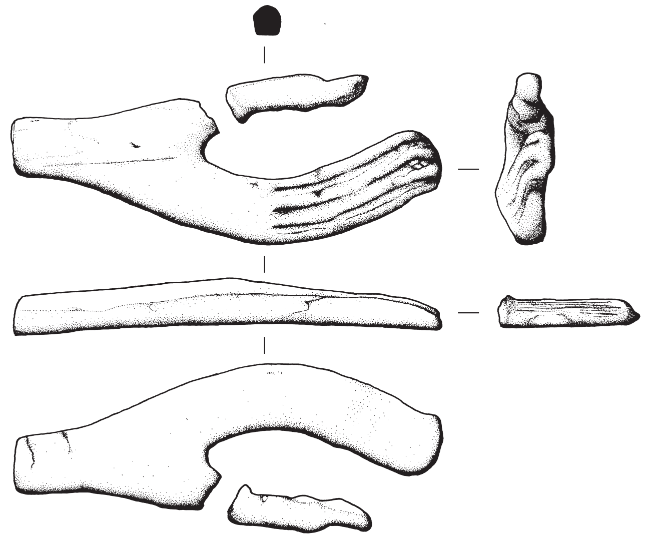
Object 33903 Square M85 Unit 10202
Material 1 Faience
Length 111.00 Breadth 36.00 Thickness 10.00
Object type Inlay fragment
Colour Red
Figure II.10 & Plate 7.8.
Red faience hand complete except for the the thumb which is missing. Probably part of an inlay. The fingers are extremely long and have bent tips. The front, which carries the detail, is only partly glazed; glaze remains on the wrist and part of the fingers. The back is glazed completely, though has a pitted surface, some cream concretions. The front is slightly convex, the back is flat. The piece was evidently dried wrong side up and so effloresced on the back rather than the front.
Note: A faience thumb comes from the same context; object no. 33904, but does not belong to this hand, as can be seen by its thickness. However, it probably came from the same mould.

Object 33904 Square M85 Unit 10202
Material 1 Faience
Length 36.00 Breadth 10.00 Thickness 8.50
Object type Inlay fragment
Colour Red
Figure II.10 & Plate 7.8.
Red faience thumb, probably part of an inlay. Bent fingertip. Only partly glazed. Glaze remains on the front and on one edge. Cream concretions on top.
Note: This probably comes from the same mould as the red faience hand, object no. 33903, but does not join with it.

Object 30478 Square K80 Unit 7999
Material 1 Clay
Length 14.70 Breadth 0.00 Thickness 5.20
Object type Kiln furniture
Brownish/grey unfired clay? Object; 3 pointed star shaped with rounded "points" and rounded edges. Flattish overall. No obvious evidence of decoration. Possibly a kiln support.

Object 34171 Square K85 Unit 8034
Material 1 Ceramic
Length 77.81 Breadth 52.90 Thickness 21.34
Object type Kiln Lining
Calcareous mixed clay ceramic with outermost surface white fired. Underside is reddish and more friable than other surface. Large pieces of limestone in matrix. Some curvature. Quite burnt.

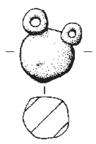
Object 34175 Square K85 Unit 8034
Material 1 Ceramic
Length 39.82 Breadth 28.82 Thickness 12.92
Object type Kiln Lining
Calcareous mixed clay ceramic with outermost surface white fired. Underside is reddish and more friable than other surface. Large pieces of limestone in matrix.



33903 & 33904

0 10cm

33903 & 33904



30689

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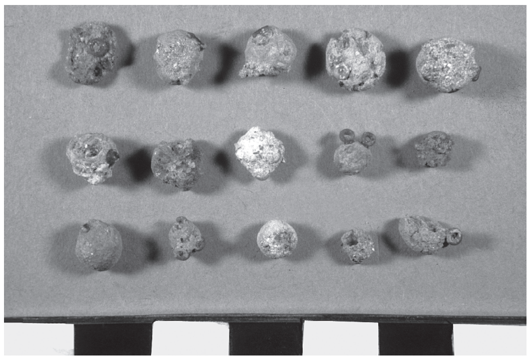


30689

Figure II.10. Inlay fragments (top) and beads adhering to clay pads (bottom).

Object 30689 Square M80 Unit 9006
Material 1 Clay Material 2 Faience
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Lime matrix
Figure II.10 & Plate 7.2.
Fifteen rolled balls of clay (12) or lime matrix-like material (1), all except one, has a bead/beads adhering or partly inset. All beads are turquoise, mid-blue or bright blue faience (?) except for one single red bead on a broken ball. Most beads appear to be of the ring type (Gurob Pl. xlv: 92C). Some bead pads are more fine grained and smooth than others. On some pads, the side on which beads rest has dirt overlying them, whilst the other side of the pad is clean. Some pads look as though heat has affected them (darker balls of clay, less bright beads). Some balls have indentations where the beads have sat. The lime pad has 4–5 beds impressed into it. Some of the pads are more like balls and have the beads lightly adhered to the surface rather than impressed into them.

Moulds for Producing Faience Objects

These are made of silt clay, and seem to have been made at O45.1, to judge by an unfired example. They all have the same general form, a slightly rounded underside with the mould itself made into the opposite face. Occasionally there is evidence of a cord coming from the mould face, suggesting that the original which was pressed into the wet clay to make the impression was retrieved using the cord. In some cases it has been possible to “type” these to examples from Gurob or from Petrie’s work at Amarna.

Object 30540 Square K85 Unit 8034
Material 1 Ceramic
Length 31.50 Breadth 25.00 Thickness 14.70
Object type Mould
Figure II.11.
Buff-coloured fine grained ceramic. Oval flattish, smooth surfaces all round. Mould cavity runs lengthwise and is an elongated almond shape as far as the broken edge. No angular edges would result on amulet, though it would be roughly rectangular in section. Orangish deposit to upper surface.

Object 30547 Square M75 Unit 8981
Material 1 Ceramic
Length 33.60 Breadth 26.00 Thickness 13.20
Object type Mould
Figure II.11.
Brown, fine-grained ceramic, lozenge-shaped Aten cartouche mould. From pit fill. Rounded edges and flattened ends. No sign of mould having been used. Cartouche is an early version of the name of the Aten (second cartouche) ‘May Re’ live, Horus-of-the-Horizon in his name ‘Shu who is Aten ‘ (See: Peet and Woolley 1923: 148–49).
Dimensions of the mould impression:
L19.3mm; B 8.5mm; T 2.3mm

Object 30548 Square M75 Unit 8981
Material 1 Ceramic
Length 27.60 Breadth 22.80 Thickness 11.20
Object type Mould
Figure II.11.
Grey-brown ceramic bead mould. Smooth pebble shape. Fabric feels quite rough to touch and appears relatively open in places. Flattish and elongated. Mould cavity runs lengthwise and consists of an oval in the centre of the item, with a thin channel running from each pointed end to the edge of the surface. Interior of cavity quite rough. No sign of mould having been used.
Bead cavity: L: c.14,7mm B: 5.2mm T: c.3mm. Channel: B: 1.2mm

Object 30549 Square M75 Unit 8981
Material 1 Ceramic
Length 25.50 Breadth 17.20 Thickness 12.70
Object type Mould
Figure II. 11.
Flattened pebble-shaped, smooth rounded ceramic mould for pendant or inlay. Brownish grey fabric (more brownish underside) teardrop shaped pendant cavity - rounded slightly across floor of cavity, so that no angles/ edges would be formed on cast. Top/point of teardrop truncated to form horizontal, c.3mm. Length of cavity 15mm. Max width of cavity c.6.8mm.
Fabric is quite fine grained. Signs of blackening to mould cavity and top surface, suggesting mould was burned.

Object 30637 Square M80 Unit 8992
Material 1 Ceramic
Length 21.20 Breadth 17.30 Thickness 13.10
Object type Mould
Figure II. 11.
Rounded pebble-shaped mould for Tauert figure (bead or pendant). No clear sign of impression for suspension loop.
Length of cavity: 14.0mm; B 7.0mm
Light grey-brown colour. No obvious signs of use.

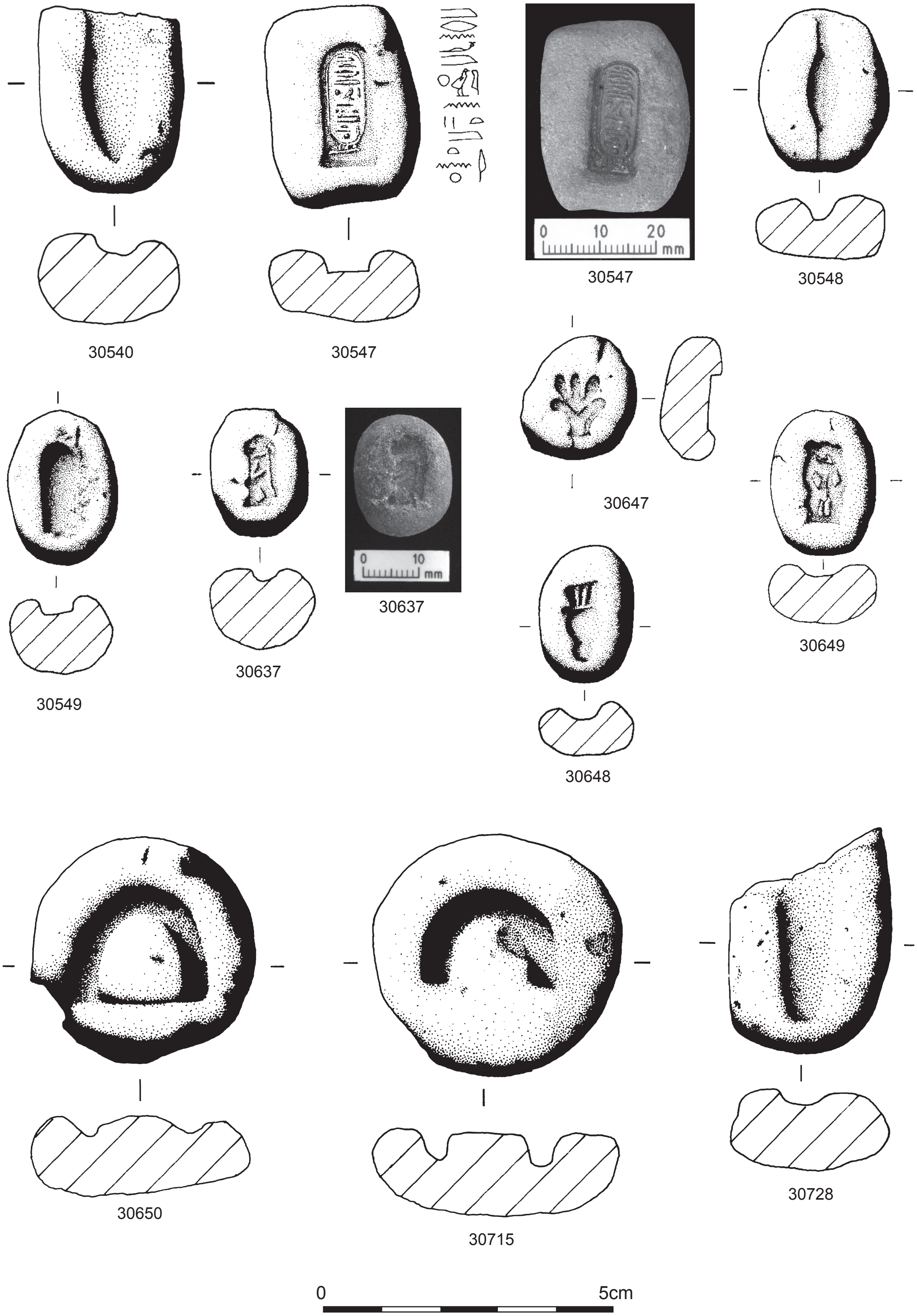


Figure II.11. Moulds for producing faience objects.

Object 30647 Square M80 Unit 9012
Material 1 Ceramic
Length 20.80 Breadth 18.10 Thickness 10.60
Object type Mould
Figure II.11.
Ceramic mould, reddish brown. Design appears to be for a conventional flower. Mould seems to have been used. White powdery substance lines mould surface and surrounds upper surface. String mark for prising out.

Object 30648 Square M80 Unit 9012
Material 1 Ceramic
Length 20.30 Breadth 17.00 Thickness 10.70
Object type Mould
Figure II.11.
Reddish-brown, oval shaped ceramic thistle mould. Three tufts on the thistle. Cast would have rounded edges. No very obvious signs of use, though there are four (possibly five) short, thin, equidistant lines (sunk relief) radiating vertically from the thistle tufts. Some brownish friable material partly in fills the tufts.
Mould itself is: L 13.1mm; B 7.1mm

Object 30649 Square M75 Unit 9004
Material 1 Ceramic
Length 24.20 Breadth 18.60 Thickness 10.40
Object type Mould
Figure II.11.
Reddish-brown, almost rectangular ceramic. The Subject is difficult to determine because of salt encrustation but appears to be a Bes figure. The mould is rounded at the back. There is a salt deposit on the front and sides.
Dimensions of the figure: L 14.2mm; B 8.2mm

Object 30650 Square M75 Unit 8981
Material 1 Ceramic
Length 38.00 Breadth 39.00 Thickness 13.50
Object type Mould
Figure II.11.
Mould for a ring shank. Semicircular depression. Rounded, flattened reddish brown ceramic. Irregular rounded back to mould. Depression still partially infilled with deposits, including possibly faience paste. Ceramic eroded and chipped in parts, small indentation towards bottom left hand of mould which meets indentation —likely to have been broken before discard. Shank impression thickness at surface is c.4mm.

Object 30715 Square K80 Unit 7984
Material 1 Ceramic
Length 42.00 Breadth 38.00 Thickness 15.00
Object type Mould
Figure II.11.
Mould for a ring shank. Semicircular depression. Rounded on the back.

Object 30728 Square K80 Unit 7976
Material 1 Ceramic
Length 37.60 Breadth 28.80 Thickness 14.20
Object type Mould
Figure II.11.
Reddish grey ceramic mould for amulet. Mould cavity runs lengthwise and is an elongated lozenge. No obvious decoration is apparent in cavity. Flattened cavity bottom with sloping sides. Diagonal break across mould breadth. Ceramic fabric quite fine grained. Upper surface reddish; underside greyish.

Object 30729 Square K85 Unit 7962
Material 1 Ceramic
Length 36.00 Breadth 22.60 Thickness 10.00
Object type Mould
Figure II.12.
Ceramic mould for amulet or leaf. Greyish ceramic. Flattish, lozenge shape. Mould cavity runs lengthwise and is bullet-shaped. No obvious decoration on the cavity. Rounded profile. Linear indentation at right angles to the cavity, on one side. Diagonal break across end of mould (though it does not affect the cavity).

Object 30749 Square M75 Unit 9016
Material 1 Ceramic
Length 48.00 Breadth 32.30 Thickness 22.70
Object type Mould
Figure II.12.
Fragment of ring mould. Both shank and bezel still apparent. Curved underside to mould. Red-brown ceramic. Ring diameter approx. 27mm (outer diameter). Deep impression which would form a thick ring—impression up to 13.8mm deep near bezel fixing. Impression showing traces of creamy-coloured calcareous powder. No similar types.

Object 30837 Unit Surface at site dump
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 12.49 Diameter 30.50
Object type Mould
Figure II.12.
Black, heat affected circular, flattish mould. Circular cavity with diameter of 10.4mm, probably intended for a sun disc, although the rim of the face of the mould is cut deeper than the rest, which would leave a raised edge on the object produced. String impression on surface. Friable buff-coloured material adheres to the upper surface.

Object 31660 Square K75 Unit 9431
Material 1 Ceramic
Length 19.50 Breadth 11.50 Thickness 11.00
Object type Mould
Figure II.12.
Silt ceramic fragment of faience mould—some of the mould shape is visible. Possibly from a floral mould.

Object 31725 Square J85 Unit 9432
Material 1 Ceramic
Length 32.50 Breadth 17.50 Thickness 13.00
Object type Mould
Figure II.12.
Fragment of a ceramic faience mould. Section of the mould design can be seen, with a series of ridges fanning out from the centre which rises to be higher than the edges suggesting that it would have had a depression at the centre. It is probably intended as Petrie's (1894) Pl. xviii: 437, an enlarged daisy-type bloom.

Object 31746 Square J85 Unit 9438
Material 1 Ceramic Material 2 Glaze
Length 19.90 Breadth 14.50 Thickness 10.00
Object type Mould
Figure II.12.
Rim of silt ceramic which has a layer of blue turquoise glaze attached to it. Probably part of a mould.

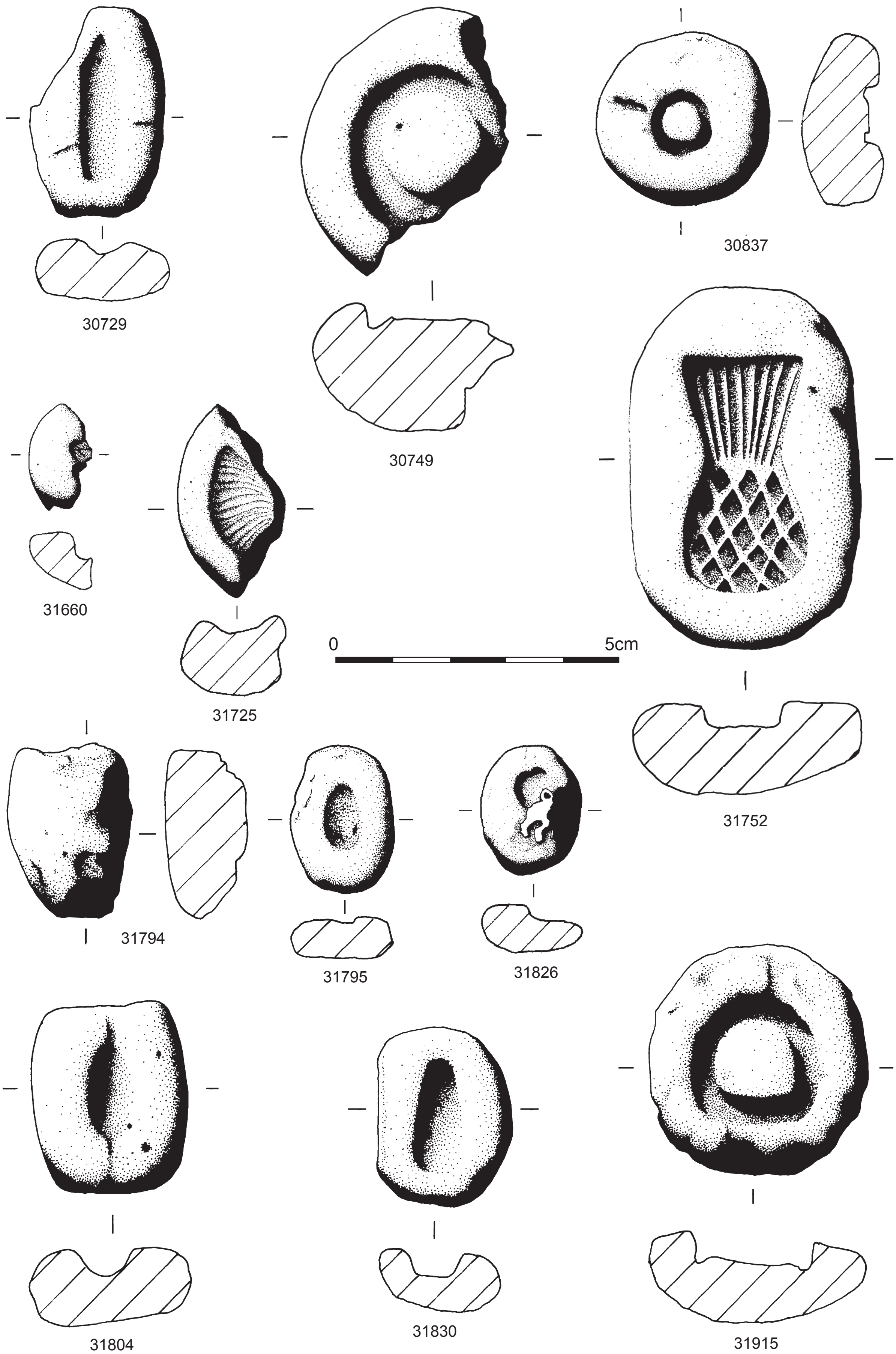


Figure II.12. Moulds for producing faience objects.

Object 31752 Square K75 Unit 9452
Material 1 Ceramic
Length 63.00 Breadth 42.00 Thickness 15.00
Object type Mould
Figure II.12.
Complete silt ceramic mould for faience object. The design of the mould is a large thistle. The mould retains traces of colour from the faience paste and suggests that such a faience object consisted of two colours—pinkish-purple for the thistle bottom and pale green for the fronded top. The design is a more accomplished version of Petrie's (1894) Pl. xviii: 482, though with the fronded top more open as his 481.

Object 31794 Square J85 Unit 9431
Material 1 Ceramic
Length 30.50 Breadth 21.60 Thickness 14.20
Object type Mould
Figure II.12.
A quarter fragment of the original whole. Part of a faience mould though there is no indication on this piece of any design apart from what appear to be two hollows, perhaps half-circular shapes moulded for forming the ring shank.

Object 31795 Square J85 Unit 9431
Material 1 Ceramic
Length 25.10 Breadth 18.20 Thickness 7.90
Object type Mould
Figure II.12.
Small, complete, ceramic faience mould. Flattened oval shap. One side has the design shape cut into it though what the shape is cannot be ascertained since it still contains the faience paste.

Object 31804 Square J85 Unit 9434
Material 1 Ceramic
Length 32.10 Breadth 28.80 Thickness 13.50
Object type Mould
Figure II.12.
Silt ceramic faience mould almost complete. It appears to have suffered abrasion at one end. Rectangular in shape with the long sides slightly curved. The mould design is of an oval shape (semicircular in cross section) with two short, thin protrusions cut at each end (top and bottom).

Object 31826 Square J80 Unit 9457
Material 1 Ceramic
Length 22.40 Breadth 17.30 Thickness 8.70
Object type Mould
Figure II.12.
Ceramic faience mould—slightly damaged on one side of the design side. Design is a figure of Bes with a tambourine, but most of it is covered by a layer of light grey infill perhaps unfired faience material. The top part of the mould has white paste and in places this has turned yellow, perhaps its intended colour.

Object 31830 Square J85 Unit 9443
Material 1 Ceramic
Length 30.80 Breadth 23.10 Thickness 11.20
Object type Mould
Figure II.12.
Silt ceramic faience mould—almost complete only a fragment of one side missing. Mould shape is complete and teardrop shaped suggesting its use for making pendants.

Object 31915 Square J85 Unit 9449
Material 1 Ceramic
Length 40.00 Breadth 38.50 Thickness 16.80
Object type Mould

Figure II.12.
Silt ceramic faience mould for making rings—complete. Inside is coated with a fragmented layer of pinkish white chalky substance. There are also traces of different pigments—light green, pale pastel blue and reddish pink. The shape suggests a rounded ring shank with a flat rectangular front to the ring.

Object 31917 Square J85 Unit 9504
Material 1 Ceramic
Length 290.00 Breadth 255.00 Thickness 11.00
Object type Mould
Figure II.13.
Clay mould for making a faience inlay of stylised grapes.

Object 31934 Square K80/85 Unit 9480
Material 1 Ceramic
Length 51.00 Breadth 34.50 Thickness 21.00
Object type Mould
Figure II.13.
Silt ceramic ring mould fragment—only shows the ring shank mould shape, design missing. Mould is very sooty on one side.

Object 31960 Square J80 Unit 9438
Material 1 Ceramic
Length 28.00 Breadth 20.50 Thickness 14.00
Object type Mould
Figure II.13.
Fragment of silt ceramic faience mould—appears to be part of a ring mould. Fragment of the shank part of mould can be seen. Two flecks of red can be seen on its base.

Object 31973 Square J80 Unit 9464
Material 1 Ceramic
Length 51.80 Breadth 34.90 Thickness 20.80
Object type Mould
Figure II.13.
Silt fragment of unfired faience mould—over half of the ring shaped mould is preserved in this piece.

Object 31979 Square J85 Unit 9504
Material 1 Ceramic
Length 29.00 Breadth 25.50 Thickness 11.00
Object type Mould
Figure II.13.
Silt ceramic faience mould. The mould is drop shaped and the surface of faience piece would have had a raised bumpy surface. Probably intended as a small grape cluster.

Object 32264 Square L80 Unit 7986
Material 1 Ceramic
Length 20.00 Breadth 17.00 Thickness 12.00
Object type Mould
Figure II.13.
Silt ceramic faience mould. The mould itself is burnt on the majority of its underside. The faience design appears to be (possibly) a hippopotamus (Tauert) such as Gurob Pl. xlii.9.D.

Object 32265 Square L80 Unit 7986
Material 1 Ceramic
Length 20.50 Breadth 17.00 Thickness 11.00
Object type Mould
Figure II.13.
Ceramic faience mould—design of mould is Bes with a tambourine.

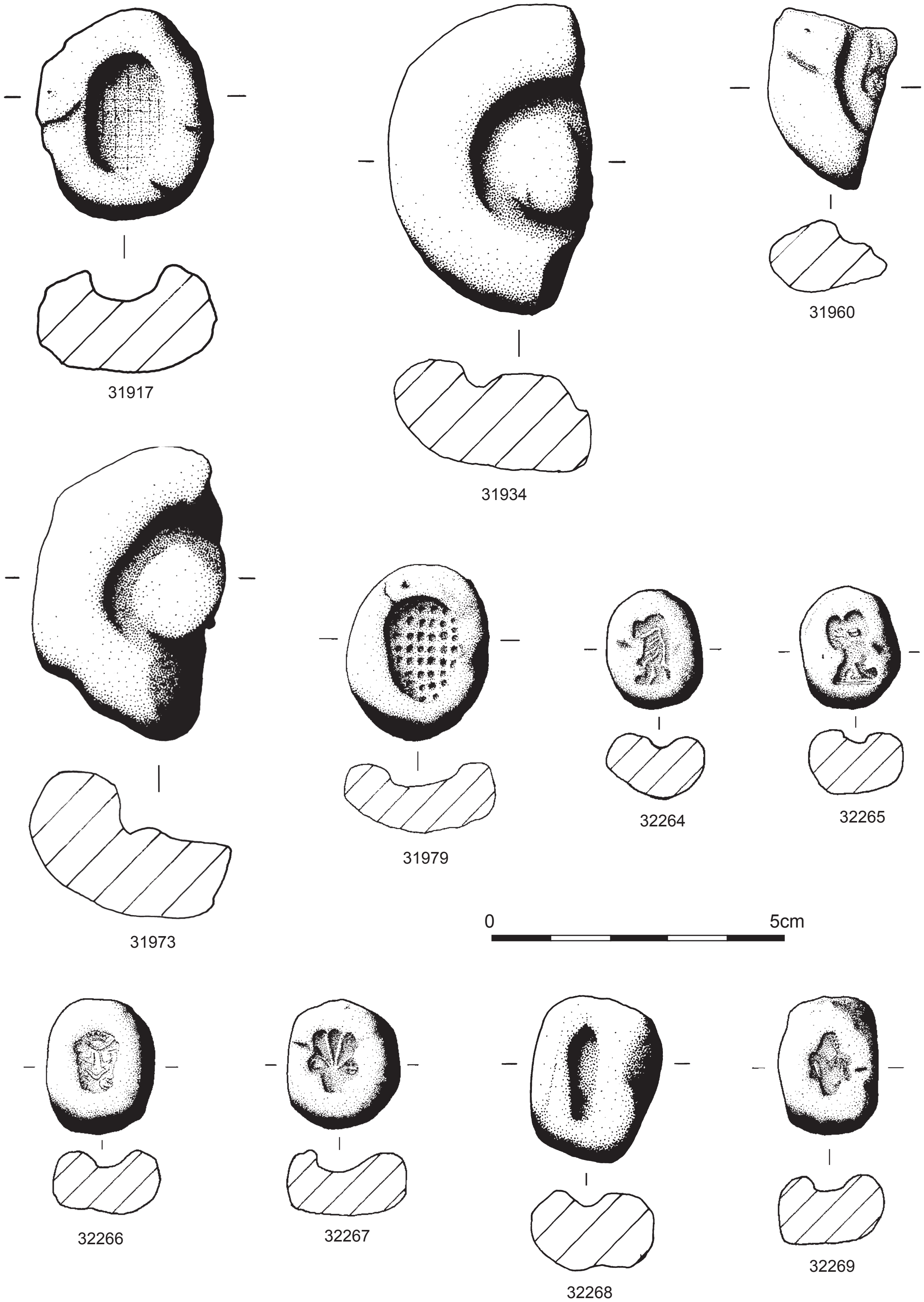


Figure II.13. Moulds for producing faience objects.

Object 32266 Square L80 Unit 7986
Material 1 Ceramic
Length 22.50 Breadth 19.00 Thickness 12.00
Object type Mould
Figure II.13.
Ceramic faience mould—the majority of its surface appears burnt (sooty appearance). Possibly a floral motif?

Object 32267 Square L80 Unit 7986
Material 1 Ceramic
Length 21.00 Breadth 19.00 Thickness 20.00
Object type Mould
Figure II.13.
Silt ceramic faience mould—slightly burnt around the design on one side. Design is of five leaves. One leaf appears to have a some faience paste in it.

Object 32268 Square L80 Unit 7986
Material 1 Ceramic
Length 27.00 Breadth 21.00 Thickness 14.00
Object type Mould
Figure II.13.
Silt ceramic faience mould. The design is of a simple drop pendant like Gurob Pl. xliii: 44.P but slightly longer and slimmer. The inside of the mould is coated in places with white powder presumably from faience paste.

Object 32269 Square K85 Unit 7965
Material 1 Ceramic
Length 23.00 Breadth 17.00 Thickness 12.50
Object type Mould
Figure II.13.
Silt ceramic faience mould. Partially burnt. It has another substance stuck to its surface which looks like a wash but is more likely to be something accidentally poured over mould. The design is similar to Petrie's (1894) Pl. xviii: 367.

Object 32270 Square K85 Unit 7976
Material 1 Ceramic
Length 20.50 Breadth 20.50 Thickness 13.00
Object type Mould
Figure II.14.
Roundish silt ceramic faience mould—slightly burnt. Design could possibly be a plant head. Patches of black on the surface.

Object 32271 Square K85 Unit 7976
Material 1 Ceramic
Length 26.50 Breadth 26.50 Thickness 13.50
Object type Mould
Figure II.14.
Silt ceramic faience mould—burnt on the outside. The design is a sun disc.

Object 32273 Square K80 Unit 7984
Material 1 Ceramic
Length 43.50 Breadth 40.50 Thickness 15.50
Object type Mould
Figure II.14.
Silt ceramic faience mould. Within the design and over one side of the top, down the side and a little underneath is a layer of white substance—faience mixture? The design is a simple rounded ring shank but is damaged around one edge.

Object 32274 Square K80 Unit 7969
Material 1 Ceramic
Length 42.50 Breadth 42.00 Thickness 17.50
Object type Mould
Figure II.14.
Silt ceramic ring mould. Shape of mould is a semicircular shank with a ring front which goes straight across. Mould is filled with a quantity of white faience mixture.

Object 32275 Square K80 Unit 7969
Material 1 Ceramic
Length 25.00 Breadth 23.00 Thickness 10.00
Object type Mould
Figure II.14.
Faience mould probably of silt ceramic, now black through burning. The mould design is very clear—a drop shape with impressions, intended to represent a grape cluster.

Object 32276 Square K80 Unit 7966
Material 1 Ceramic
Length 20.00 Breadth 20.00 Thickness 12.50
Object type Mould
Figure II.14.
Small round silt ceramic faience mould. Mould looks slightly sooty underneath but not burnt. The design is a rectangle (though almost square) with a line running down its centre as a slight ridge. The floor of the mould also slopes—the end one side of the line being shallower than at the other side. A string mark on mould surface coming from design may be for the removal of the archetype.

Object 32277 Square K85 Unit 8036
Material 1 Ceramic
Length 27.00 Breadth 27.50 Thickness 13.00
Object type Mould
Figure II.14.
Silt ceramic faience mould. Design is of an oval drop. There is white faience paste attached to the mould surface.

Object 32278 Square L85 Unit 7989
Material 1 Ceramic
Length 22.00 Breadth 17.00 Thickness 10.00
Object type Mould
Figure II.14
Silt ceramic faience mould. Mould bottom has a patch of soot adhering. The design of a Tauert figure.

Object 32279 Square L85 Unit 7989
Material 1 Ceramic
Length 20.00 Breadth 16.50 Thickness 11.00
Object type Mould
Figure II.14.
Silt ceramic faience mould. Mould has a dark patch like stain around the top right hand side of the design, following on down right side and over the face. Design is of a Tauert figure.

Object 32360 Square K80 Unit 7998
Material 1 Ceramic
Length 36.00 Breadth 21.00 Thickness 19.50
Object type Mould
Figure II.14.
Silt ceramic fragment of a faience ring mould. Only a tiny section of the ring shank design remains.

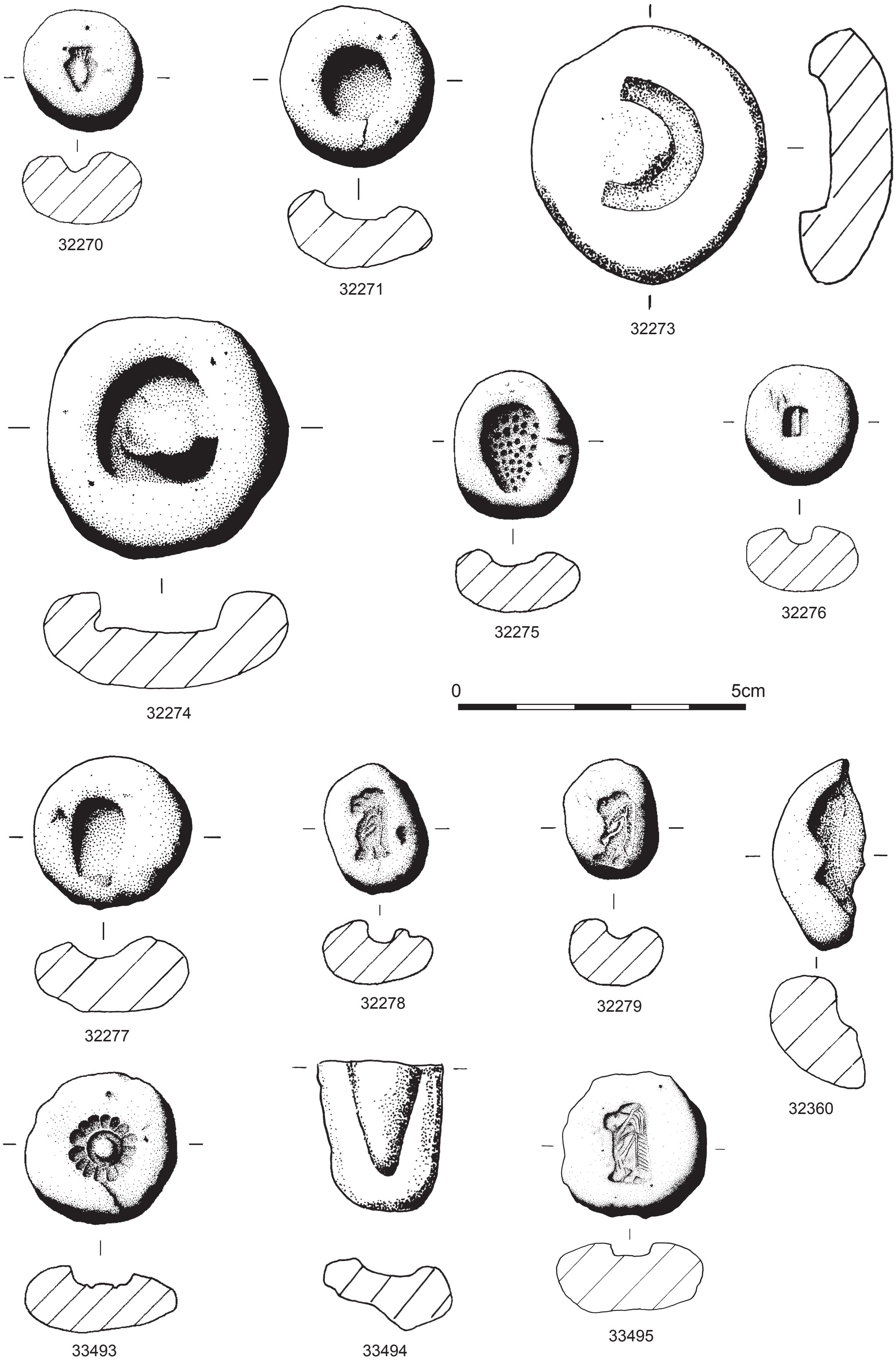


Figure II.14. Moulds for producing faience objects.

Object 33493 Square K90 Unit 10185
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 11.00 Diameter 26.00
Object type Mould
Figure II.14.
Reddish-brown silt ceramic faience mould. It is complete, lozenge shaped with rounded edges. Mould design for a flower. Signs of blackening to surface suggesting that the mould was used? Diameter of the cavity: 11mm. Impression of string visible, probably originally attached to the metal piece to make the flower impression. Finger/thumb prints on the back.

Object 33494 Square K90 Unit 10185
Material 1 Ceramic
Length 27.00 Breadth 21.00 Thickness 11.00
Object type Mould
Figure II.14.
Red silt ceramic mould, broken across its breadth. The mould shape is a teardrop shaped pendant (?). Length of remaining cavity: 20.0mm, max. width of cavity; 10.0mm. Signs of blackening to surface, suggesting that it has been used.

Object 33495 Square K90 Unit 10185
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 11.00 Diameter 24.00
Object type Mould
Figure II:14.
Red silt ceramic mould, complete. Mould in the shape of a Tauert. Almost "lozenge"-shaped with rounded edges. No very obvious signs of use.

Object 33518 Square K90 Unit 10185
Material 1 Ceramic
Length 28.00 Breadth 18.00 Thickness 9.00
Object type Mould
Figure II.15.
Brown-greyish silt ceramic mould. Cavity runs lengthwise, "bullet" shaped, max. length 22.0mm; max width of cavity: 7.0mm. No obvious decoration on the cavity.
For large version of Petrie's (1894) Pl. xx: 522.

Object 33519 Square K90 Unit 10185
Material 1 Ceramic
Length 27.00 Breadth 19.00 Thickness 10.00
Object type Mould
Figure II.15.
Red silt ceramic fragment of mould, with grey core. Cavity with rounded edges, may be bullet shaped? For Petrie 1894: Pl. xx: 518.

Object 33548 Square K90 Unit 10185
Material 1 Ceramic
Length 37.00 Breadth 30.00 Thickness 17.00
Object type Mould
Figure II.15.
Silt ceramic mould, broken across. Cavity in the shape of a tapering rectangular (may be bullet-shaped or teardrop?). No obvious signs of use. Max. width cavity: 10.0mm; min. width: 6.0mm. For Petrie's (1894) Pl.xx: 563 possibly.

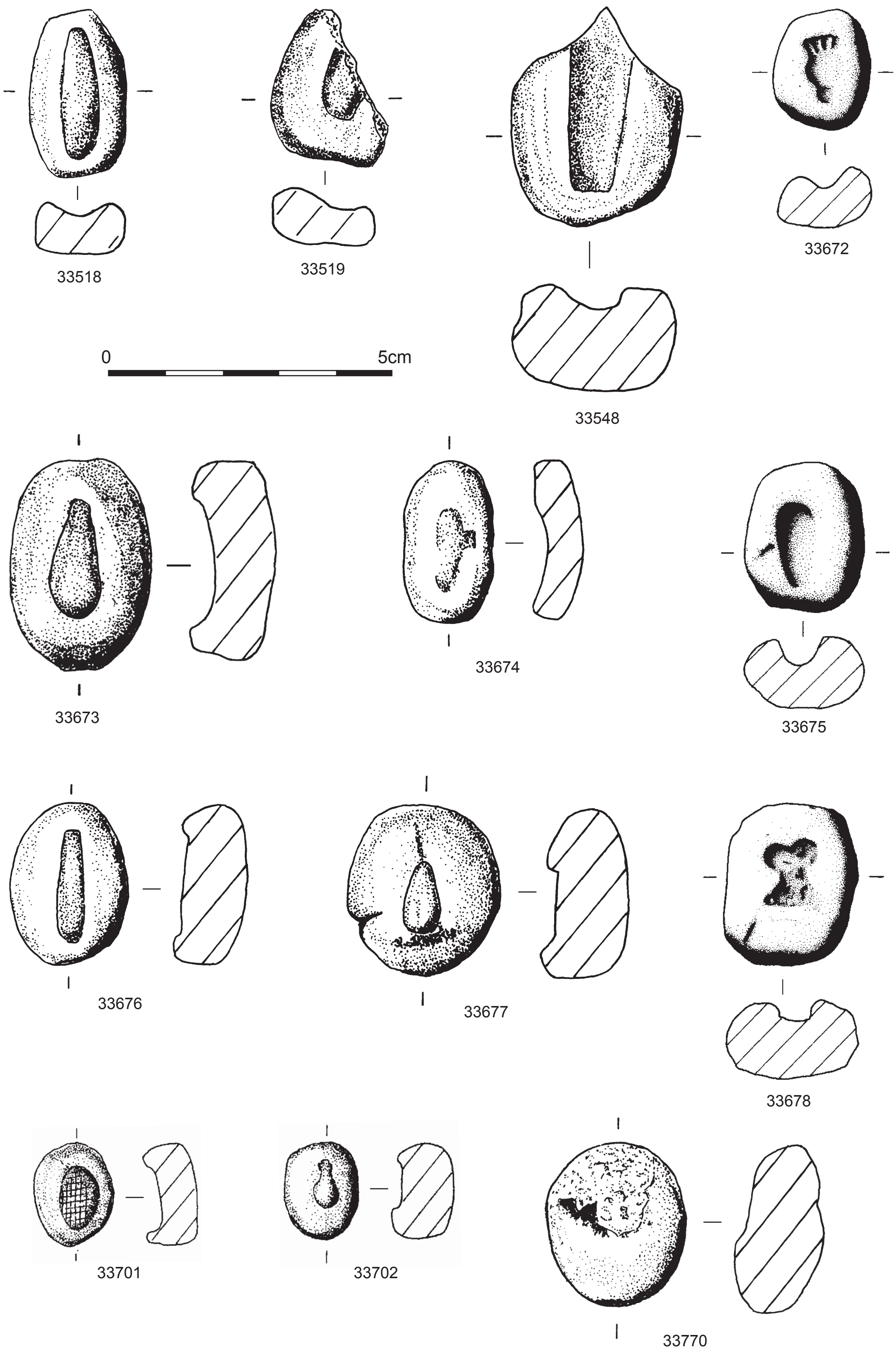


Figure II.15. Moulds for producing faience objects.

Object 33672 Square M85 Unit 10179
Material 1 Ceramic
Length 22.00 Breadth 16.00 Thickness 9.00
Object type Mould
Figure II.15.
Reddish brown ceramic mould, complete, silt ware, oval in shape, rounded edges. Mould design for a small thistle (probably calyx). No obvious signs of use.

Object 33673 Square M85 Unit 10174
Material 1 Ceramic
Length 36.00 Breadth 25.00 Thickness 12.00
Object type Mould
Figure II.15.
Red-brown silt ceramic mould, complete. Oval shaped with rounded edges. Mould design for a teardrop pendant. Signs of blackening to the surface. Max. length cavity: 21.0mm; max. breadth: 9.0mm. Red colour in cavity from faience paste. For Petrie's (1894) Pl. xx: 506.

Object 33674 Square M85 Unit 10174
Material 1 Ceramic
Length 27.50 Breadth 15.00 Thickness 6.00
Object type Mould
Figure II. 15.
Badly worn ceramic mould (silt ware), oval shaped with rounded edges. Only bottom remains. No clear cavity. Design unknown.

Object 33675
Square M85 Unit 10179
Material 1 Ceramic
Length 26.00 Breadth 20.00 Thickness 12.00
Object type Mould
Figure II.15.
Reddish ceramic mould, silt ware, complete. Oval shaped, rounded edges. Cavity in the shape of a teardrop pendant. No signs of use. . For Petrie 1894: Pl. xx: 506.

Object 33676 Square M85 Unit 10179
Material 1 Ceramic
Length 27.00 Breadth 21.00 Thickness 10.00
Object type Mould
Figure II. 15.
Brown ceramic mould, silt ware, complete. Oval in shape, slightly worn. Mould design in a tear drop shape, shallow cavity. On the back some black marks, suggesting the mould was used? String mark visible which would have facilitated the removal of the finished item. For Petrie 1894: Pl.xx: 524 but perhaps larger.

Object 33677 Square M85 Unit 10179
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 14.00 Diameter 28.00
Object type Mould
Figure II.15.
Brown silt ceramic mould, complete. Round, design in droplet shape. The front and back have a sooty appearance (some black marks visible). The mould is slightly damaged; a crack on the left side. Off to the side of the mould, from the top of the droplet design, runs an impression of a string line.

Object 33678 Square M85 Unit 10179
Material 1 Ceramic
Length 27.00 Breadth 23.00 Thickness 14.00
Object type Mould
Figure II.15.

Silt ceramic faience mould, more or less oval in shape, brownish in colour. Design is of a Bes-figure with tambourine. The inside of the mould is still coated in places with white/beige material. On the left side of the cavity, off to the side of the mould, a string line is visible. For Petrie 1894: Pl. xx: 288.

Object 33701 Square L85 Unit 10192
Material 1 Ceramic
Length 24.00 Breadth 20.00 Thickness 11.50
Object type Mould
Figure II.15.
Silt ceramic faience mould, complete. Oval in shape, brown-red in colour with some patches of soot on the back. Possibly design of a bunch of grapes. Oval cavity with vertical and horizontal "scoring" forming small squares. Some impressions of fingerprints on the mould. Some salt concretions on the back. An impression of a string visible running from the grape design off to the side of the mould. Probably for Petrie's (1894) Pl. xix: 445.

Object 33702 Square L85 Unit 10192
Material 1 Ceramic
Length 23.00 Breadth 19.00 Thickness 13.00
Object type Mould
Figure II.15.
Silt ceramic faience mould, complete. Brown-grey in colour, partially burnt (front and back). Design of a coarse nfr-sign.

Object 33770 Square K95 Unit 10190
Material 1 Ceramic
Length 28.00 Breadth 25.00 Thickness 14.00
Object type Mould
Figure II.15.
Nile silt ceramic faience mould, "pebble" shaped. Damaged surface and cavity. Original design unclear, may be a flower motif? The mould is grey/brown in colour, some darker grey patches around the original cavity.

Object 33785 Square K90 Unit 10185
Material 1 Ceramic
Length 26.00 Breadth 24.00 Thickness 9.00
Object type Mould
Figure II.16.
Fragment of silt ceramic faience mould. Badly worn, only part of bottom and bit of the top is preserved. No clear design. The mould is grey-brown in colour with a cream patch on the bottom. Fingerprints on the back.

Object 33823 Square K95 Unit 10190
Material 1 Ceramic
Length 17.00 Breadth 17.00 Thickness 11.00
Object type Mould
Figure II.16.
Greyish fragment of a faience mould. Only a part of the cavity remains, maybe the design. On the left side of the cavity, off to the upper part of the mould, is a string line visible.

Object 33858 Square L85 Unit 10202
Material 1 Ceramic
Length 30.00 Breadth 26.00 Thickness 14.00
Object type Mould
Figure II.16.
Red Nile silt ceramic faience mould. Broken, only part of the cavity remains, design may be for a teardrop or bullet-shaped pendant. No obvious signs of use.

Object 33955 Square M85 Unit 10224
Material 1 Ceramic
Length 48.00 Breadth 43.00 Thickness 34.00
Object type Mould ?
Figure II.16.
Silt ceramic, reddish in colour, with worked edges. Probably part of a mould? Burnt in places. Three finished edges, like the corner of a mould and of similar fabric.

Object 34165 Square WT Unit Spoil heap
Material 1 Ceramic
Length 30.60 Breadth 21.28 Thickness 10.47
Object type Mould
Figure II.16.
Ceramic mould for making faience pendants. Similar to Petrie's (1894) Pl. xx: 535v. Triangular leaf shape.

Object 34166 Square WT Unit Spoil heap
Material 1 Ceramic
Length 27.47 Breadth 26.03 Thickness 11.31
Object type Mould
Figure II.16.
Ceramic mould for faience object. A simplified version of Petrie's (1894) Pl. xix: 462v. 'Three-feather' type style.

Object 34235 Square WT Unit Western spoil heap
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 14.84 Diameter 36.59
Object type Mould
Figure II.16.
A silt ceramic mould for an Aten sun disc faience inlay. Some paste remains in the mould.

Object 34236 Square WT Unit Western spoil heap
Material 1 Ceramic
Length 33.46 Breadth 25.86 Thickness 13.87
Object type Mould
Figure II.16.
Mould for a faience inlay/amulet. A floral design; a stalk opening into three leaves/petals. No corpus match. Central leaf/petal ribbed with lunate ribs. The left and right hand petal/leaf ribbed diagonally (downward and out). Traces of red faience adhering.

Object 34237 Square WT Unit 34237
Material 1 Ceramic
Length 29.65 Breadth 24.08 Thickness 12.19
Object type Mould
Figure II.16.
Ceramic mould for faience inlay/amulet. Has faint detail as though for stylistic grapes, but very elongated. Line impressions on mould perhaps for a wire to be run through the back of the faience amulet. When this is removed the amulet could be threaded onto a string.

Object 34238 Square WT Unit Western spoil heap
Material 1 Ceramic
Length 30.06 Breadth 22.71 Thickness 12.46
Object type Mould
Figure II.16.
Mould for faience amulet/inlay in drop shape.

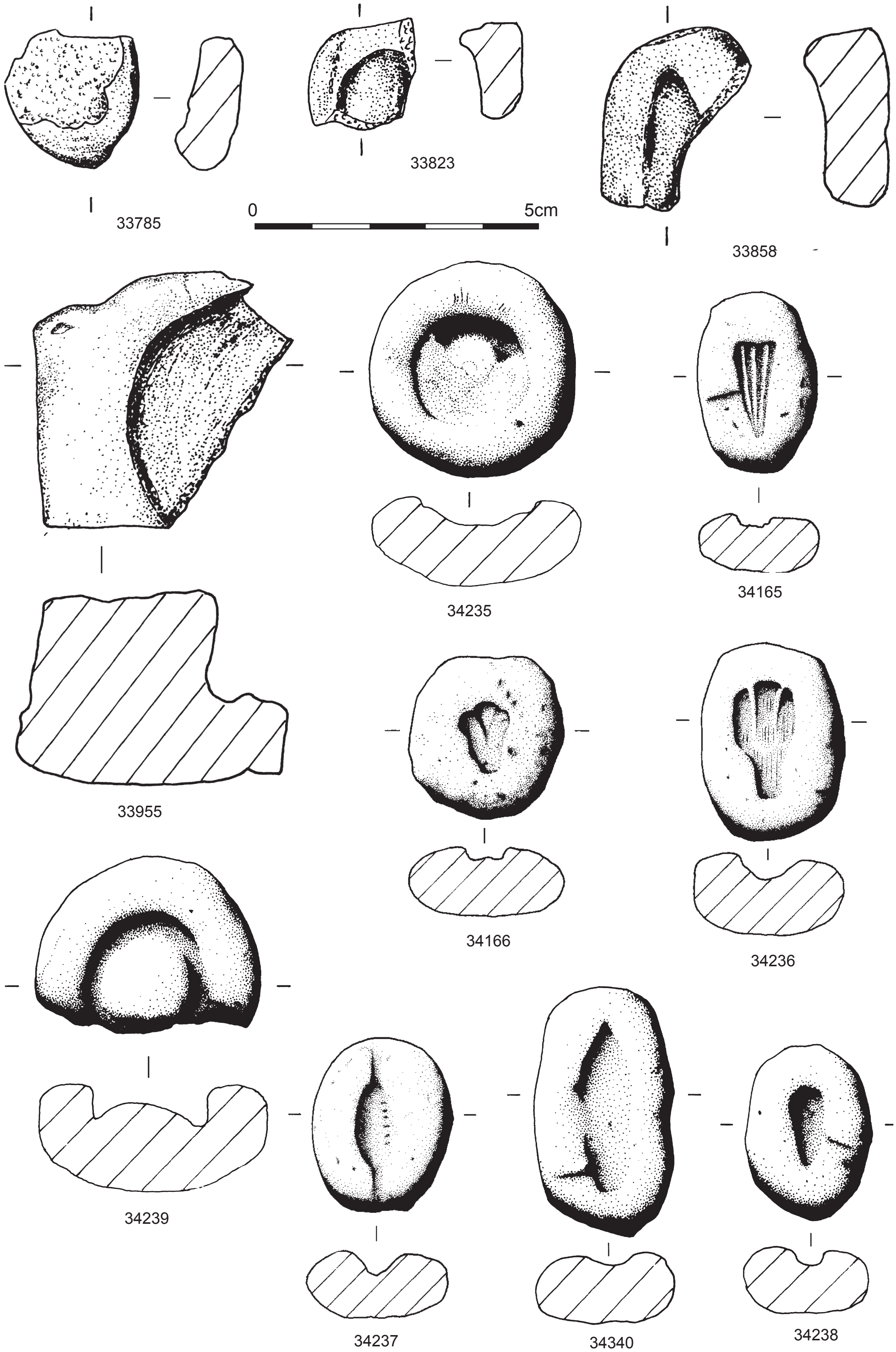


Figure II.16. Moulds for producing faience objects.

Object 34239 Square WT Unit Western spoil heap
Material 1 Ceramic
Length 40.62 Breadth 30.03 Thickness 18.88 Diameter 40.62
Object type Mould
Figure II.16.
Three quarters of a ceramic mould for a faience ring. Diameter is for the mould as approximated if whole.

Object 34240 Square WT Unit Western spoil heap
Material 1 Ceramic
Length 43.00 Breadth 23.82 Thickness 11.88
Object type Mould
Figure II.16.
Ceramic mould for faience amulet/pendant. One string mark on mould. Leaf shaped mould.

Miscellaneous Industrial

Object 33791 Square L85 Unit 10202
Material 1 Metal—copper/copper alloy
Length 12.00 Breadth 8.00 Thickness 9.00
Object type Nail
Fragment of a copper alloy nail, green in colour. Part of the head remains (slightly distorted), as well as part of the point.

Object 34210 Square J85 Unit 9449
Material 1 Metal—copper/copper alloy
Length 12.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Nail
Small fragment of Cu (alloy) nail or rivet. <1g in weight.

Object 33906 Square M85 Unit 10221
Material 1 Faience
Length 26.00 Breadth 8.00 Thickness 3.00
Object type Pendant
Colour White
Figure II.17.
Beige (discoloured) pendant of faience, complete. The pendant is teardrop shaped with a suspension loop on both ends. The suspension loop to the bottom of the teardrop is glazed over; the glaze fills the hole. Flat back.

Object 31584 Square L80 Unit 7961
Material 1 Glass
Length 17.10 Breadth 19.00 Thickness 6.20
Object type Pincer piece
Colour Copper Blue
Translucent copper blue pincer glass—adhering to sandstone. Uneven upper surface with corroded copper alloy.

Object 33742 Square M85 Unit 10189
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 113.00
Object type Pivot
Figure II.17.
Stone object in the shape of a "doughnut", with rounded edges. The hole—which tapers—was probably drilled from two sides, maximum diameter c.60mm. The stone is brownish in colour, sandy in composition with some pebble inclusions. May be a door pivot?

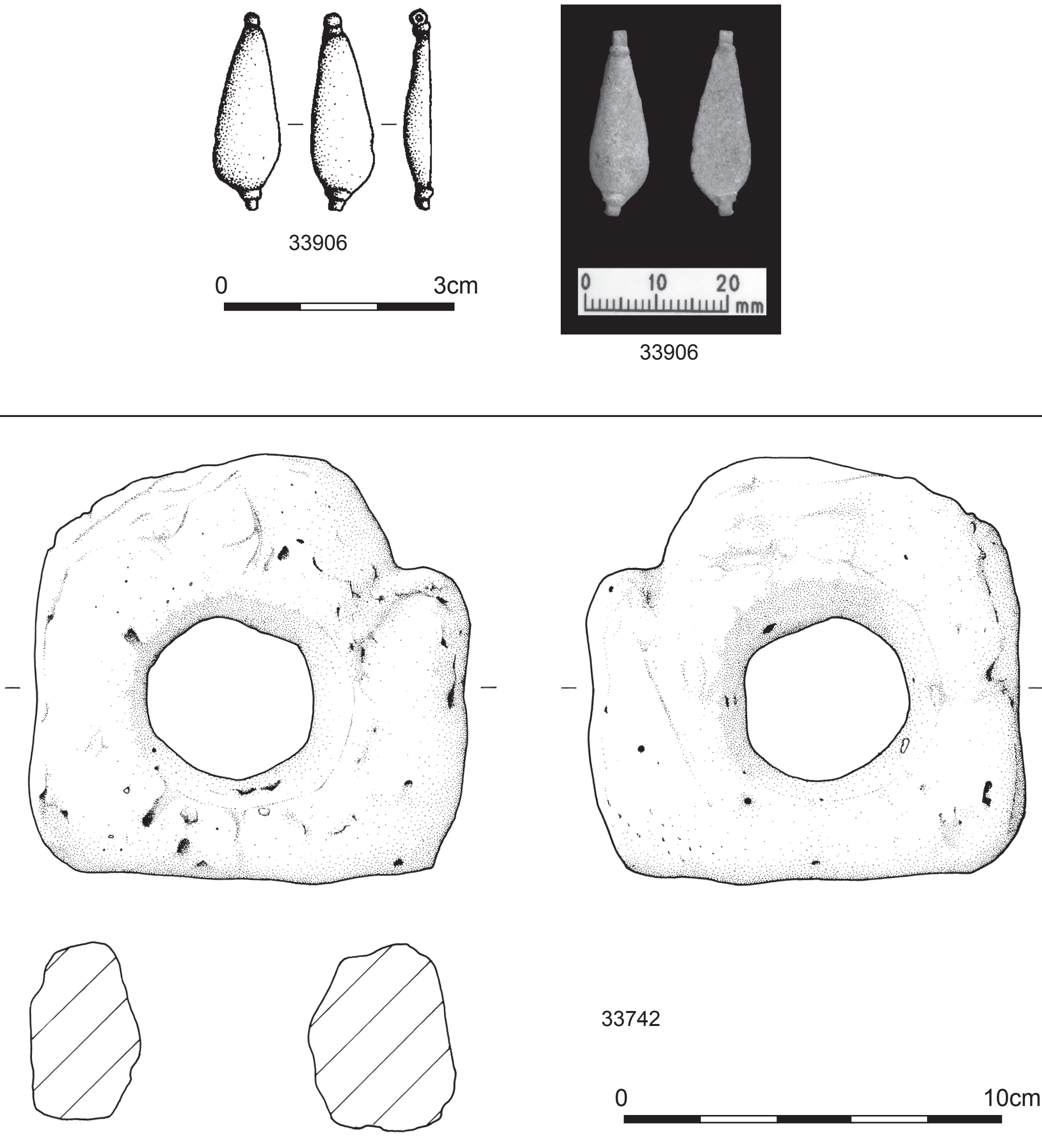


Figure II.17. Pendant (top) and clay object (bottom).

Object 31836 Square J85 Unit 9434
Material 1 Stone - basalt
Length 50.50 Breadth 37.50 Thickness 32.50
Object type Pounder
Irregularly shaped lump of basalt—dark grey in colour. Probably used as a pounding tool.

Object 32214 Square M75 Unit 8981
Material 1 Stone—basalt
Length 154.00 Breadth 128.00 Thickness 46.00
Object type Pounder
Half of a large basalt pounder with small amounts of gypsum adhering to outer surface.

Object 34217 Unit Surface
Material 1 Stone—basalt
Length 60.15 Breadth 51.94 Thickness 45.64
Object type Pounder
Basalt hammer stone.

Object 32375 Square L80 Unit 7961
Material 1 Stone—basalt
Length 97.00 Breadth 80.00 Thickness 49.50
Object type Pounder fragment
Fragment of basalt pounder. Upper surface is rounded/smooth, rising quite steeply from smoothed round edge up to centre. One side rounded out, other side curves round inwards—third side has a wide groove in it which thumb fits so as to give hand grip. On side where edge curves in, the surface appears to have covering of gypsum powder and red pigment.

Object 30400 Square L80 Unit 8978
Material 1 Glass
Length 22.30 Breadth 0.00 Thickness 0.00 Diameter 2.90
Object type Rod
Colour Copper Blue
From kiln 2. Opaque copper blue glass rod. Slightly bent. Broken at both ends.

Object 30675 Square M75 Unit 9005
Material 1 Glass
Length 11.30 Breadth 1.90 Thickness 1.30
Object type Rod
Colour Copper Blue
Fragment of drawn glass rod. Opaque copper blue/turquoise. Fine stretch marks visible lengthwise. Both ends appear to be broken. Slightly flattened to give oval in profile.

Object 30677 Square L80 Unit 9001
Material 1 Glass
Length 13.80 Breadth 0.00 Thickness 0.00 Diameter 2.20
Object type Rod
Colour Copper Blue
Fragment of a trail or drip of translucent copper blue glass. Broken at one end. Tapers toward the other end, where rod coils round to form a circle. Possibly bead formation? Long thin indentation along length from broken end.

Object 30788 Square L75 Unit 9026
Material 1 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Rod
Colour Green
Two fragments of opaque pale green rod. Solid. Rough outer surface (moulded?) with rounded ends. Likely to join. Total length with 2 ends joined = 30mm.
1. L 17.0mm; D 3.4mm
2. L 12.9mm; D 3.4mm

Object 30826 Square M80 Unit 9006
Material 1 Glass
Length 11.00 Breadth 4.50 Thickness 3.50 Diameter 2.0
Object type Rod
Curved end of flattened glass rod which broadens out into bulbous end.

Object 31578 Square L80 Unit 8031
Material 1 Glass
Length 13.00 Breadth 0.00 Thickness 0.00 Diameter 3.00
Object type Rod
Colour Turquoise
Small cylindrical blue turquoise glass rod fragment.

Object 31684 Square J80 Unit 9438
Material 1 Glass
Length 25.00 Breadth 0.00 Thickness 0.00 Diameter 3.50
Object type Rod
Colour Green
Fragment of green opaque glass tube—the hole through the middle has gone through at an angle leading to the incompleteness of the rod on one side. Folded at one end, although incompletely. Must have been on the end of the rod.

Object 31730 Square J85 Unit 9432
Material 1 Glass
Length 32.50 Breadth 0.00 Thickness 0.00 Diameter 4.00
Object type Rod
Colour Blue
Fragment of dark blue glass rod—straight with circular cross section. Broken at both ends. Dark blue in colour.

Object 31810 Square J85 Unit 9434
Material 1 Glass
Length 17.20 Breadth 4.00 Thickness 3.20
Object type Rod
Colour Turquoise
Fragment from a rod of turquoise blue glass. Oval in cross section.

Object 31861 Square J85 Unit 9453
Material 1 Glass
Length 20.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Rod
Colour Turquoise
Fragment of glass rod, broken both ends, circular in cross section and can see the fold where two edges rolled together along one side. Turquoise blue in colour.

Object 31978 Square J85 Unit 9504
Material 1 Glass Material 2
Length 36.00 Breadth 0.00 Thickness 0.00 Diameter 4.50
Object type Rod
Colour Blue
End fragment of blue glass rod. One end finished with a straight edge—so the end of the rod, the other end is broken.

Object 32104 Square K80 Unit 7969
Material 1 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Rod
Colour Green
Two fragments of glass rod. 1. Opaque bottle green, 2. Translucent light blue.
1. L 14.0mm; D 2.5mm
2. L 23.0mm; D 2.5mm

Object 33400 Unit 10171
Material 1 Glass
Length 23.00 Breadth 0.00 Thickness 0.00 Diameter 3.00
Object type Rod
Colour Green
Green rod of glass, broken at both ends. Slight texture visible from marvering.

Object 33431 Unit 10171
Material 1 Glass
Length 13.00 Breadth 0.00 Thickness 0.00 Diameter 1.00
Object type Rod
Colour Blue
Light-blue rod of glass, broken at both ends.

Object 33612 Square M85 Unit 10179
Material 1 Glass
Length 5.50 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Rod
Colour Blue
Light blue opaque fragment of a rod of glass. Broken at both ends. Slight texture visible from marvering.

Object 33643 Square M85 Unit 10174
Material 1 Glass
Length 18.00 Breadth 0.00 Thickness 2.00
Object type Rod
Colour Cobalt Blue
Fragment of a cobalt-blue glass rod. Broken at both ends. Slight impressions of marvering, some white marks on the glaze.

Object 33782 Square L85 Unit 10202
Material 1 Glass
Length 15.50 Breadth 0.00 Thickness 2.00
Object type Rod
Colour Blue
Light blue fragment of glass rod, broken at both ends. Slight texture of marvering visible. The glass rod is slightly flattened, not completely round in cross section.

Object 33891 Square M85 Unit 10221
Material 1 Glass
Length 10.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Rod
Colour Blue
Fragment of a flattened glass rod, broken at both ends. Originally blue, now with white spots, because of devitrifying-process.

Object 33933 Square M85 Unit 10202
Material 1 Glass
Length 9.50 Breadth 0.00 Thickness 0.00 Diameter 2.50
Object type Rod
Colour Blue
Light blue flattened glass rod, broken at both ends, hollow, infilled with brown material. White patches, possibly from devitrification.

Object 33934 Square M85 Unit 10202
Material 1 Glass
Length 16.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Rod
Colour Blue
Light blue glass rod, broken at both ends. The glass is discolouring to white.

Object 33993 Square M85 Unit 10202
Material 1 Glass
Length 21.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Rod

Colour Blue
Solid light blue rod of glass. White lines/patches on the glass (devitrification?).

Object 31664 Square J85 Unit 9433
Material 1 Metal—copper/copper alloy
Length 18.00 Breadth 11.00 Thickness 4.50
Object type Rod
Fragment of copper rod which has been bent round into a teardrop shape. Rectangular in cross section. Green copper corrosion covers what is left of the copper—surprisingly much of the copper is preserved with corrosion layer being relatively thin. Possibly a suspension loop or the top part of an ankh.

Object 31703 Square K75 Unit 9431
Material 1 Metal—copper/copper alloy
Length 12.20 Breadth 5.00 Thickness 3.50
Object type Rod
Small fragment of copper rod (preserved as two joining fragments) of which only a little can still be seen in the centre—oval strip of dark grey, surrounded now in a thick layer of green corrosion product.

Object 31952 Square J85 Unit 9454
Material 1 Metal—copper/copper alloy
Length 15.30 Breadth 0.00 Thickness 0.00 Diameter 2.40
Object type Rod
Fragment of copper rod—covered almost in its entirety with green copper corrosion product, at one end however, there is a light brown appearance to the broken end which on closer inspection has a few tiny areas of metal, shiny goldish in colour. Broken at both ends. So copper still intact under copper corrosion to an extent. The other end is pinched as if it has been bent at some point, or held to brake off another part of the rod. <1g. weight.

Object 33976 Square L85 Unit 10214
Material 1 Metal—copper/copper alloy
Length 74.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Rod
Copper rod or part of a needle (eye is missing), dark green in colour, very friable. Sand and small stones adhering to the corrosion.

Object 34068 Square L85 Unit 10214
Material 1 Metal—copper/copper alloy
Length 63.00 Breadth 0.00 Thickness 0.00 Diameter 2.50
Object type Rod
Two fragments of a copper rod. Friable. Corrosion adhering on one end.

Object 33975 Square M85 Unit 10221
Material 1 Metal—copper/copper alloy
Length 22.00 Breadth 16.00 Thickness 1.00
Object type Sheet(s)
Sheet of copper alloy, red brown in colour with some green patches on one surface.

Object 31875 Square J80 Unit 9463
Material 1 Metal—copper/copper alloy
Length 31.50 Breadth 22.50 Thickness 1.00
Object type Sheet/strip fragment
Copper strip fragment—one original finished edge is preserved. Half a rivet hole is preserved. Covered in copper corrosion product.

Object 30398 Square L75 Unit 8976
Material 1 Ceramic Material 2 Pigment
Length 27.30 Breadth 21.30 Thickness 9.50
Object type Sherd
Nile silt sherd (Fabric I:1) with blue pigment fragments adhering to one side.

Object 31657 Square J80 Unit 9440
Material 1 Ceramic Material 2 Crucible fragment
Length 44.00 Breadth 49.50 Thickness 11.00 Diameter 120.00
Object type Sherd
Figure II.18.
Sherd of silt ceramic—now in two pieces which is coated on the interior with slag and traces of green pigment. Ceramic is very burnt. Probably a metallurgical crucible. 15% of diameter preserved.

Object 33868 Square L85 Unit 10198
Material 1 Ceramic Material 2 Glass
Length 34.00 Breadth 26.00 Thickness 14.00
Object type Sherd
Rim sherd, probably over fired, with glass or slag stuck to it. Green and red patches on the inner surface of the rim.

Object 33422 Unit 10171
Material 1 Ceramic—silt Material 2 Lime
Length 50.00 Breadth 50.00 Thickness 9.00 Diameter 200.00
Object type Sherd
Red Nile silt rim sherd with adhering lime on both sides and the rim. 7% of rim diameter preserved. C019 type rim.

Object 33867 Square M85 Unit 10196
Material 1 Ceramic—silt Material 2 Pigment
Length 36.00 Breadth 15.00 Thickness 6.00 Diameter 220.00
Object type Sherd
Rim sherd of silt ceramic with a red slip on the outer surface and spots of light blue pigment on the inner surface. Amarna pottery catalogue D13 rim type.

Object 30486 Square K80 Unit 7991
Material 1 Glass
Length 32.90 Breadth 12.00 Thickness 4.30
Object type Strip
Colour Blue
Figure II.18.
Flattened glass strip with 2 broken ends and rounded edges. Main body is dark blue translucent glass. One side has stripes of other colours; 2 yellow alternating with 2 white opaque stripes. Coloured stripes are 2mm wide and <1mm deep in section. Blue side shows long thin lines, characteristic of "drawing" glass. Probably meant as an inlay. Same as 31390 and 31975?

Object 30696 Square M80 Unit 9006
Material 1 Glass
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Strip
Colour Blue
Glass strip and rod:
1. L 15.0mm; B 1.0mm; T 0.5mm
Glass strip; light blue. Two broken ends. Faint stretch marks visible.
Sampled 112
2. L 6.6mm; D 0.8mm
Glass rod; transluscent copper blue.

Object 30861 Square M80 Unit 8987
Material 1 Glass
Length 11.80 Breadth 11.00 Thickness 1.30
Object type Strip
Colour Red
Sealing-wax red opaque glass. Some faint striations to one surface at right angles to one another. Thin greyish streaks, plus one on one edge. Vaguely square. Slight bevel to one edge. Tiny pieces of green copper can be seen on the surface of the broken edges.

Object 31829 Square J85 Unit 9443
Material 1 Glass
Length 23.00 Breadth 12.50 Thickness 2.00
Object type Strip
Colour Green
Fragment of thin flat strip of green opaque glass with slightly rounded edges. Both ends broken. Adhering lime (tested with HCl).

Object 32121 Square K80 Unit 7984
Material 1 Stone
Length 46.50 Breadth 12.00 Thickness 9.00
Object type Tool
Figure II.18.
Smooth piece of unidentified stone, tapers to oblong shape one end, to a more blunt pointed end the other. Stone is green grey with a white friable inclusion one end. Stone is very smooth which suggests its use as a burnishing/smoothing tool. May be natural.

Object 32118 Square K80 Unit 7969
Material 1 Stone—basalt
Length 50.00 Breadth 12.00 Thickness 8.00
Object type Tool (?)
Figure II.18.
Fragment of an oblong piece of basalt, broken one end. Thickness tapers at other end. Very smooth—suggesting that it might have been used as a burnishing tool. The possibility remains that it may be a natural pebble, but the material and its context suggest that it is a genuine artefact.

Object 30645 Square M75 Unit 8979
Material 1 Stone—sandstone
Length 77.50 Breadth 72.80 Thickness 17.80
Object type Tool
Figure II.18.
Fine grained cream-coloured sandstone object in 2 pieces (broken across centre) Now adhered together. Triangular and gently wedge shaped in section. Worn/rounded corners and edges. Scraper?

Object 30402 Square M80 Unit 7961
Material 1 Plaster—lime
Length 38.00 Breadth 24.30 Thickness 12.80
Object type Tray
Fragment of flat, buff-coloured, plaster. Lines and short straight impressions to upper surface. Area of powdery buff material on underside.

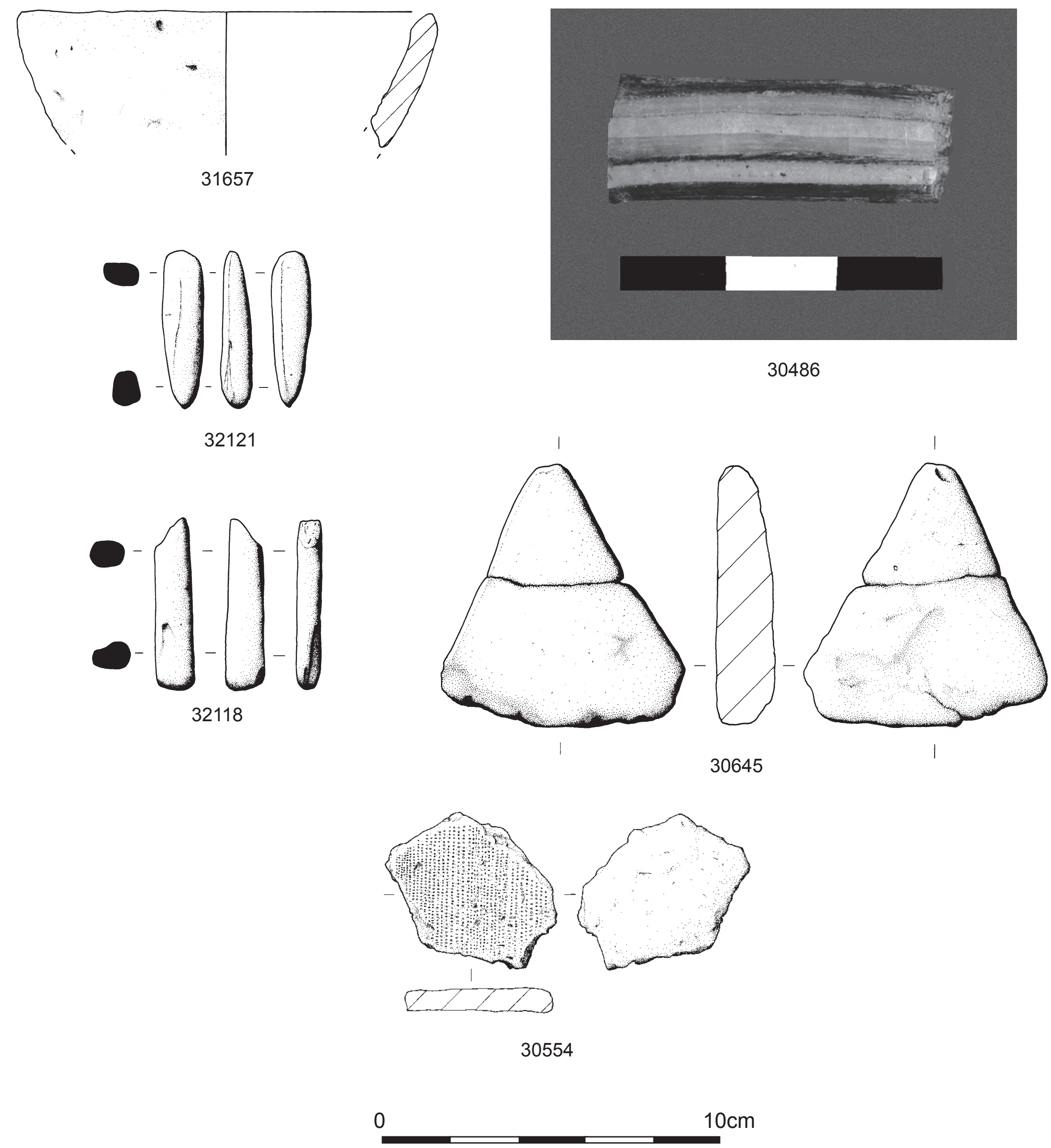


Figure II.18. Miscellaneous "Industrial" finds.

Object 30554 Square M75 Unit 8981
Material 1 Plaster—lime
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Tray
Figure II.18. & Plate 7.1
Six fragments of lime plaster, all of them with clear textile impressions. One has an upturned rim.
1. 15.4g. 51.27 x 38.64 x 7.06mm
Textile impression on one side, chaff on the other.
2. 8.0g. 35.47 x 33.39 x 6.99mm
Textile impressions to one side, rim on one edge.
3. 10.8g. 43.48 x 44.04 x 6.28mm
Textile impression on one side, chaff on the other.
4. 6.2g. 31.24 x 26.75 x 6.47mm

Textile impression on one side, chaff on the other.
5. 4.1g. 28.67 x 20.30 x 5.98mm
Textile impression on one side, chaff on the other.
6. 1.2g. 17.67 x 15.63 x 5.37mm
Textile impression on one side, chaff on the other.

Object 30556 Square M80 Unit 8991
Material 1 Plaster—lime
Length 35.00 Breadth 25.60 Thickness 6.10
Object type Tray
Roughly triangular fragment of plaster. Flat. Yellowish cream in colour. Faint textile impressions to one flat surface. Impressions from organics (straw) to other flat surface. Fabric quite dense, though some air holes and small white (quartz?) inclusions.

Object 30578 Square M80 Unit 8989
Material 1 Plaster—lime
Length 33.50 Breadth 26.70 Thickness 7.00
Object type Tray
Flat fragment of plaster; yellow cream. Quite fine grained and hard. Impressions from organics (straw?) to both surfaces. Glazing material stuck to surface. Faience in glazing material.

Object 30695 Square M75 Unit 9004
Material 1 Plaster—lime
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Tray
Seven fragments of cream plaster with fine, densely packed textile impressions on one surface. Opposite surface smoothed. Some of smaller fragments have no textile impressions. Plaster relatively fine-grained with few inclusions. The largest piece has good textile impressions and is coming up to an edge. The second largest piece has similarly good textile impressions. One piece has charcoal/lime/brick mixture baked onto it. Very good impressions on the smallest piece.
1. L 38.0mm; B 36.8mm; T 6.2mm
2. L 29.5mm; B 27.8mm; T 5.4mm
3. L 28.6mm; B 22.7mm; T 6.8mm
4. L 36.0mm; B 16.6mm; T 6.8mm
5. L 21.3mm; B 19.3mm; T 6.8mm
6. L 18.2mm; B 14.1mm; T 6.3mm
7. L 13.0mm; B 9.0mm; T 5.4mm

Object 31508 Square L80 Unit 7974
Material 1 Plaster—lime
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Tray
Figure II.19.
Five fragments of lime plaster - pinkish in colour. Inclusions - white granular fragments; chalky white inclusions; plant impressions. All pieces show the impression of a woven material on one side, some more clearly than others. One piece (1.) has 6 flecks of turquoise pigment on it and the other side, a dark black smudge. Others show areas of dark smudges too. The smallest piece has one raised edge.
1. L 37.2mm; B 37.5mm; T 7.0mm
2. L 47.0mm; B 40.8mm; T 6.2mm
3. L 40.8mm; B 49.2mm; T 7.9mm
4. L 43.5mm; B 34.8mm; T 6.0mm
5. L 32.2mm; B 17.4mm; T6.0mm. Curves along side, thickening.
Possibly from drying trays in faience factory.

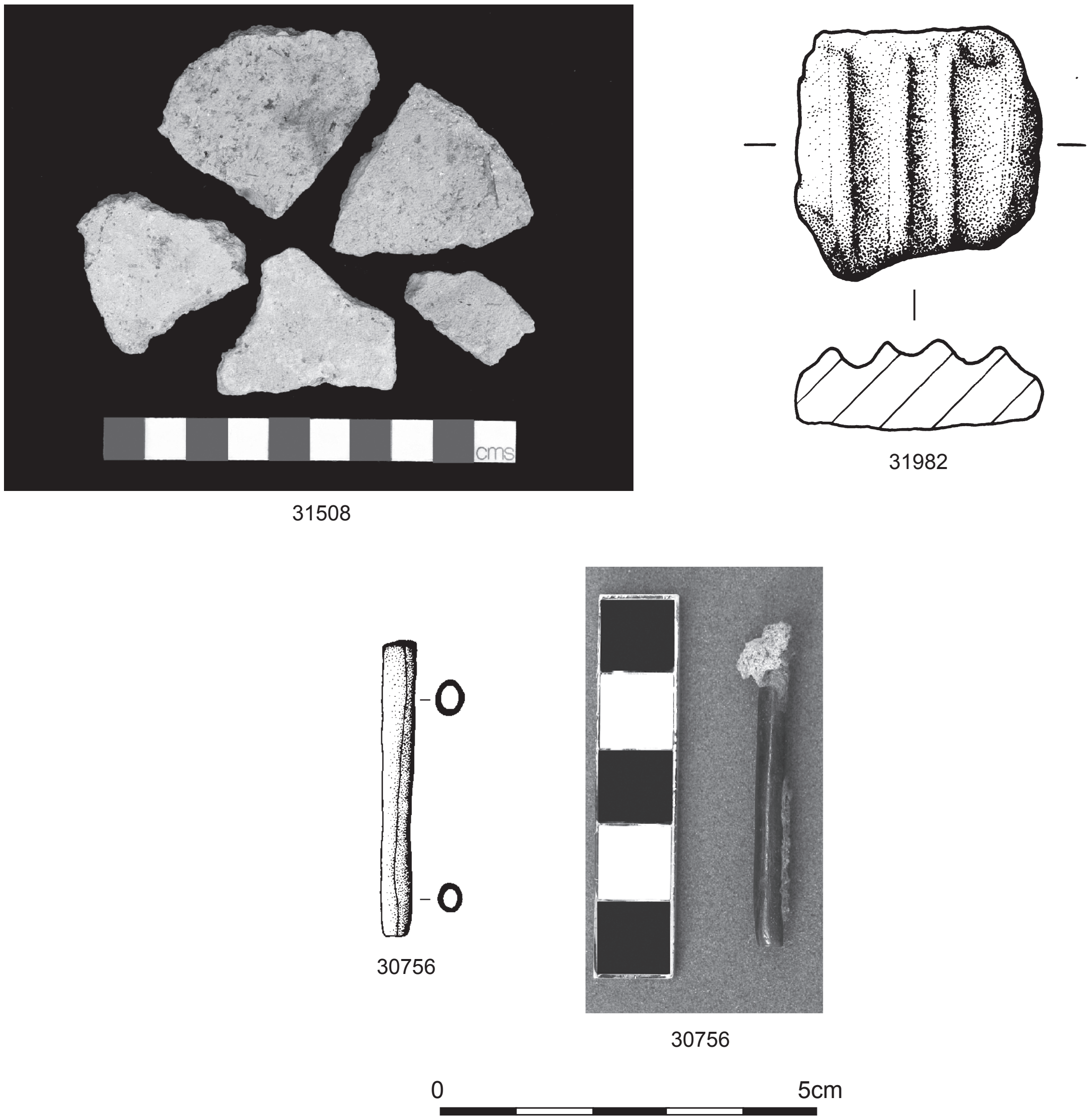


Figure II.19. Calcareous plaster (top) and bronze tube (bottom).

Object 31524 Square L80 Unit 7986
Material 1 Plaster—lime
Length 36.00 Breadth 32.50 Thickness 7.20
Object type Tray
Fragment of lime plaster—pinkish in colour with chalky and granular inclusions. One side is rough showing plant impressions, the other side is relatively flat with very defined textile impressions on its surface. Possibly a piece from a drying tray.

Object 31574 Square L80 Unit 7974
Material 1 Plaster—lime
Length 26.00 Breadth 16.00 Thickness 5.50
Object type Tray
Fragment of lime plaster—beige initially but black through burning. Inclusions visible are lime. Quite burnt, this may be secondary as the burning goes over the broken edges.

Object 31982 Square J85 Unit 9502
Material 1 Plaster—lime
Length 32.10 Breadth 32.00 Thickness 11.00
Object type Tray

Figure II.19.
Fragment of lime plaster—pinkish. One side is flat, the other has a series of ridges suggesting that it may have been used as a drying tray for beads (beads placed in troughs in between the ridges).

Object 32124 Square M75 Unit 9005
Material 1 Plaster—lime
Length 47.00 Breadth 33.50 Thickness 5.50
Object type Tray
Fragment of lime plaster in two pieces. Appears to be a ceramic type substance. Pink in colour with many white inclusions. Both surfaces have organic impressions in them. The two pieces join and have been measured as one piece.

Object 32241 Square M80 Unit 9006
Material 1 Plaster—lime
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Tray
Fifty-two fragments of lime plaster - many have fabric impressions on one side. 9 have patches of lime stuck to them, sometimes quite thick. A few look as if they have been slightly exposed to burning. One tiny piece has a small bright blue fleck in or on it - possibly from faience.

Object 33457 Unit 10171
Material 1 Plaster—lime
Length 44.00 Breadth 22.00 Thickness 6.00
Object type Tray
Fragment of lime plaster tray, more or less triangular in shape, yellowish in colour, broken on all edges, raised lip on one side, textile impressions on one surface.

Object 33543 Square M85 Unit 10187
Material 1 Plaster—lime
Length 56.00 Breadth 39.00 Thickness 10.00
Object type Tray
More or less rectangular fragment of lime plaster tray, buff-coloured, flat surfaces, quite smooth. On one surface textile impressions visible, on the other grey patches. The plaster is fairly compact, some straw impressions. Uneven on underside and slightly burnt.

Object 34254 Square M75 Unit 8981
Material 1 Plaster—lime
Length 23.00 Breadth 18.00 Thickness 6.00
Object type Tray
Small fragment of lime plaster tray. No fabric impression as the fabric survives. Organic impressions to upper and lower surface.

Object 30756 Square L75 Unit 9020
Material 1 Metal—copper/copper alloy
Length 42.90 Breadth 5.50 Thickness 4.50
Object type Tube
Figure II.19.
Flattened tube shape of copper, coated in copper corrosion product (green granules) plus some pebbles and buff -coloured friable material. Flattened lump adheres to one end, lengthwise (rather than like a nail head).

Object 30413 Square L80 Unit 8031
Material 1 Glass
Length 103.50 Breadth 38.90 Thickness 3.00
Object type Fragment
Colour Blue
Twenty-six fragments of blue-green transparent modern bottle glass. Moulded (evidence of seam on 1 fragment). Largest dimensions shown above.

Architectural Fragments

This category includes examples of those materials which it is believed can be related directly to architecture in its broadest sense. Thus worked fragments of building stone are included, along with fragments of the statuary which adorned such buildings. Flooring material such as agglomerate are also included as are fragments of tiles and inlays. These latter may be regarded as controversial inclusions since they are faience and may simply be discards from the faience manufactory at O45.1. Similarly, we have no tiled walls from Amarna, and it may be that the tiles were fitted into items of furniture, rather than onto solid walls.

Object 30448 Square L80 Unit 7961
Material 1 Agglomerate
Length 23.00 Breadth 20.00 Thickness 18.00
Object type Fragment
Creamy white friable lime agglomerate with large pebble inclusions (largest visible is 9mm long). Three smooth edges arranged to form triangle shape where other pebbles used to be adhered to it. Other edges are rough and broken. Hollows in broken surface where pebble inclusions have fallen out. Some other material (tiles?) may have been impressed/have rested on smooth edges.

Object 30634 Square M80 Unit 8992
Material 1 Faience
Length 27.90 Breadth 14.60 Thickness 14.90
Object type Inlay fragment
Figure II.20.
Colour 295C
Dark blue Variant D faience object. Possibly part of a bunch of grapes (cf. Petrie 1894: Pl. xix: 445 etc.). Flattish undecorated back and base (or top?). Curved front, with vertical scoring, cross cut with diagonal lines. Broken across/horizontally to reveal very fine grained greyish core. Some buff-coloured concretions. Glaze very shiny.

Object 31949 Square K75 Unit 9481
Material 1 Mortar
Length 47.50 Breadth 25.00 Thickness 14.40
Object type Fragment
Burned mortar. Reasonably hard fragment. Many inclusions such as small stones, sand and quite large lime pieces.

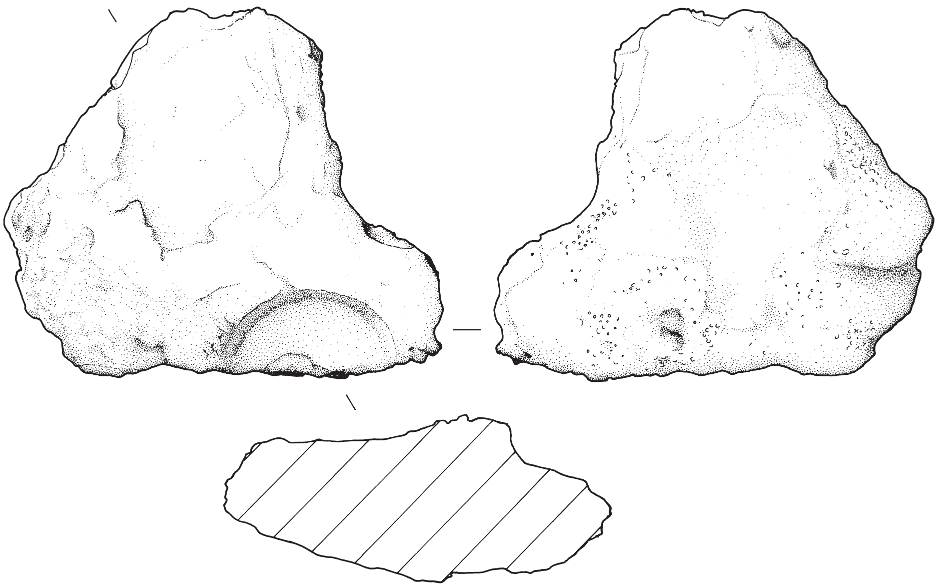
Object 32314 Square M80 Unit 9006
Material 1 Mud
Length 69.00 Breadth 41.00 Thickness 33.50
Object type Fragment
Lump of mud possibly from a floor, or less certainly, a roofing fragment. On one side is an impression left by a stick. One end has a lump of frit (faience) stuck in it (embedded in it). Also contains small stones and brick-red coloured material. Also has a groove running on opposite side to stick one which could also be organic stick impression.

Object 31485 Square K85 Unit 7991
Material 1 Plaster Material 2 Plant fibres
Length 28.00 Breadth 23.00 Thickness 6.50
Object type Fragment
White, chalky plaster fragment. Very friable. Containing a high proportion of plant fibres and possible organic plant impressions.

Object 32237 Square L75 Unit 9002
Material 1 Plaster
Length 45.00 Breadth 27.50 Thickness 13.00
Object type Fragment
Fragment of purposely scratched sandy, friable plaster which has a thin cream firing surface on one side.

30634

34216



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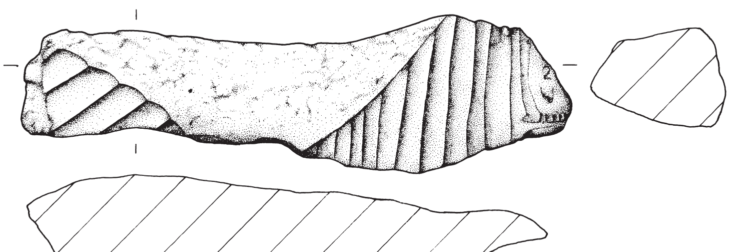

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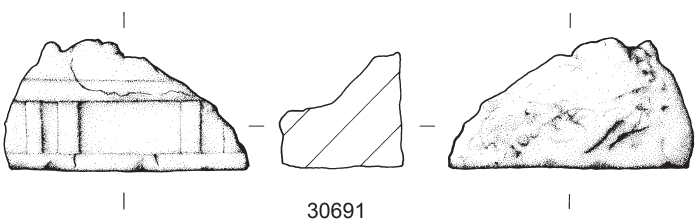
31884



30691

Figure II.20. Architectural fragments.

Object 34216 Unit Surface
Material 1 Plaster
Length 112.30 Breadth 103.75 Thickness 39.39
Object type Fragment
Figure II.20.
Architectural fragment possibly from a relief. Broken semicircular depression. Red pigment suggesting an Aten sign. Adjacent is a rectangular depression with a chiselled out hieroglyph.

Object 30691 Square L75 Unit 9002
Material 1 Stone—alabaster
Length 63.50 Breadth 34.30 Thickness 28.70
Object type Fragment
Figure II.20.
Decorated corner piece from furniture? Or altar piece? Architectural fragment? Frieze on one surface showing relief of vertical and horizontal lines.

Object 31884 Square J85 Unit 9431
Material 1 Stone—limestone
Length 143.50 Breadth 43.50 Thickness 30.50
Object type Fragment
Figure II.20.
Fragment of limestone which has been carved into a series of ridges suggesting that it is a fragment from a human statue which was wearing a kilt (of which this is a part); bottom of the fragment under the horizontal/diagonal line ridges seems to be fragments of hieroglyphics, with perhaps the edge of a cartouche just visible bottom left.

Object 34034 Square M85 Unit 10233
Material 1 Stone—limestone
Length 119.00 Breadth 89.00 Thickness 41.00
Object type Fragment
Figure II.21.
Fragment of white/beige stone, more or less rectangular with a surface of grooves and ridges on one side. Red paint is visible on the ridges. Space between the grooves c.3mm. Some of the grooves are filled in with a grey material, possibly plaster or clay. The object might be related to decorative architectural features.

Object 33498 Square K100 Unit 10178
Material 1 Stone—quartzite
Length 60.00 Breadth 59.00 Thickness 24.00
Object type Fragment
Fragment of buff-coloured stone, broken at two ends. Might be a pebble or part of a sculpture? Very smooth surfaces.

Object 33499 Square K100 Unit 10178
Material 1 Stone—quartzite
Length 62.00 Breadth 58.00 Thickness 25.00
Object type Fragment
Figure II.21.
Stone fragment, possibly quartzite, shaped in the form of a breast with nipple, curved surface. Part of a statue.

Object 30684 Square M75 Unit 9015
Material 1 Faience
Length 49.10 Breadth 19.00 Thickness 4.00
Object type Inlay fragment
Colour 295C
Fragment of Variant D blue faience inlay, curved/scalloped/undulated edge with glaze. Glazed on both sides although one side appears to be accidental. Part of it seems to be secondarily shaped after glazing to fit into something.

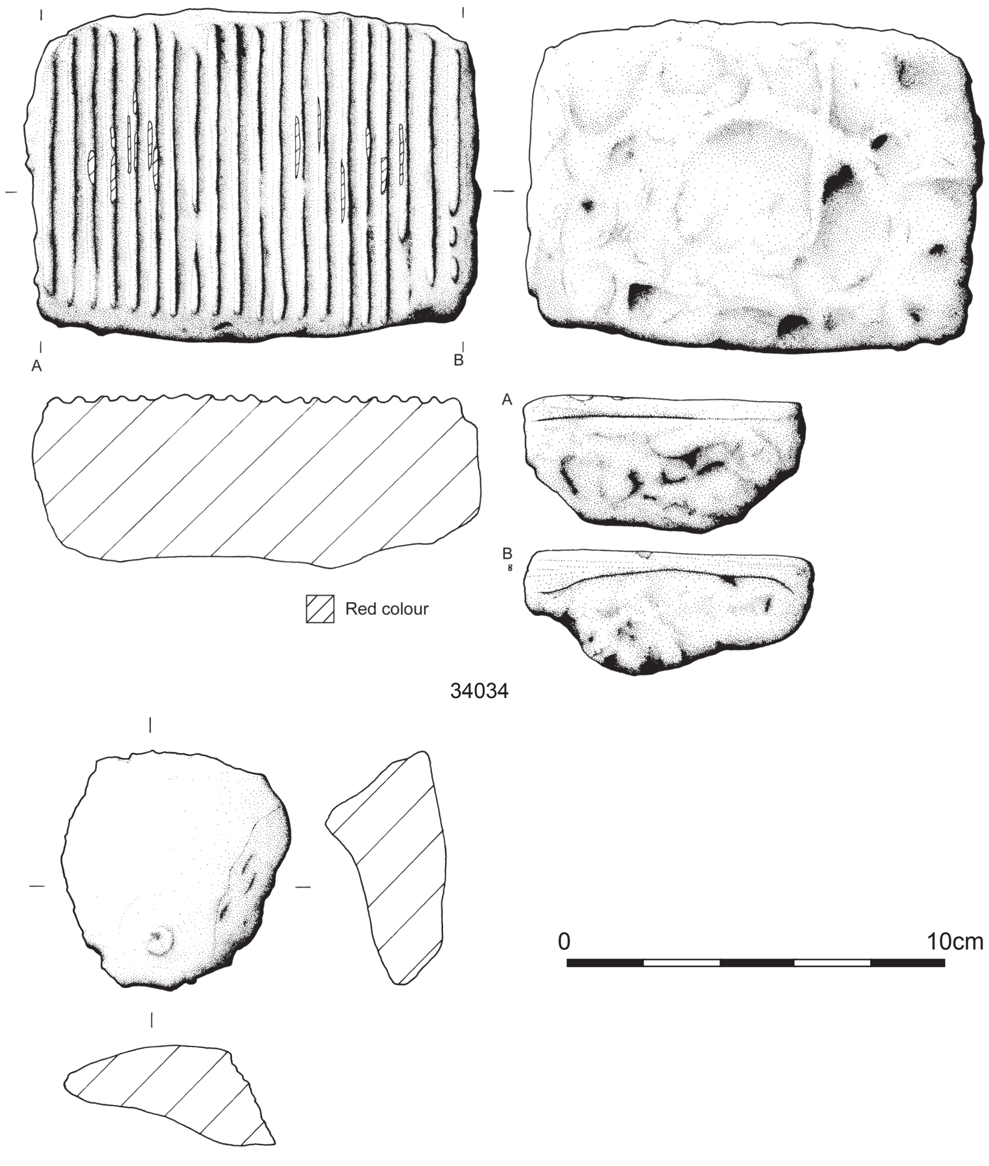


Figure II.21. Architectural fragments.

Object 31643 Square J80 Unit 9440
Material 1 Faience
Length 21.00 Breadth 11.00 Thickness 6.00
Object type Inlay fragment
Colour Black
Black faience bar with brown/beige core. The bar is broken at both ends to reveal that the glaze is c.0.5mm thick. One side of the fragment (the underside?) has less well formed glaze suggesting that glazing was by efflorescence.

Object 31693 Square J85 Unit 9438
Material 1 Faience
Length 28.50 Breadth 24.00 Thickness 11.00
Object type Inlay fragment
Colour 322C
Large fragment of a circular faience object which has probably been mould formed judging by the very flat bottom to the piece. The turquoise glaze continues from the top, down the intact edge of the fragment.

Object 33384 Unit 10171
Material 1 Faience
Length 9.00 Breadth 9.00 Thickness 3.00
Object type Inlay fragment
Colour 3025C
Roughly square fragment of faience inlay or tile, broken edges, mid to dark-blue glaze on one side only, thin layer of white under glaze, greyish faience core.

Object 33414 Unit 10171
Material 1 Faience
Length 14.00 Breadth 8.00 Thickness 5.00
Object type Inlay fragment
Colour 314C
Mid-blue fragment of faience, angular with broken edges, probably part of an inlay or tile, thin layer of glaze, thin layer of white material under glaze, glaze on one side only. Greyish core with limestone inclusions.

Object 33466 Square K90 Unit 10184
Material 1 Faience
Length 6.00 Breadth 6.00 Thickness 2.00
Object type Inlay fragment
Colour 314C
Mid-blue square fragment of faience, probably part of an inlay or tile. Fine white layer under glaze, brownish faience core.

Object 33520 Square K90 Unit 01085
Material 1 Faience
Length 10.00 Breadth 5.00 Thickness 1.00
Object type Inlay fragment
Colour 295C
Cobalt-blue fragment of faience, part of an inlay or tile? Glaze on one side only, buff-coloured faience core.

Object 33567 Square M85 Unit 10179
Material 1 Faience
Length 28.00 Breadth 11.00 Thickness 4.00
Object type Inlay fragment
Colour Green
Green fragment of faience, broken on all edges, glaze on one side only, greenish faience core. Curved front and back, raising to a lip.

Object 33600 Square M85 Unit 10179
Material 1 Faience
Length 11.00 Breadth 9.00 Thickness 1.00
Object type Inlay fragment
Colour 3025C
Fragment of blue faience, probably part of inlay or tile. Glaze on one side only. Fine light blue layer between glaze and remains of pink faience core. Brown encrustations on glaze.

Object 33603 Square M85 Unit 10179
Material 1 Faience
Length 16.00 Breadth 11.00 Thickness 4.50
Object type Inlay fragment
Colour 3025C
Fragment of mid-blue faience, probably part of an inlay or tile. Scratched surface. Glaze on one side only, part of the glaze is broken off, revealing a fine grey/blue layer under glaze. Greyish faience core.

Object 33757 Square M85 Unit 10196
Material 1 Faience

Length 6.00 Breadth 4.00 Thickness 0.00
Object type Inlay fragment
Colour 3025C
Fragment of dark blue faience, possibly part of an inlay or tile. Fine white layer under glaze. No faience core.

Object 33797 Square K90 Unit 10185
Material 1 Faience
Length 13.00 Breadth 10.00 Thickness 2.00
Object type Inlay fragment
Colour 3115C
Light blue fragment of faience inlay or tile. Glaze on one side only, discoloured, with white spots. Some cream concretions on the glaze. Pink layer under glaze, buff-coloured faience core.

Object 33853 Square M85 Unit 10202
Material 1 Faience
Length 9.00 Breadth 8.00 Thickness 3.50
Object type Inlay fragment
Colour 310C
Light blue, almost discoloured to white at some spots, fragment of faience. Probably part of an inlay or tile. Glaze on one side, beige layer under glaze, pinkish faience core. Some brown encrustations.

Object 33980 Square M85 Unit 10221
Material 1 Faience
Length 35.00 Breadth 18.00 Thickness 11.00
Object type Inlay fragment
Colour Red
Part of a red faience hand, broken at both ends. Probably part of an inlay. Partly glazed on back and edges, textile impressions visible on back. Fingers only partly preserved.

Object 33999 Square M85 Unit 10202
Material 1 Faience
Length 30.00 Breadth 9.00 Thickness 5.00
Object type Inlay fragment
Colour Red
More or less rectangular fragment of red faience, broken on one end, probably part of an inlay. Only partly glazed. Some cream encrustations on one surface.

Object 34061 Square L85 Unit 10214
Material 1 Faience
Length 22.00 Breadth 14.00 Thickness 4.50
Object type Inlay fragment
Colour 314C
More or less rectangular fragment of bright blue faience, probably part of an inlay or tile. Broken on all edges. Glaze on one side only. Thin white layer under glaze. Grey, coarse faience core. Some brown encrustations on glaze.

Object 31627 Square K80 Unit 7966
Material 1 Glass
Length 12.00 Breadth 11.50 Thickness 1.00
Object type Inlay fragment
Colour Turquoise
Fragment of turquoise blue opaque glass. Possibly inlay?

Object 31699 Square K75 Unit 9431
Material 1 Glass
Length 11.50 Breadth 10.00 Thickness 1.50
Object type Inlay fragment
Colour Blue
Small fragment of flat blue glass with a rounded edge on one side. Possibly inlay. Dark copper/cobalt blue strip.

Object 31944 Square J85 Unit 9449
Material 1 Plaster—white
Length 58.00 Breadth 45.30 Thickness 22.20
Object type Sculpture(s)
Figure II.22.
Fragment of white, gypsum plaster forming a cast of part of a design—the design consists of two tapering straight grooves with rounded tops and then a series of shapes. Probably from the atef crown of Min—feather design.
Plaster is dense and hard.

Object 31980 Square North of J85 Unit surface
Material 1 Stone—alabaster
Length 73.30 Breadth 47.10 Thickness 37.30
Object type Statue fragment
Alabaster fragment of a sun disc with rays and uraea on sun disk though very faint.

Object 33655 Square M85 Unit 10179
Material 1 Stone—basalt
Length 34.00 Breadth 29.00 Thickness 14.00
Object type Statue fragment
Figure II.22.
Fragment of a statue? Possibly an eye and part of a nemes head cloth.

Object 31885 Square J85 Unit 9431
Material 1 Stone—limestone
Length 196.00 Breadth 195.00 Thickness 70.00
Object type Statue fragment
Fragment of limestone carved on one side so smooth and curved round, decreases in width slightly from top to bottom, suggesting that it could be a fragment from a leg or even an arm, depending on whether the statue was life-sized or larger.

Object 30518 Square K85 Unit 8036
Material 1 Faience
Length 34.30 Breadth 30.00 Thickness 14.60
Object type Tile fragment
Colour Green
Figure II.22.
Fragment of faience with green shiny surface. Glaze <1mm thick, under which is a fine grained efflorescing layer of approximately 2mm thick. Underneath this is a coarser grained, quite dense, buff-coloured friable core with tiny fragments of glass in the matrix. The fragment has a D shaped profile. The edges of the piece and the underside have traces of red pigment which runs over the break in the glaze. Some of the coarser core has broken away on the underside, to reveal underside of denser/fine grained core which follows contour of surface. Line/patch of fine grained buff-coloured material runs parallel to the top of the curve although it is not at the top, where something has adhered to it during firing. Possibly part of fluted tile?

Object 30651 Square M75 Unit 8981
Material 1 Faience
Length 10.30 Breadth 8.90 Thickness 5.00
Object type Tile fragment

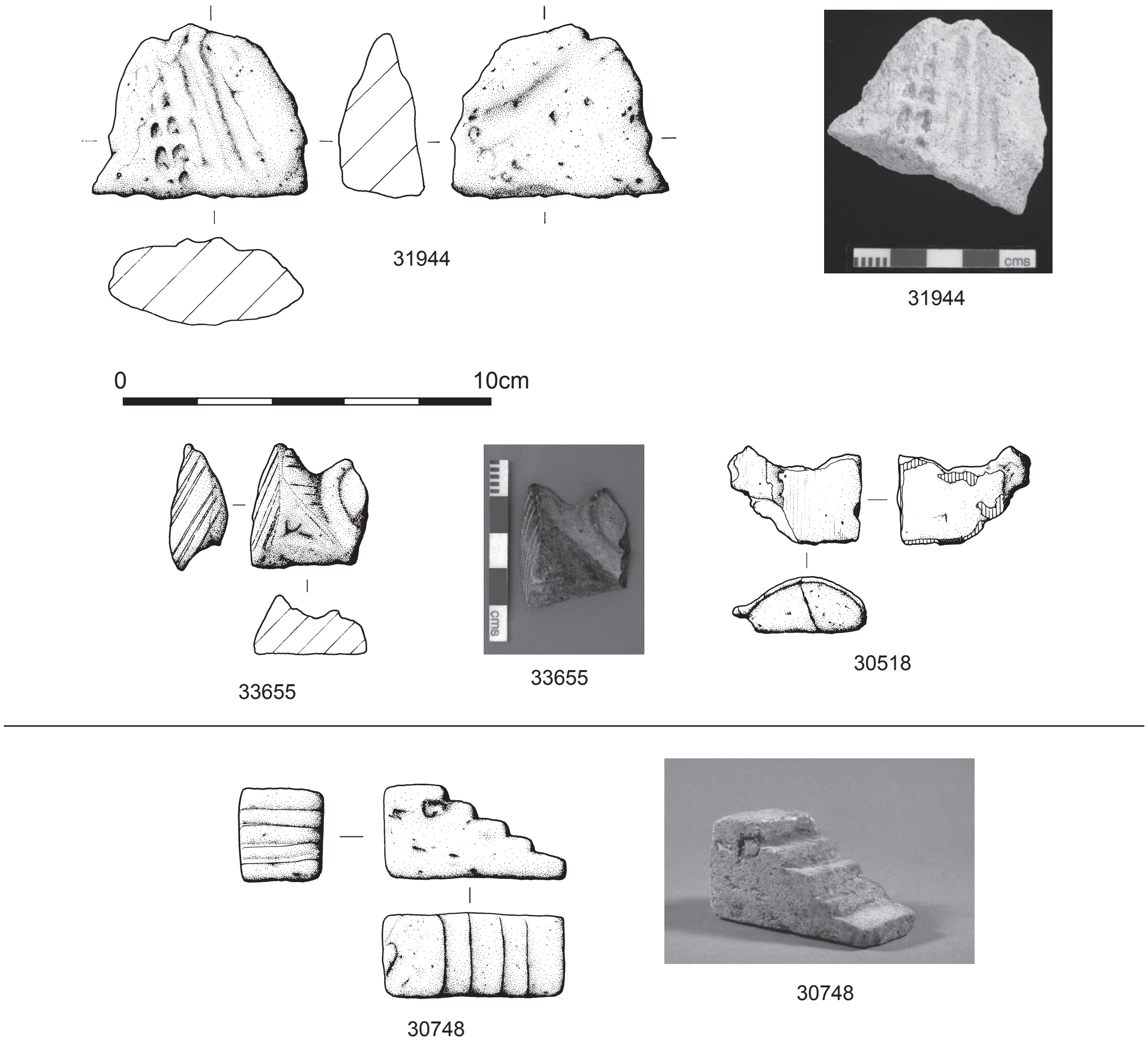


Figure II.22. Architectural Fragments (top) and domestic (bottom).

Colour 314C
Turquoise blue fragment of tile or inlay. One surface glazed only. Buff-grey ceramic on underside. One side possibly original surface. Turquoise blue surface very thin, dull with some ceramic concretions on surface.

Object 31513 Square L80 Unit 7974
Material 1 Faience
Length 8.00 Breadth 5.20 Thickness 4.00
Object type Tile fragment
Colour 325C
Small piece of faience—possibly a fragment of tile or inlay. The glazed greeny-blue side is now quite dull but strong in colour. A build up of salts seems to have occurred underneath the thin pigmented layer whilst the rest of the underside is a reddish brown.

Object 31735 Square surface Unit find
Material 1 Faience
Length 30.00 Breadth 27.50 Thickness 10.00
Object type Tile fragment
Colour Green
Fragment of pale green faience. Large part of it is the core. Surface still has a trace of sheen though quite dull on the whole. “Glazed” surface is flattish with slight ridge at its broken edge and then towards the opposite side about 7mm from the edge there is another larger/longer ridge which slopes away from the top.

Object 31947 Square K75 Unit 9481
Material 1 Faience
Length 14.00 Breadth 8.90 Thickness 3.20
Object type Tile fragment
Colour 322C
Fragment of faience tile—blue turquoise in colour, a slight sheen remains to parts of the glazed surface.

Object 32260 Square M80 Unit 9006
Material 1 Faience
Length 8.50 Breadth 5.00 Thickness 2.00
Object type Tile fragment
Colour 322C
Tiny fragment of faience tile or inlay bright blue turquoise and still with a sheen to its surface.

Object 32377 Square J80 Unit 9440
Material 1 Faience
Length 14.00 Breadth 11.50 Thickness 2.00
Object type Tile fragment
Colour 2955C
Fragment of faience tile. Dark blue, still sheen to surface. Curved from left to right through shortest side.

Object 33564 Square M85 Unit 10179
Material 1 Faience
Length 15.00 Breadth 0.00 Thickness 4.00
Object type Tile fragment
Colour 3025C
Triangular mid-blue fragment of faience, glaze on one side, fine white layer under glaze, grey to pink faience core. Small brown concretions on glaze. Probably part of an inlay or tile.

Object 33647 Square M85 Unit 10174
Material 1 Faience
Length 21.00 Breadth 8.00 Thickness 4.50
Object type Tile fragment
Colour 318C
Rectangular fragment of faience, light blue in colour, probably part of a tile or inlay. Possibly Lucas's (1962) "variant D". Weathered surface, granular. Grey faience core. Glaze on one surface and edge.

Domestic

Object 30748 Square M80 Unit 9025
Material 1 Stone—limestone
Length 49.50 Breadth 24.30 Thickness 26.50
Object type Sculpture(s)
Figure II.22.
Small regular block stairway with 5 steps—each slightly different tread depth. Top step wider than others. Each step approx. 5mm high by 7mm deep. Very regular, sharp surface.

Object 31759 Square K75 Unit 9452
Material 1 Ceramic Material 2 Resin
Length 41.20 Breadth 27.10 Thickness 11.10
Object type Fragment
Sherd of silt (fabric I:4) ceramic which on its interior has traces of an orangish red resin not unlike rust in colour. From mudbrick collapse.

Object 32176 Square M75 Unit 8976
Material 1 Ceramic Material 2 Resin
Length 48.00 Breadth 25.50 Thickness 10.00

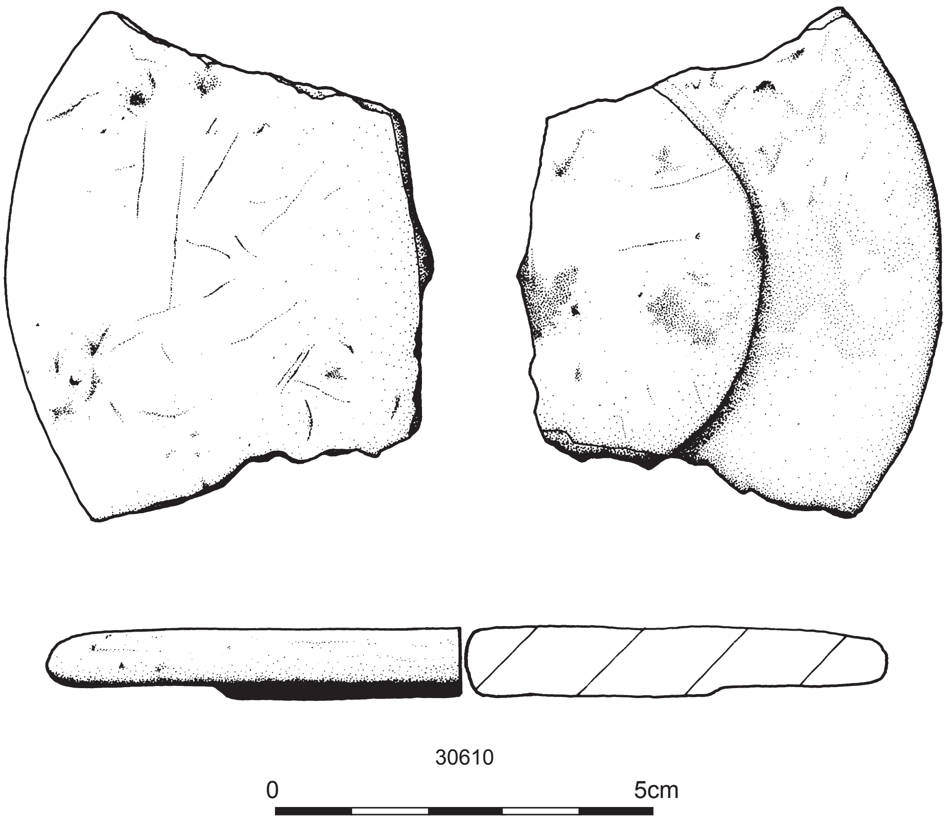


Figure II.23. Domestic find (lid).

Object type Fragment
Fragment of ceramic which after having been broken has been splashed with some sort of resin—stain of black with areas of bright glassy orange.

Object 33501 Square K90 Unit 10184
Material 1 Stone—quartzite
Length 71.00 Breadth 43.00 Thickness 31.00
Object type Fragment
Stone fragment (quartzite?), rounded edges, originally round object with hole pierced through? Maybe part of a loom weight?

Object 31992 Square J85 Unit 9502
Material 1 Ceramic Material 2 Resin
Length 13.90 Breadth 36.00 Thickness 7.30
Object type Sherd
Fragment of silt ceramic (fabric I:5) which has resin with chalky white grains within it partially covering the interior surface. Interior surface of ceramic has a red slip.

Object 32234 Square J80 Unit 9457
Material 1 Ceramic Material 2 Resin
Length 129.00 Breadth 68.00 Thickness 14.50
Object type Sherd
Body sherd of Canaanite amphora? (fabric III.10) which has a large patch of glassy burnt—orange—coloured resin attached to it.

Object 32409 Square L80 Unit 7974
Material 1 Ceramic Material 2 Resin
Length 43.50 Breadth 43.00 Thickness 7.50
Object type Sherd
Silt ceramic sherd (fabric IV:1b) which has two patches on its outer surface and larger patches on inner surface of an orange glassy resin.

Object 32420 Square L80 Unit 7969
Material 1 Ceramic Material 2 Resin
Length 90.00 Breadth 51.50 Thickness 8.50
Object type Sherd
Marl ceramic sherd (fabric III:10) which has a layer of orange resin on its inner surface and over the break.

Object 30610 Square K75 Unit Surface
Material 1 Stone - alabaster
Length 68.00 Breadth 55.20 Thickness 8.70
Object type Stopper/Lid
Figure II.23.
Fragment of round, thin alabaster lid. Flat, thickening away from the rounded edge. Smooth upper and lower surfaces (and finished edge). Underside—a central, rounded raised circle, approx. 1mm thick, with bevelled edge. Creamy white in colour with brownish grey friable concretions in short thin lines to upper surface. Underside raised section has orangish tint. Greyish brown patches of dirt adhere.

Object 31763 Square J85 Unit 9438
Material 1 Faience
Length 13.00 Breadth 8.10 Thickness 4.90
Object type Vessel fragment
Colour Green
Faience fragment—edge of a larger faience piece, since it is very definitely shaped sloping down to edge which then flattens out to vertical edge before turning to a flat bottom. Glazed top and bottom, core of middle visible in breaks. Colour pale green (pastel shade).

Object 33522 Square K100 Unit 10183
Material 1 Faience
Length 17.00 Breadth 17.00 Thickness 5.00
Object type Vessel fragment
Colour 322C
Rim sherd of mid-blue faience, glaze on both surfaces and rim. Fine white layer under glaze, fresh breaks reveal a white faience core.

Ostraca

I am indebted to Dr. Kasia Szpakowska of Swansea University for reading the legible ostraca on my behalf. She has done this from photographs only and has not had the opportunity to examine the original pieces.

Object 31656 Square J80 Unit 9440
Material 1 Ceramic
Length 62.10 Breadth 41.00 Thickness 9.80
Object type Fragment
Sherd of marl (fabric III:6) ceramic which has on the interior side charcoal markings. These resemble Arabic characters, but are illegible.

Object 31866 Square J80 Unit 9457
Material 1 Ceramic
Length 54.60 Breadth 34.00 Thickness 9.00
Object type Ostracon
Figure II.24.

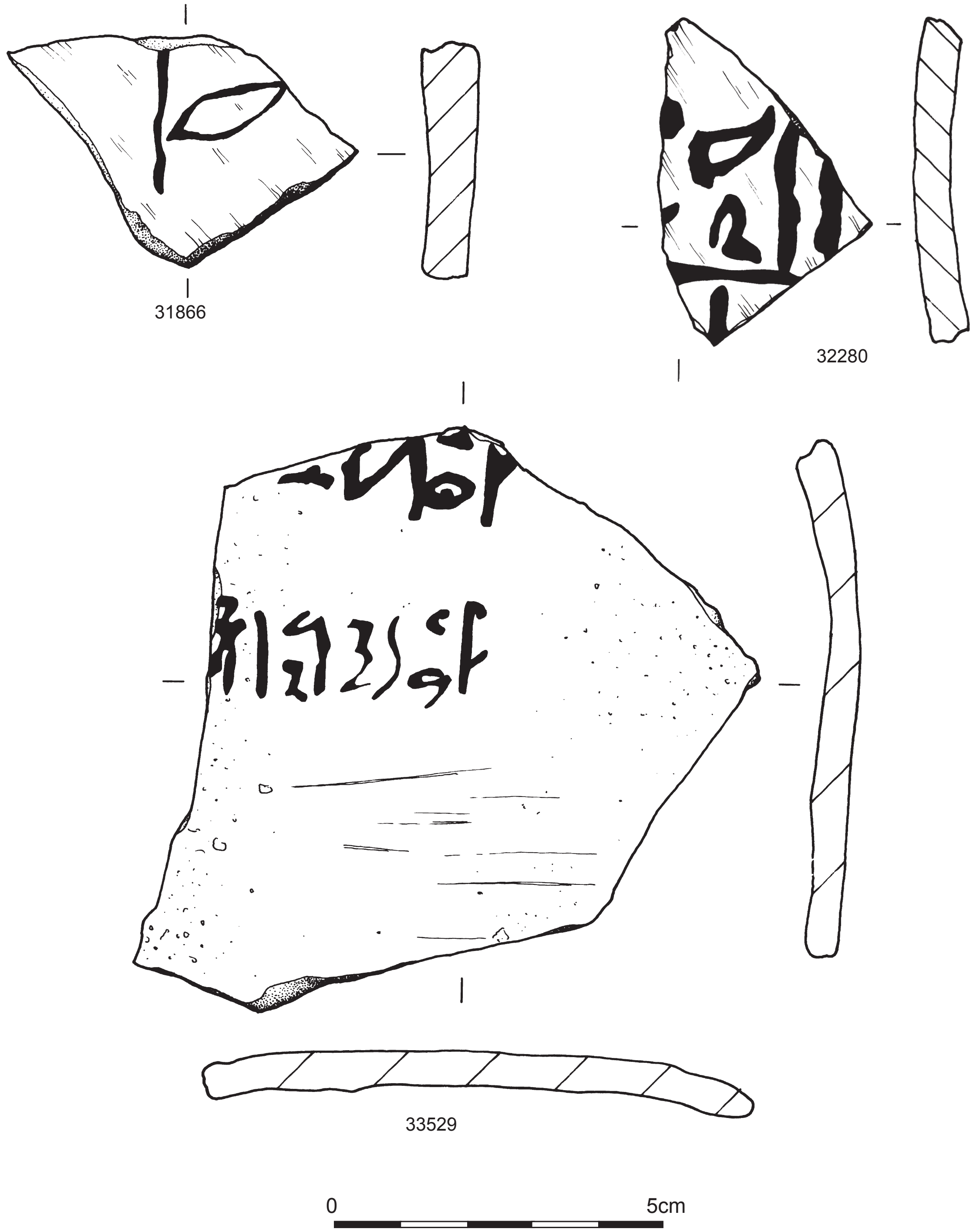


Figure II.24. Ostraca.

Marl (fabric III:6) ceramic sherd which has a whitish slip over its exterior surface on top of which is a drawing in black of a line with an oval.

Object 32280 Square L80 Unit 7986
Material 1 Ceramic
Length 105.00 Breadth 82.00 Thickness 5.50
Object type Ostracon
Figure II.24.
Marl ceramic body sherd. Included as a small find due to the writing found on the outer surface of piece, part of two lines can be seen written using black pigment. Dr. Kasia Szpakowska has been able to read it as: *jtrw jmn.t*, "river of the west" or "west river".

Object 33529 Square K90 Unit 10185
Material 1 Ceramic—marl
Length 48.00 Breadth 32.00 Thickness 7.00
Object type Ostracon
Figure II.24.
Hieratic ostracon. Marl ceramic sherd, cream surface. Writing in black ink. Dr. Szpakowska reads this as: bḥ or ḥw there is insufficient text to translate.

Personal Adornment

Object 30551 Square M75 Unit 8981
Material 1 Faience
Length 13.00 Breadth 9.00 Thickness 3.90
Object type Amulet
Colour 3115C
Bes amulet, turquoise blue faience. Flattish. Plain back with strong slightly shiny turquoise surface. Front with Bes design may have lost some of its glaze or may appear thus owing to fine-grained material adhering. Perhaps glaze unsuccessful on moulded surface or more likely glazed on the wrong side.

Object 32272 Square L80 Unit 7974
Material 1 Faience
Length 11.00 Breadth 8.50 Thickness 7.50
Object type Amulet
Colour 322C
Figure II.25.
A faience frog (Gurob Pl. xlii.17.G) of bright blue turquoise colour. The hole going through the frog has not been completed for some reason so he was discarded as waste.

Object 34232 Square WT Unit Slaughter house trench
Material 1 Faience
Length 19.36 Breadth 18.83 Thickness 3.84
Object type Amulet
Colour White
Figure II.25.
Inlay or amulet of white trefoil leaf. Cloverleaf type shape. Flat on reverse. No suspension loop.

Object 30707 Square M80 Unit 9012
Material 1 Clay Material 2 Faience
Length 0.00 Breadth 0.00 Thickness 4.40 Diameter 6.70
Object type Bead
Figure II.25.
Small clay pad with 5 turquoise ring beads arranged in circular formation on one surface. Upper surface of beads coated with lime. Beads form a ring around the outside edge of the pad. Bead diameter approx. 2.5mm. Thickness approx 1.5mm.

Object 30801 Square M80 Unit 8987
Material 1 Clay Material 2 Faience
Length 8.00 Breadth 6.80 Thickness 3.20
Object type Bead
Circular fine grained clay pad. Some cracks apparent and section missing on one side. Four beads (disc or mixture of ring and disc) lying flat around edge of upper surface. Two beads embedded on edge near damaged section.

Object 30365 Square M80 Unit 7961
Material 1 Faience
Length 2.20 Breadth 0.00 Thickness 0.00 Diameter 2.60
Object type Bead

Colour 3115C
Turquoise blue; multiple bead—two beads joined on top of each other; each bead H c.1.0mm. Hole D <1mm.

Object 30368 Square M80 Unit 7961
Material 1 Faience
Length 0.70 Breadth 0.00 Thickness 0.00 Diameter 1.80
Object type Bead
Colour 3025C
Turquoise blue ring bead.

Object 30385 Square M80 Unit 7961
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 0.70 Diameter 5.80
Object type Bead
Colour 322C
Turquoise flat wafer bead.

Object 30386 Square M80 Unit 7961
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 1.20 Diameter 2.40
Object type Bead
Colour 314C
Spheroid bead. Turquoise.

Object 30388 Square M75 Unit 8976
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 3.00 Diameter 3.00
Object type Bead
Colour 3025C
Cobalt blue bead. Perforation contains lime.

Object 30389 Square M75 Unit 8976
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 1.00 Diameter 3.20
Object type Bead
Colour 310C
Turquoise ring bead. Slight buff concretion to one surface.

Object 30458 Square L85 Unit 8070
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 2.90 Diameter 3.20
Object type Bead
Colour Green, 7
Bead within a bead (one lodged in other).
Outer bead: green faience disc bead. Small "pit" infilled with brownish friable material on side of bead. Perforation infilled with same material at one side. White erosion mark around edge. Other end; smaller disc (?) bead visible inside.
Inner bead: Turquoise blue faience. Infilled with brown friable material.

Object 30659 Square M75 Unit 9004
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 1.00 Diameter 6.20
Object type Bead
Colour Green
Yellowish green matt disc bead. Originally turquoise? Surface weathered/contaminated (?). Buff-coloured friable material adheres. Whitish concretion to one side.

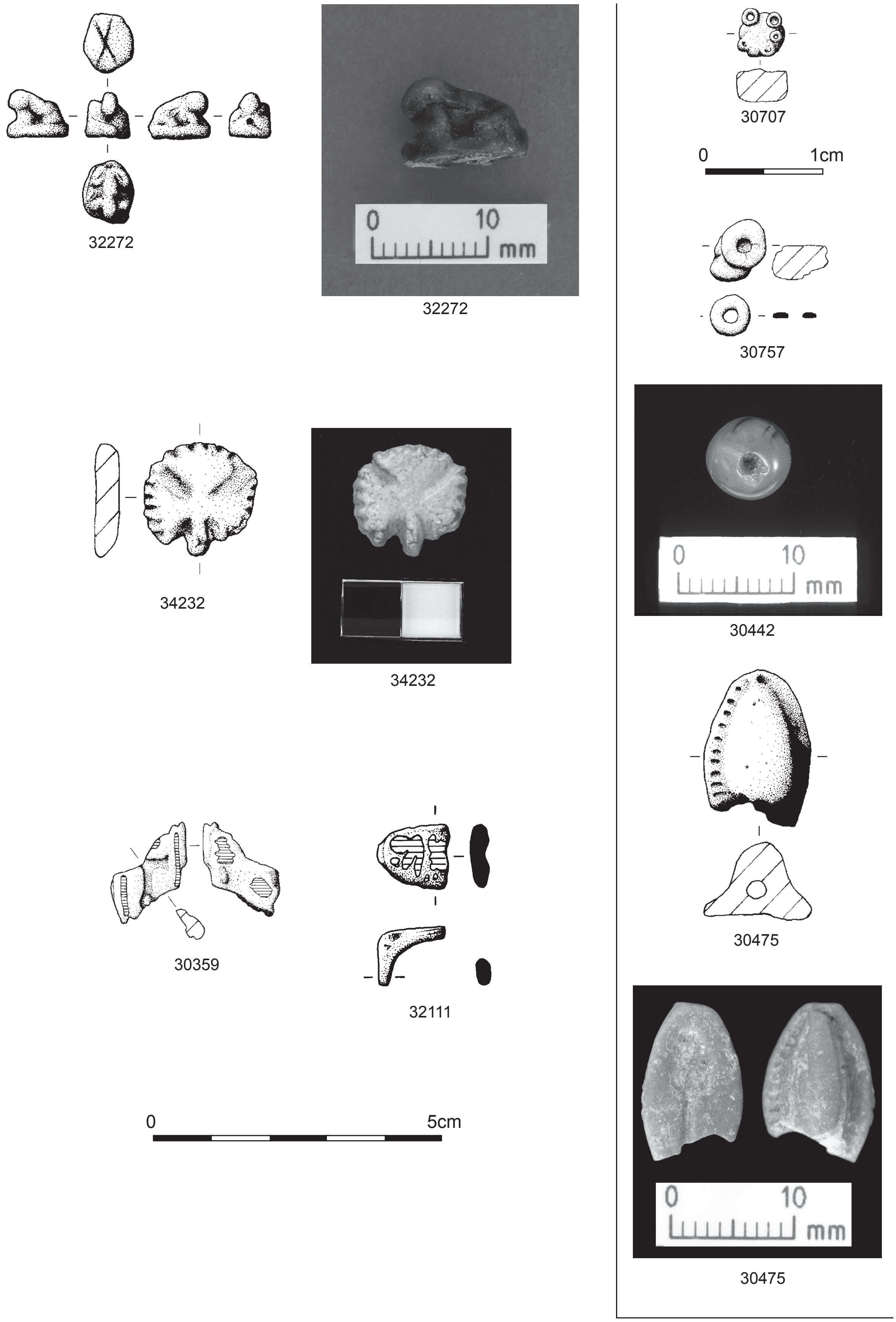


Figure II.25. Items of personal adornment.

Object 30750 Square L75 Unit Between kilns 2 + 4
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 1.00 Diameter 7.80
Object type Bead
Colour 314C
Turquoise blue disc bead. Slightly misshapen. Pock-marked surface. One edge with buff-coloured concretions.

Object 30757 Square M80 Unit 9006
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Bead
Colour 3025C
Figure II.25.
Wafer beads:
1. Whole mid-blue wafer bead. Semi-transparent. Matt surface covered with buff friable material. Turquoise.
D 5.3mm; T 0.9mm
2. Turquoise blue opaque faience wafer bead stuck to (by large flat surface) flattened sphere of light brown unfired clay. Partly covered by whitish friable concretion.
D (bead) 6.4mm; T 0.8mm
D (sphere and bead) 7.8mm; T 4.1mm
Bead slightly bent (following contour of sphere to an extent).

Object 30772 Square M80 Unit 9012
Material 1 Faience
Length 3.40 Breadth 0.00 Thickness 0.00 Diameter 2.40
Object type Bead
Colour 3025C
Copper blue whole barrel bead. Whitish opalescence to surface. Faience.

Object 30800 Square M80 Unit 9025
Material 1 Faience
Length 3.10 Breadth 4.40 Thickness 2.40
Object type Bead
Colour 322C
A spacer bead. Turquoise blue. Some buff concretions adhering to outer surface. The diameter of each bead is 2.4mm (one bead is slightly larger than the other).

Object 30808 Square M80 Unit 8987
Material 1 Faience
Length 4.30 Breadth 0.00 Thickness 0.00 Diameter 4.40
Object type Bead
Colour 3115C
Like cylinder bead 68R but shorter. Turquoise blue with buff concretions on circumference and filling perforation.

Object 30835 Square M80 Unit 9006
Material 1 Faience
Length 4.00 Breadth 2.50 Thickness 2.00
Object type Bead
Colour 310C
Bright blue faience. Ring bead appears to have broken and refused. Joined at circumference of ring bead and face of disc bead.

Object 31536 Square L80 Unit 7986
Material 1 Faience
Length 3.90 Breadth 0.00 Thickness 0.00 Diameter 2.20
Object type Bead
Colour 3025C
Tiny faience bead which is fashioned to look like two rings stuck together with a hole through the middle. The surface which it was stuck to when glazing has left a visible scar. Multiple bead as Gurob Pl. xliii.56.N.

Object 31544 Square L80 Unit 8031
Material 1 Faience
Length 2.00 Breadth 0.00 Thickness 0.00 Diameter 2.00
Object type Bead
Colour 295C
Tiny cobalt dark blue (turquoise) bead possibly a multiple bead or just an ordinary small cylinder which has just a suggestion of a division down the centre. Still glazed and shiny. Like type sample but only two segments.

Object 31641 Square J80 Unit 9440
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 1.00 Diameter 5.00
Object type Bead
Colour 322C
Turquoise blue faience disc bead with white material adhering to both surfaces. Bead type Gurob 92-R.

Object 31724 Square J80 Unit 9438
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 2.00 Diameter 5.10
Object type Bead
Colour 314C
Circular dark blue turquoise faience bead—rectangular in cross section though outer edge has a slight curve to it. Part of the blue turquoise glaze has come off in one area exposing the core. Typology: Gurob Pl. xlv.92.N.

Object 33374 Unit 10171
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 1.00 Diameter 3.00
Object type Bead
Colour 3025C
Blue disc bead, perforation in filled with buff coloured material. Internal diameter of perforation 1.5 mm.

Object 33381 Unit 10171
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 0.00 Diameter 6.00
Object type Bead
Colour 314C
Mid-blue wafer bead, perforation 1.5 mm in diameter.

Object 33444 Square K100 Unit 10173
Material 1 Faience
Length 11.00 Breadth 5.50 Thickness 3.00
Object type Bead
Colour 325C
Turquoise multiple bead, but misshapen on one end (slightly bent and broken). Originally six or seven segments.

Object 33711 Square L85 Unit 10192
Material 1 Faience
Length 0.00 Breadth 0.00 Thickness 2.00 Diameter 11.00
Object type Bead

Colour Brown
Brown-red boss bead, not perfectly round. Diameter of perforation is c.4.0mm. Curved front, flat back.

Object 30379 Square M80 Unit 7961
Material 1 Glass
Length 7.50 Breadth 0.00 Thickness 0.00 Diameter 3.50
Object type Bead
Colour Blue
Blue translucent glass barrel bead. Buff-coloured material fills hole.

Object 30804 Square M80 Unit 8987
Material 1 Glass
Length 12.30 Breadth 4.80 Thickness 2.70
Object type Bead
Colour Turquoise
Long opaque turquoise cylinder bead. Outer surface covered in dull cream coating. Broken longitudinally—only half of the bead remains. May also be broken transversely and therefore the full length is not possible to measure. Snapped example of Gurob Pl. xliv: 68-J.

Object 30442 Square L80 Unit 8067
Material 1 Stone—carnelian
Length 0.00 Breadth 0.00 Thickness 6.50 Diameter 7.20
Object type Bead
Figure II.25.
Amber coloured bead (flattened sphere) with central perforation. Then curved lines of darker red (feature of original material) visible on surface. Darker "patches" of orange. Some brown concretion through perforation.

Object 30475 Square K80 Unit 7991
Material 1 Faience
Length 13.30 Breadth 9.10 Thickness 5.20
Object type Bead fragment
Colour 322C
Figure II.25.
Fragment of lozenge-shaped turquoise faience bead? Flat on back, with part of sunk relief design remaining (possibly part of "nefer" sign). "Top" is domed—like a cowrie shell, with sunk relief border of short, thin, radiating lines, within which are curved sunk relief lines running lengthwise. Perforation hole evident at one end; traces of this at broken edge too. Core of object creamy-white faience. Approx 75% remains.

Object 31671 Square J80 Unit 9438
Material 1 Faience
Length 10.00 Breadth 0.00 Thickness 0.00 Diameter 3.40
Object type Bead fragment
Colour 325C
Pale blue turquoise faience multiple bead fragment—a series of segments like disc beads which graduates down in size forming a cone type shape. Narrower end has been broken. 6 segments.
Diameter at small end = 2.8mm; large end = 3.4mm.
Typology: similar to Gurob Pl. xliii.56.T.

Object 33892 Square M85 Unit 10221
Material 1 Faience
Length 8.00 Breadth 0.00 Thickness 0.00 Diameter 1.50
Object type Bead spacer
Colour 2955C
Dark blue faience multiple bead (bead spacer), four segments, of which one segment seems to be malformed and one is broken. This seems to be intended as a multiple bead, rather than a series of linked beads. Cream-coloured concretions on both surfaces. The perforations of only two segments remain, diameter <1 mm, one perforation is partly infilled with buff-coloured material.

Object 31712 Square J85 Unit 9439
Material 1 Faience
Length 12.70 Breadth 5.50 Thickness 4.30
Object type Earring fragment
Colour 322C
Fragment of a faience earring, light green turquoise, has a dull appearance (glazed surface lost); triangular in cross section. The core is itself blue. Suggesting interstitial glass. In one section there are three distinct layers. Glass, faience and a yellow core whereas the other end has a glass layer directly upon the yellow layer. There is manganese decoration.

Object 30451 Square L80 Unit 8065
Material 1 Faience
Length 16.60 Breadth 8.00 Thickness 4.70
Object type Pendant fragment
Colour Green
Green faience leaf pendant. Central sunk relief, long rib with myriad veins impressed, radiating to sides. Bevelled edge, so that whole broadens towards underside. Broken approx. 75% down the pendants length, revealing faience core in section. Coloured end remains, but unlike Petrie's (1894) Pl. xx: 545 there is a suspension ring on the back of the bottom point suggesting that it may originally have been used to space rows of jewellery. Underside of pendant shows some bubbles to surface.

Object 30453 Square L85 Unit 8070
Material 1 Faience
Length 16.00 Breadth 7.50 Thickness 1.30
Object type Pendant fragment
Colour 295C
Cobalt blue, flat, ribbed, —shaped leaf. Whole. 6 ribs lengthwise. Tapers to rounded point. Glaze quite shiny. The back is less shiny but same pigment. Slightly bubbled surface. Small buff concretion to wider end.
Smaller than type example.

Object 30605 Square L75 Unit 9001
Material 1 Faience
Length 12.10 Breadth 8.60 Thickness 3.50
Object type Pendant fragment
Colour Red
Red faience "fruit" pendant, broken across approximately 2/3 way down. Lilac-coloured decoration to convex surface at narrow end. Above the lilac is possible beginnings of a broken, white faience suspension loop.
Reverse side has larger area of lilac decoration; a downwards pointed rough triangular shape joining a rough upwards pointing one. This reverse side of pendant is flat.
Oval shaped. Highly glazed. Core revealed along break is fine grained and red (on body). White on suspension loop.

Object 33573 Square K90 Unit 10185
Material 1 Faience
Length 12.00 Breadth 6.50 Thickness 3.50
Object type Pendant fragment
Colour Green
Light green fragment of faience leaf pendant: long rib with veins impressed, radiating to sides. Bevelled edge, pendant broadens towards underside. Broken across, approximately three-quarters down to the pendants length, revealing faience core (beige in colour) in section. Suspension loop on back is broken, but "blob" of red) faience remains where the ring was attached.

Object 33596 Square M85 Unit 10179
Material 1 Faience
Length 9.00 Breadth 5.00 Thickness 1.00
Object type Pendant fragment
Colour Yellow

Fragment of a yellow faience teardrop shaped bead or pendant, broken across, top with suspension loop is missing, approximately three-quarters of the pendant/bead remains. At break faience core visible, light yellow in colour. Flat back with beige encrustations.

Object 30359 Square M80 Unit 7961
Material 1 Faience
Length 14.00 Breadth 10.00 Thickness 2.00
Object type Ring fragment
Colour 3025C
Figure II.25.
Fragment of ring bezel with ankh. Bottom of the ankh is either split like the end of a Was sceptre or a broken circle. The border around the design is in cobalt blue glaze whereas the ring itself is a medium turquoise glaze.

Object 30375 Unit Surface
Material 1 Faience
Length 12.50 Breadth 7.50 Thickness 3.80
Object type Ring fragment
Colour 322C
Surface find by local farmer. Approx. 25% bezel and 25% shank. Turquoise faience. Part of eye of wd3t— left hand as in illustration from Petrie (1894) Pl. xvi: 176. Faience core clearly visible in shank. Shank 4.2 x 3.5mm.

Object 30505 Square K80 Unit 7961
Material 1 Faience
Length 22.60 Breadth 4.80 Thickness 3.20
Object type Ring fragment
Colour 322C
Fragment mid-blue matt ring shank in faience. Both ends broken revealing blue in section. Whole ring would be large diameter. Buff-coloured core obvious on break. One end clearly broadening as it approaches bezel.

Object 30553 Square M75 Unit 8981
Material 1 Faience
Length 17.30 Breadth 11.30 Thickness 3.10
Object type Ring fragment
Colour 295C
Broken wd3t eye ring bezel. Dark copper blue faience. Broken ends reveal faience core (fine grained, buff-coloured). One broke edge to the right-hand side of bezel. Other broken area on the rear at the left-hand side, suggesting the shank was attached to the back of the bezel.

Object 30569 Square L75 Unit 8998
Material 1 Faience
Length 10.00 Breadth 6.50 Thickness 3.00
Object type Ring fragment
Colour 314C
Fragment of mid-blue faience ring shank. Possibly broken in manufacture as only one broken end shows faience core in section; the other broken end appears to be glazed over. Section broadens towards the bezel at one end. Visible core is buff/cream-coloured.

Object 30596 Square M75 Unit 8981
Material 1 Faience
Length 11.10 Breadth 5.40 Thickness 2.50
Object type Ring fragment
Colour 3115C
Fragment of turquoise blue faience ring shank. Broadens towards one end. Both ends broken. Inner surface raises to a slight ridge lengthwise. Outer surface: glaze eroded at wider end. Two small white concretions. Core is buff-coloured.

Object 31720 Square J80 Unit 9341
Material 1 Faience
Length 14.20 Breadth 3.50 Thickness 2.50
Object type Ring fragment
Colour 325C
Fragment of blue turquoise faience ring shank. Gently curving with almost a rectangular cross section. Surface worn so dull.

Object 32111 Square K80 Unit 7963
Material 1 Faience
Length 11.00 Breadth 10.50 Thickness 2.50
Object type Ring fragment
Colour 2955C
Figure II.25.
Fragment of a faience ring—half of design on face of ring and connected to part of the ring shank. Face design seems to be a cartouche design. Pale blue with light green turquoise patches, still a sheen to surface.

Object 33571 Square M85 Unit 10179
Material 1 Faience
Length 10.00 Breadth 9.00 Thickness 3.00
Object type Ring fragment
Colour 325C
Fragment of light blue/turquoise faience, part of shank and bezel, possibly wd3t-eye design.

Object 33618 Square M85 Unit 10179
Material 1 Faience
Length 6.00 Breadth 5.00 Thickness 0.00 Diameter 1.50
Object type Ring fragment
Colour 314C
Light blue fragment of faience, may be part of a ring (wd3t design) or border of cartouche. Brown faience core. Front: several ridges and grooves; flat back.

Object 33753 Square M85 Unit 10196
Material 1 Faience
Length 3.50 Breadth 3.00 Thickness 1.00
Object type Ring fragment
Colour 314C
Fragment of bright blue faience, may be part of a ring bezel. White faience core visible on breaks.

Object 30526 Square K85 Unit 7965
Material 1 Glass
Length 9.50 Breadth 9.30 Thickness 3.00
Object type Ring fragment
Colour Blue
Section of broad end of ring shank attached to fragment of bezel. Mid-blue opaque glass (no sign of faience "core" on broken edges). Design in sunk relief difficult to distinguish, partly owing to buff-coloured concretions to interior of bezel surface. Possibly a wd3t-eye design.

Sealings and Dockets

I am grateful to Dr. Anthony Leahy of Birmingham University for his translations of the inscriptions on these objects. The translations are based on photographs and drawings only, since he has not had the opportunity to see the original artefacts. Fairman (1951:143–45, and Pl. lxxxiii) devised a three-fold typology of jar sealings from Amarna and that has been adhered to here, where reasonable certainty as to type was possible. These types are hereafter referred to as "COA Type A" etc.

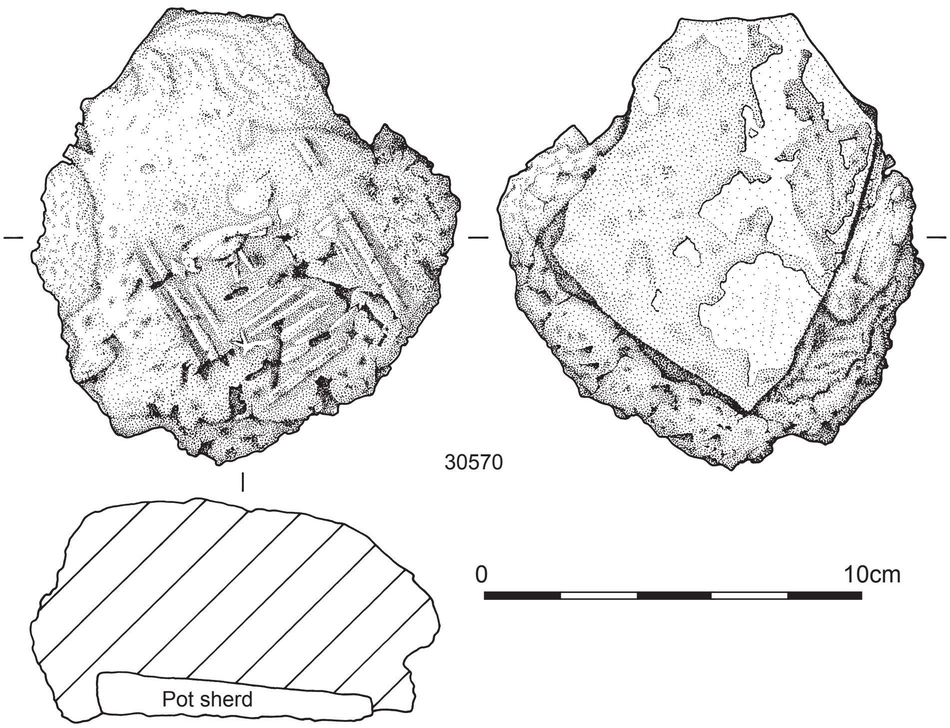
Object 31496 Square L80 Unit 8031
Material 1 Ceramic
Length 27.80 Breadth 19.20 Thickness 7.10
Object type Fragment
Fragment of irregular fired clay. Fairly coarse and hard. One side has a sandy colour—side with cracking visible. Both firing surfaces. Other side is reddish-brown. Outside edges are sooty black suggesting burning. Possibly a fragment of docket.

Object 34161 Square K80 Unit 7981
Material 1 Clay
Length 45.84 Breadth 34.05 Thickness 14.58
Object type Fragment
Fragment of clay with a smooth interior from where it has been pressed against a vessel. May be a docket type seal. Rough exterior.

Object 30570 Square L75 Unit 8979
Material 1 Clay Material 2 Resin
Length 125.00 Breadth 113.00 Thickness 42.00
Object type Jar Seal
Figure II.26.
Creamy coloured lentoid plaster and ceramic jar seal. Linear impressions on creamy-coloured surface plus some embedded angular inclusions, various hues, sizes. Organic material evident around sides (straw?). Flattish underside where a roughly rectangular marl sherd (12.5mm thick) coated with a rust-coloured layer of resinis visible, suggesting that the jar may have been a resin container. Jar seal COA Type C.
Cartouche reads: Ax-n-… "Akhen[aten]…"
Area of the actual bung (where fitted into the vessel neck): c.100mm x 90mm.

Object 30789 Square L75 Unit 9019
Material 1 Clay
Length 111.00 Breadth 86.20 Thickness 29.80 Diameter 140.00
Object type Jar Seal
Figure II.27.
Fragment of wine jar sealing.
The thicker, lower edge tapers toward the inside following the profile of the original wine jar. There is a broken stamp impression on the clay which reads:
pr THn itn 'estate of Aton gleams' possibly as Pendlebury (1951:148 and Pl. lxxxi 61–64): "Wine of the Western river (of the house) of the Aten gleams". The fabric has been damaged by boring insects—termites?—cores from which are visible on the interior. Very friable. Grey-brown clay. Fine grained.
Would have sealed a vessel with exterior diameter of neck 85mm. 20% of the diameter is preserved. COA Type A.

Object 30838 Square L75 Unit 9035
Material 1 Clay
Length 126.00 Breadth 112.50 Thickness 52.00
Object type Jar Seal
Figure II.28.
Extremely friable mid-brown clay jar seal with cartouche on convex outer surface. Upper/outer surface cracked and scored. Buff, friable material adheres in places. Underside is concave, with impression of circular jar neck. Broad sunk relief lines in random arrangement across surface. Probably COA Type A, though little of the sides remains.
Inscription reads: bity pr Hmt nTr nfr ir… "honey of the estate of the god's wife Nefer-ir" or "honey of the estate of the wife of the good god Ir…"
Dr. Leahy believes that this is the only example of this particular title which is not otherwise attested during the Amarna period. Other honey jar seals are well known (cf. Pendlebury 1951: Pl. 82, Nos 107–110).



30570

Figure II.26. Jar seals.

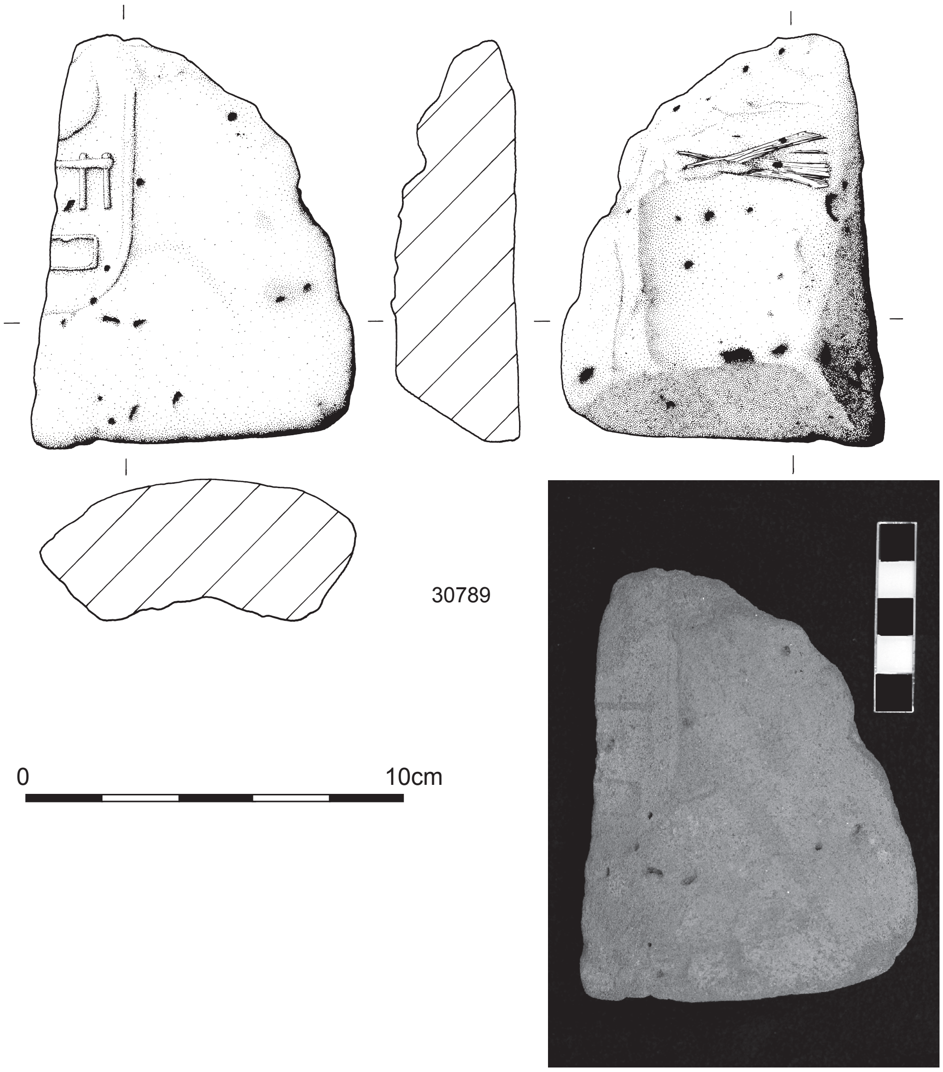
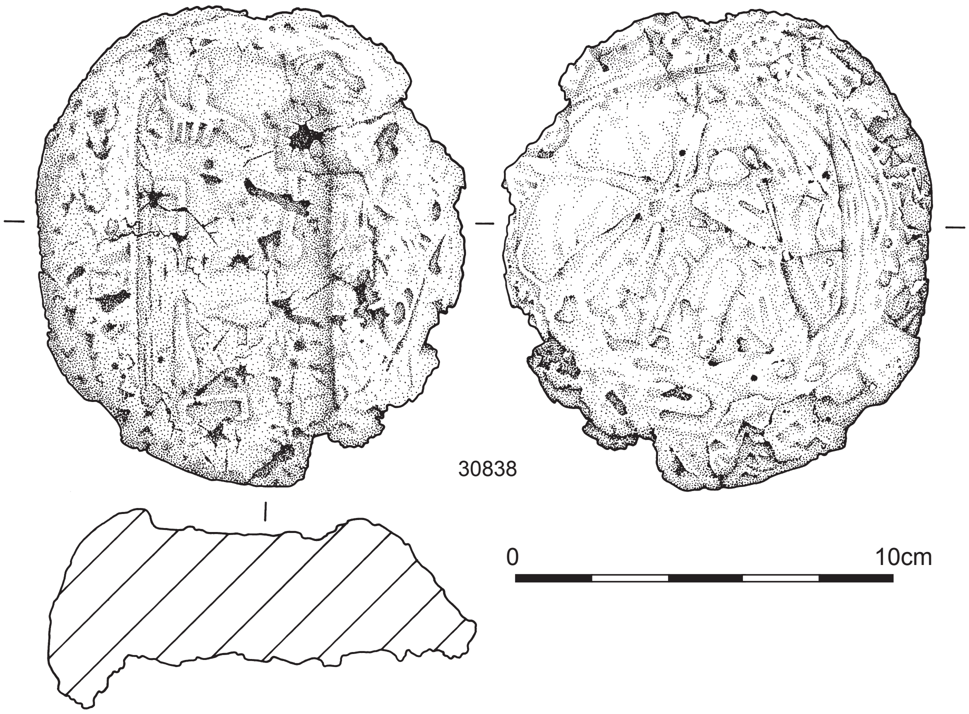


Figure II.27. Jar seals.

Object 30839 Square L80 Unit 9020
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 90.00 Diameter 127.00
Object type Jar Seal
Figure II.29.
Inscribed clay jar sealing. Three stamps around its exterior. Circular pits from insect activity are visible on the surface. Square top of three rectangular inscriptions. Broken off at 36.5mm length. Thumb print in the bottom of the plug. COA Type B.
Signs may be an ankh. Dr. Leahy was not able to determine more from the images.
Possibly for oil? (cf. Pendlebury 1951:Pl. lxxxii, No.115). Would have sealed a vessel with exterior diameter of neck 88.9mm 100%.

Object 30840 Square L75 Unit 9020
Material 1 Clay
Length 108.00 Breadth 100.00 Thickness 46.50
Object type Jar Seal
Figure II.30.
Flattish seal fragment. Convex top surface and underside with rim impression and string impressions. Would have sealed a vessel with exterior diameter of neck 91mm. 100% of diameter preserved. Probably COA Type B.



30838

Figure II.28. Jar seals.

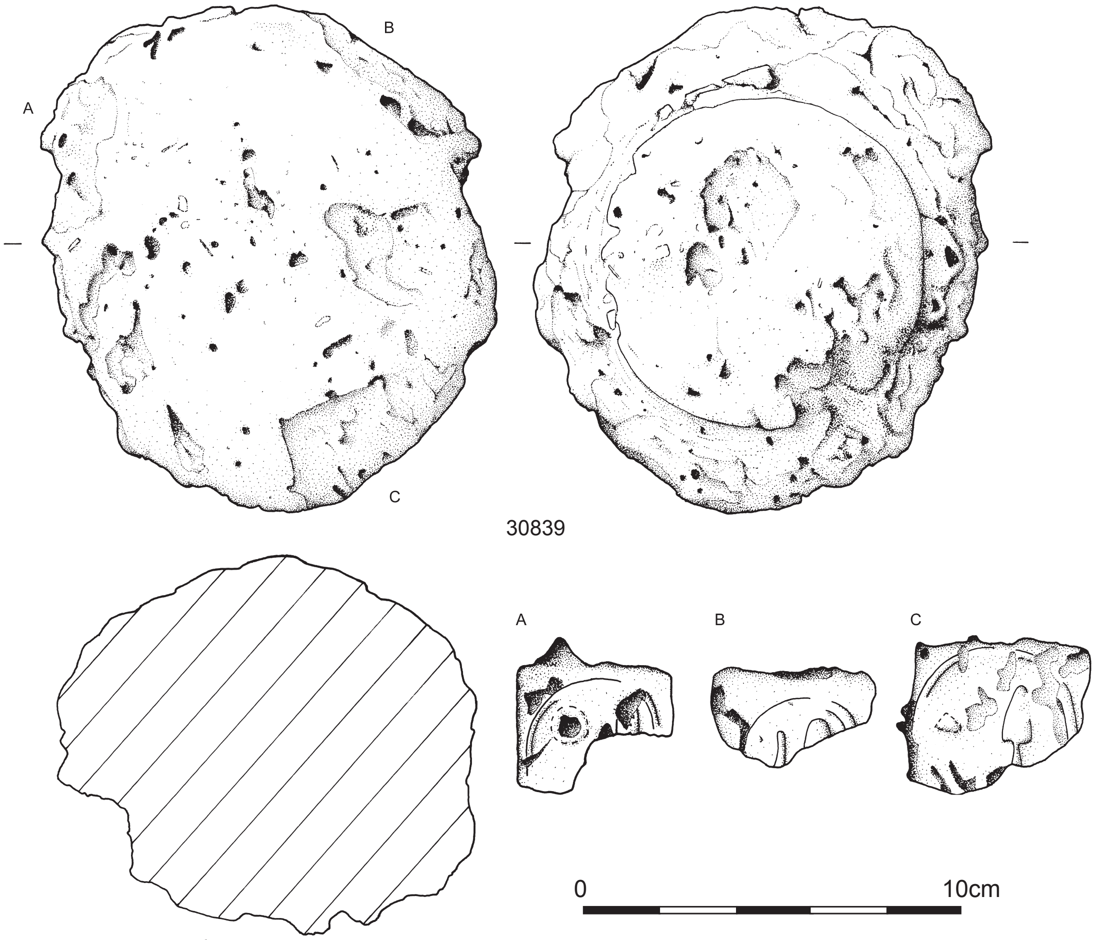


Figure II.29. Jar seals.

Object 30841 Square M75 Unit 9014
Material 1 Clay
Length 85.20 Breadth 42.30 Thickness 43.30
Object type Jar Seal
Figure II.30.
Mid-brown extremely friable clay jar seal. Mushroom shaped. Almost intact, though with insect holes on most surfaces. This would have sealed a vessel with exterior diameter of neck 65.71mm. 100% of diameter preserved. COA Type B.

Object 31886 Square J80 Unit 9459
Material 1 Clay
Length 117.00 Breadth 108.00 Thickness 35.00
Object type Jar Seal
Figure II.30.
Jar seal which has been pushed on to a ceramic jar rim to seal the jar. The rim impression doesn't make a complete circle and so it is possible that the piece was discarded before it was properly in place. Would have sealed a vessel with exterior diameter of neck 83.7mm. COA Type B.

Object 31887 Square J80 Unit 9459
Material 1 Clay
Length 75.50 Breadth 60.20 Thickness 40.00
Object type Jar Seal
Figure II.31.
Fragment of unfired clay, roughly flattened out and then pushed on to a jar top to seal the contents in and insects out. The impression from the ceramic vessels rim is visible on the very edge of the inside of the unfired clay fragment.

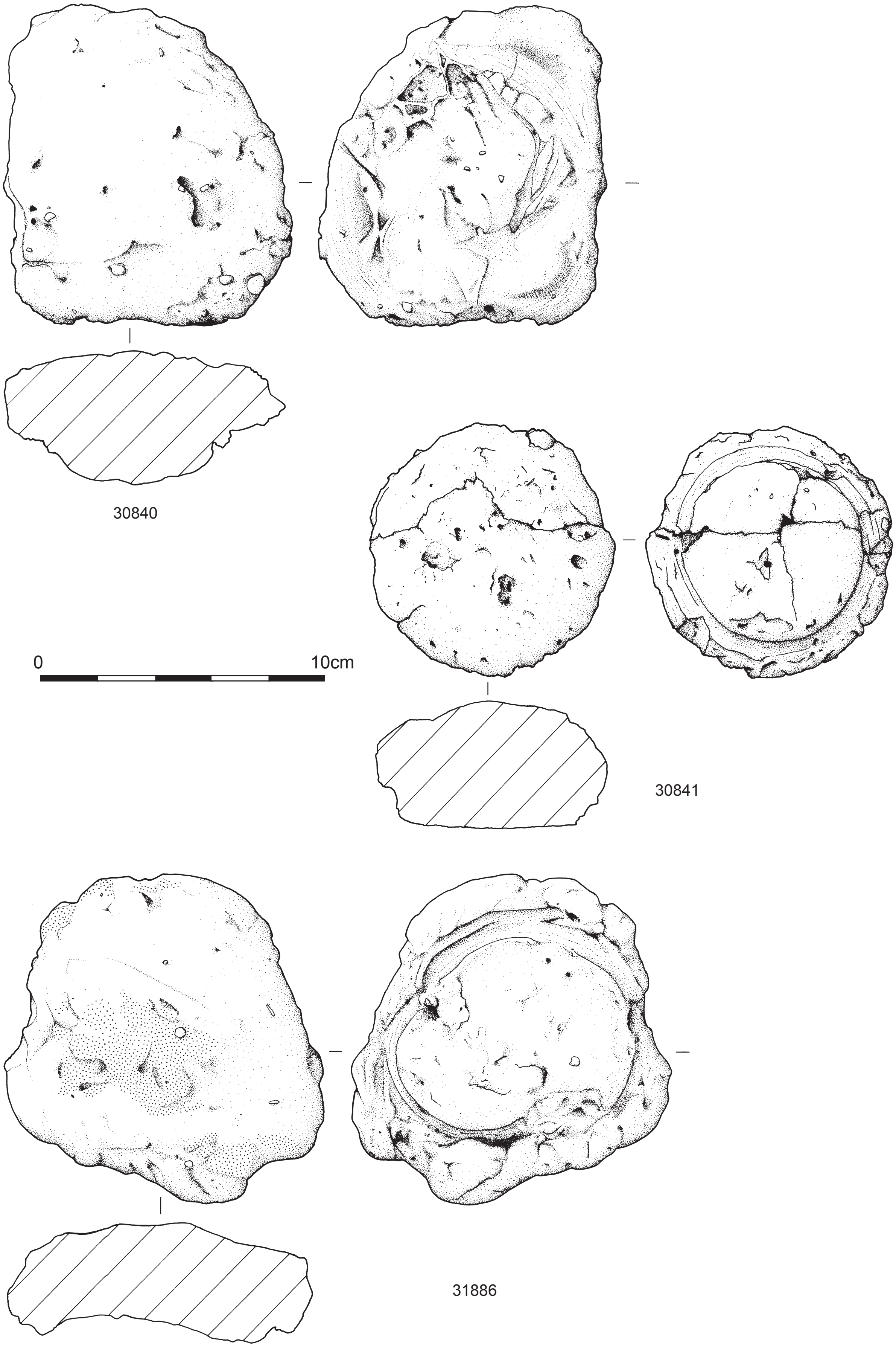


Figure II.30. Jar seals.

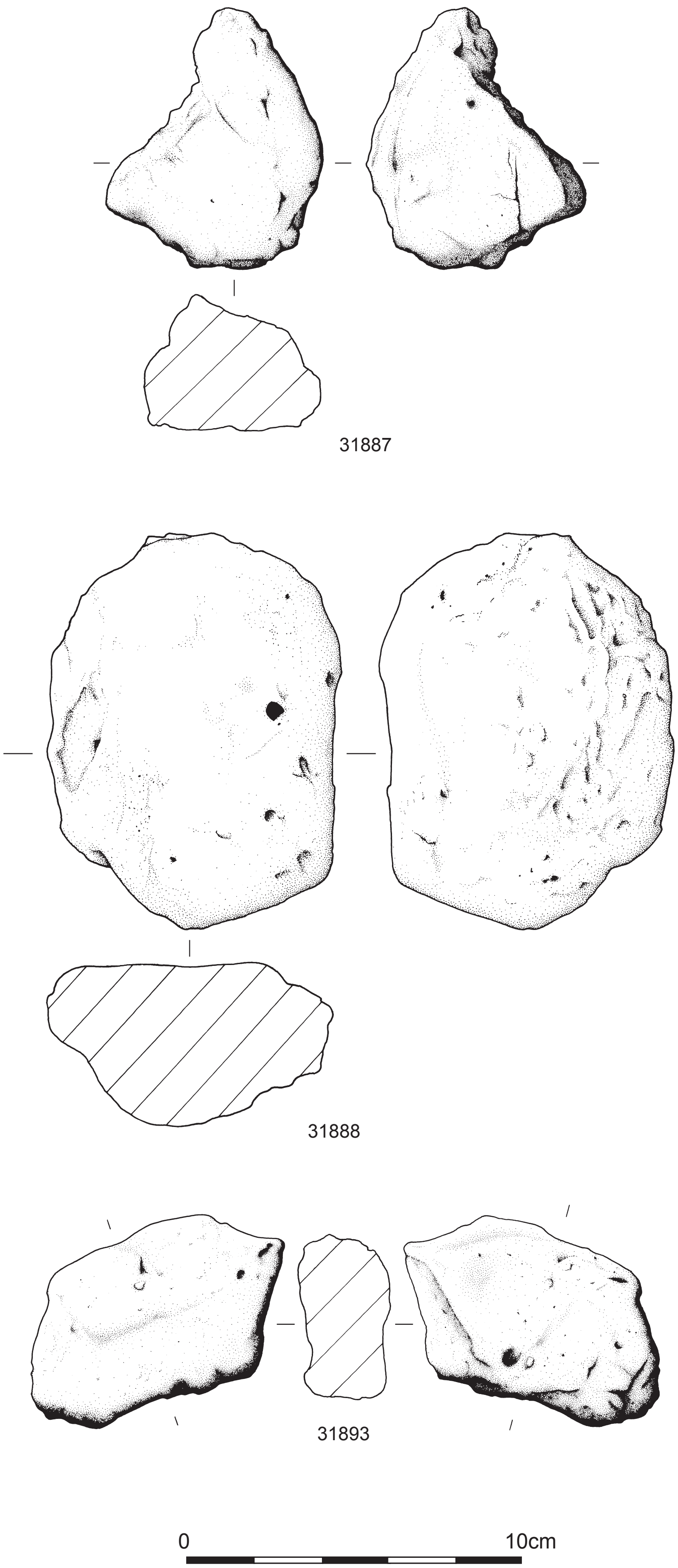


Figure II.31. Jar seals.

Object 31888 Square J85 Unit 9443
Material 1 Clay
Length 117.50 Breadth 87.00 Thickness 49.50
Object type Jar Seal
Figure II.31.
Unfired clay lump—possibly a jar stopper though it has no visible evidence to back up this supposition, i.e. impressions of vessel rim, though the bulging bit on the side could be where pushed onto vessel; vessel impression missing probably because it is very friable. Uncertain as to type as it cannot be confirmed as a jar seal with certainty.

Object 31893 Square J80 Unit 9459
Material 1 Clay
Length 85.90 Breadth 53.00 Thickness 27.30
Object type Jar Seal
Figure II.31.
Roughly flattened and rounded lump of unfired clay which has been pushed onto the top of a vessel as a seal. The impression left by the rim of the vessel is just visible—more from the shape. Very friable so detail probably lost. Type uncertain.

Object 32171 Square M75 Unit 9014
Material 1 Clay
Length 102.50 Breadth 85.00 Thickness 35.00
Object type Jar Seal
Unfired clay used as a plug which sat in the neck of a jar. Holes from insects eating organic matter used as a temper in the plug. Would have sealed a vessel with exterior diameter of neck 85.79mm. 100% of diameter preserved. COA Type B.

Object 32172 Square M75 Unit 9014
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Jar Seal
Figure II.32.
Three fragments of unfired clay which come from jar sealings—all are of COA Type B. The holes are from insects eating the organic temper material.
1. L 85.0mm; B 44.0mm; T 24.5mm
2. L 54.0mm; B 55.0mm; T 27.0mm
3. L 56.0mm; B 35.0mm; T 23.0mm
4. L 55.0mm; B 35.0mm; T 27.0mm
Uncertainty as to type. This would have sealed a vessel with exterior diameter of neck 100mm. 16% preserved.

Object 32173 Square M75 Unit 9014
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 0.00
Figure II. 32.
Two joining fragments of unfired clay with smooth interior surface suggesting they were stuck to the exterior of a vessel. The interior surface is white suggesting that the vessel was lime covered. Possibly COA Type A.
1. L 71.69mm; B 56.11mm; T 19.68mm
2. L 45.34mm; B 33.1mm; T 24.98mm

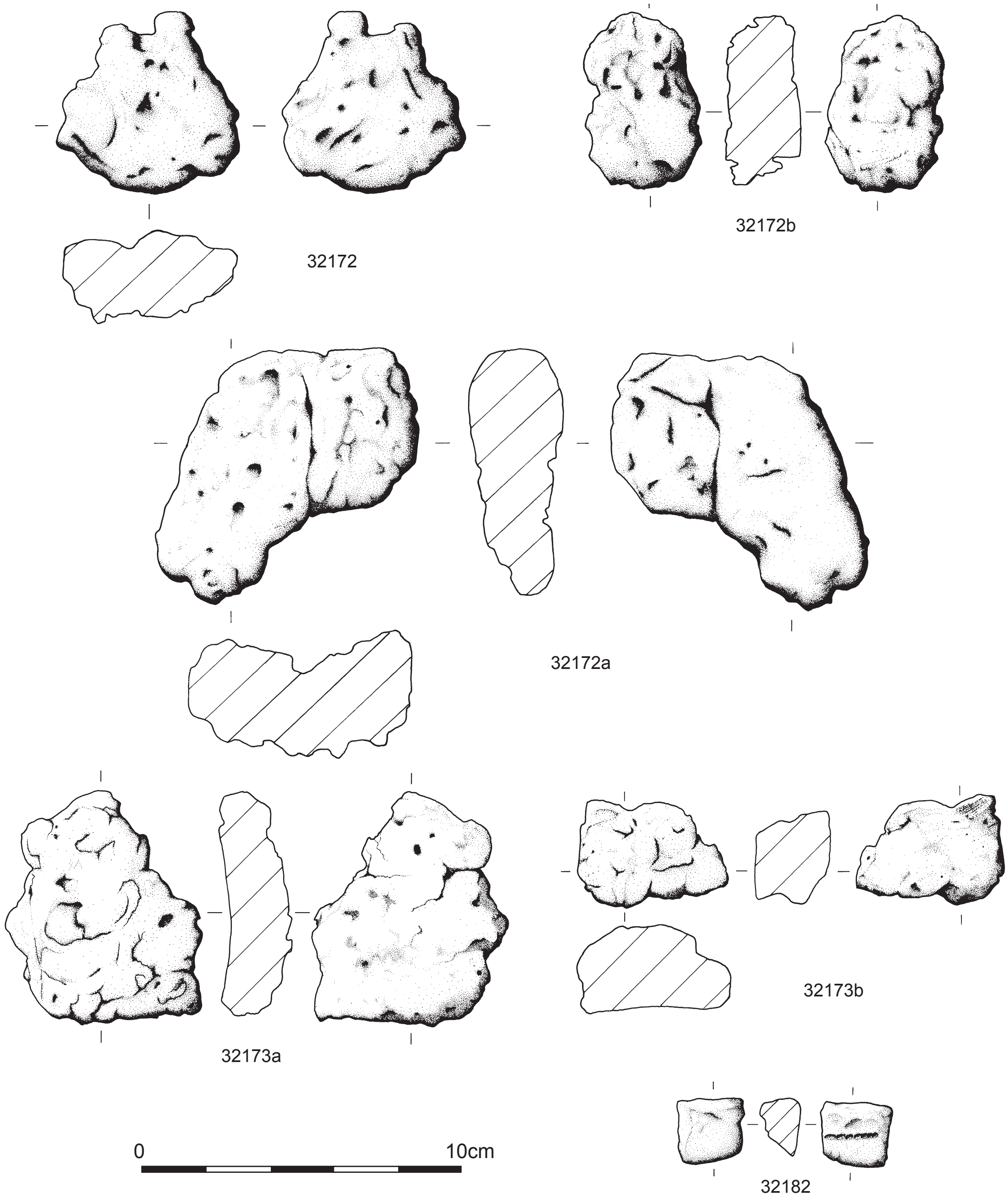


Figure II.32. Jar seals.

Object 32182 Square M75 Unit 8981
Material 1 Clay
Length 22.50 Breadth 19.50 Thickness 12.00 Diameter 82.00
Object type Jar Seal
Figure II.32.
Fragment of jar sealing in fine clay. It has been burned to an overall blackened appearance. Bottom edge slopes to where it was in contact with vessel wall. Further up on the inside are the impressions of two lines of cord. Uppermost band of cord is more coarse than the lower and less well preserved. COA Type A.
Exterior diameter given as interior diameter was not possible. This would have sealed a vessel with exterior diameter of neck 60mm. 10% of diameter preserved.

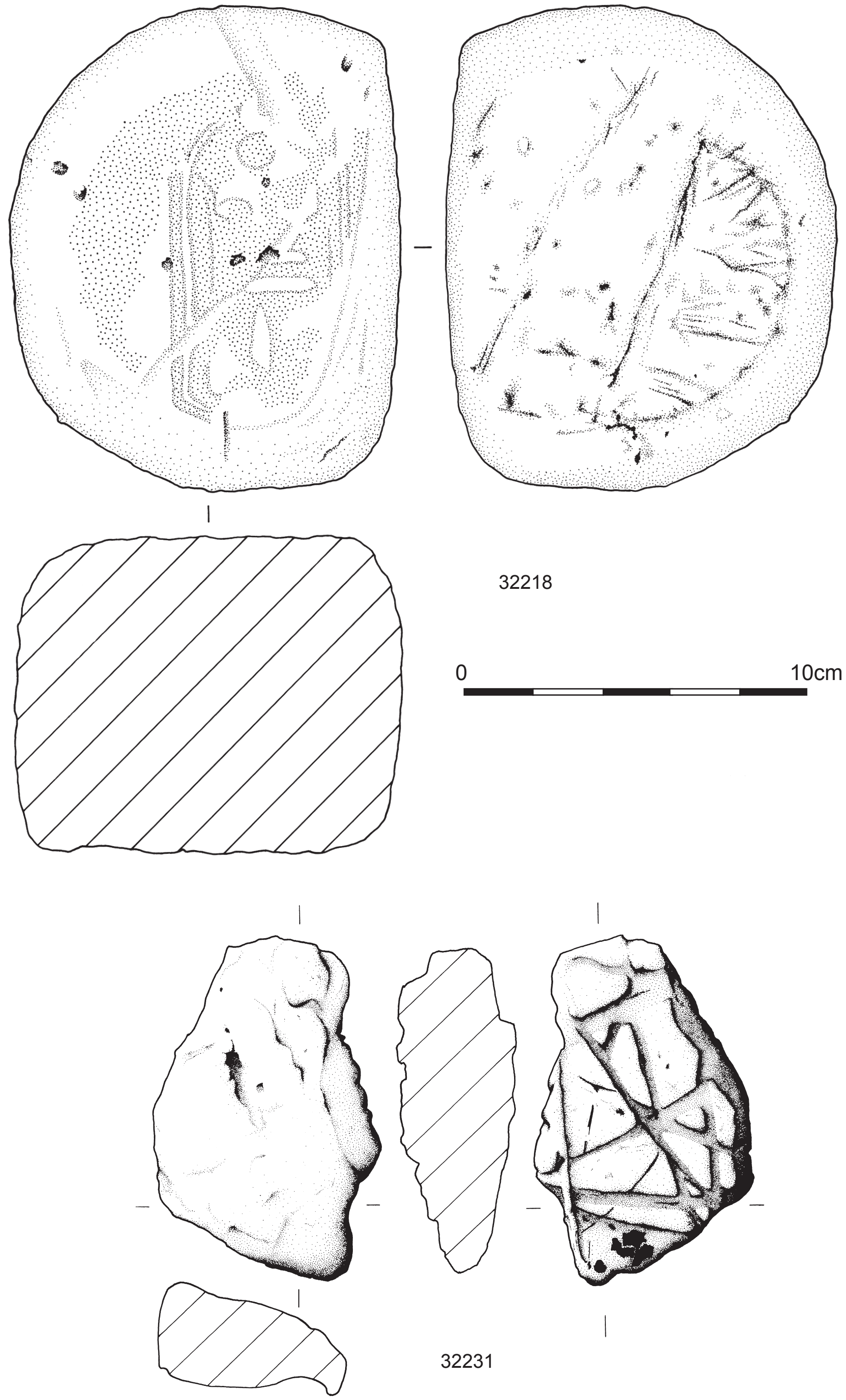


Figure II.33. Jar seals.

Object 32218 Square L75 Unit 9035
Material 1 Clay
Length 139.00 Breadth 114.00 Thickness 93.00
Object type Jar Seal
Figure II. 33.
A fragment of a jar seal. It is the part that would have sat on top of the neck of the vessel and has matting

imprints on its underside. On its top side are shallow grooves and a number of faint impressions which suggest the seal stamp added to the sealed vessel. COA Type B.
Sun disc only preserved itn "Aten". This would have sealed a vessel with exterior diameter of neck 105.64. 100% of diameter preserved.

Object 32231 Square L75 Unit 9019
Material 1 Clay
Length 92.00 Breadth 65.50 Thickness 35.50
Object type Jar Seal
Figure II.33.
Fragment of mud jar seal—possibly part of the top which sat on the neck like COA Type C, but lacking any indication of a sherd. It cannot be typed with certainty. On its underside impressions of some sort of rope or fibre present—string of plug mud sealed put on. No indication of a seal stamp on the top side.

Object 32284 Square K75 Unit 9488
Material 1 Clay
Length 81.00 Breadth 72.00 Thickness 25.50
Object type Jar Seal
Fragment of the neck of a jar sealer which fitted over the neck of the vessel. A curve to its profile can be seen and is smooth on the inner surface. Holes are just from insects eating out the organic temper used. COA Type A.

Object 32381 Square L75 Unit 9035
Material 1 Clay
Length 94.00 Breadth 74.50 Thickness 28.50
Object type Jar Seal
Fragment of unfired mud jar sealing. Appears to have part of the bottom edge, which would have rested on the outside shoulder of the vessel. From the type of jar seal which sat over the neck of the vessel rather than the type which sat as a plug in the top. Outside surface of fragment is very smoothly curved, inside has a number of holes where insects have eaten out the organic material. COA Type A.

Object 32382 Square L75 Unit 9035
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Jar Seal
Figure II.34.
Two fragments of unfired mud jar sealer. Probably both are from the part which would extend down the outside of the vessel in COA Type A. First piece, the largest, is semi-oval curving roughly round one side which also has a tapered edge. Outside surface is smooth, inner surface slightly rough. Second fragment is tiny, roughly triangular in shape, some of the outer surface remains - one side of piece.
1. L 76.0mm; B 39.5mm; T 20.5mm
2. L 31.5mm; B 22.0mm; T 15.0mm

Object 32392 Square K80 Unit 7981
Material 1 Clay
Length 72.50 Breadth 67.00 Thickness 25.50
Object type Jar Seal
Figure II.34.
Fragment of unfired mud jar seal. Probably from a COA Type A. This fragment may be the bottom of the jar seal that would rest against the vessel as one can see a smooth curved area on the inside at bottom. Colour of mud = pale grey/brown/cream possibly due to a greater amount of marl present. Very soft and crumbly/friable. Organic inclusions can be seen (e.g. straw) and impressions left by others also remain. Other inclusions = small stones. Holes exist where bugs may have eaten organic matter.
Calcareous. Would have sealed a vessel with exterior diameter of neck 140mm. 9% of which is preserved.

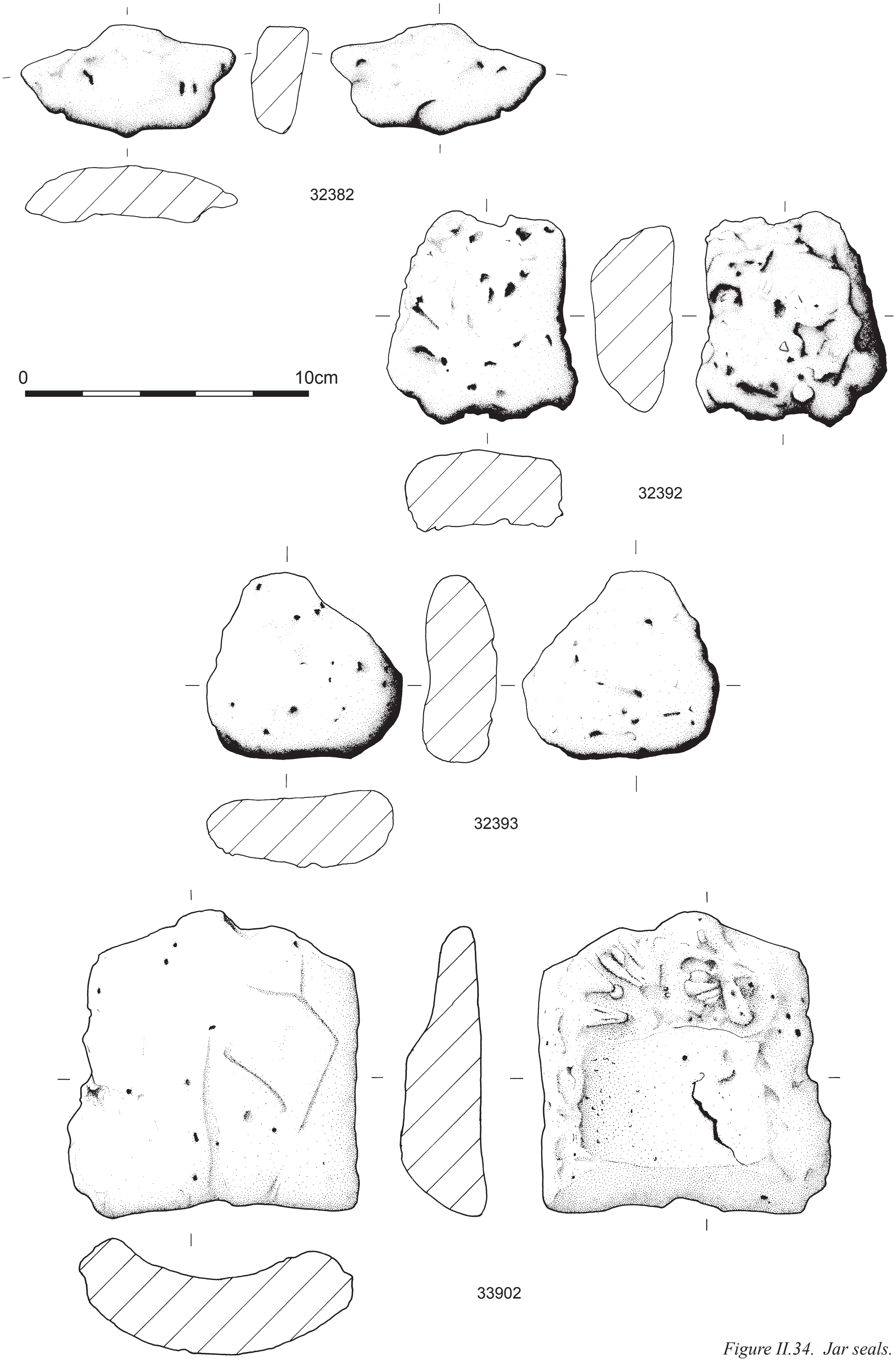
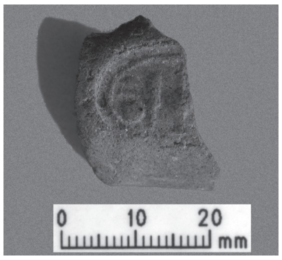
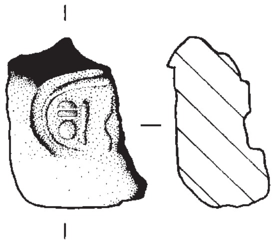


Figure II.34. Jar seals.

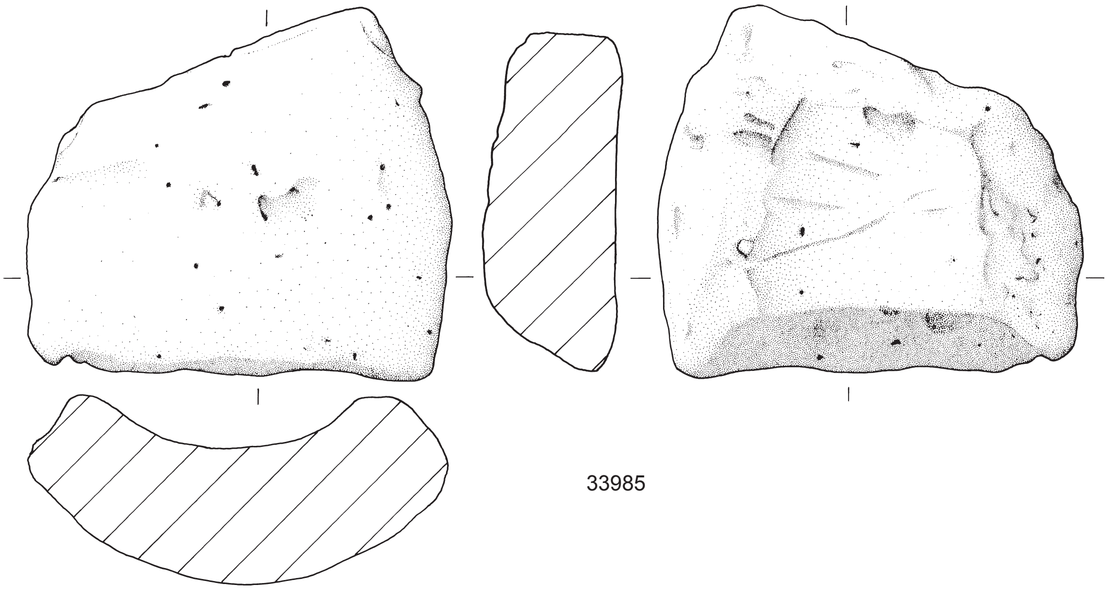


33905

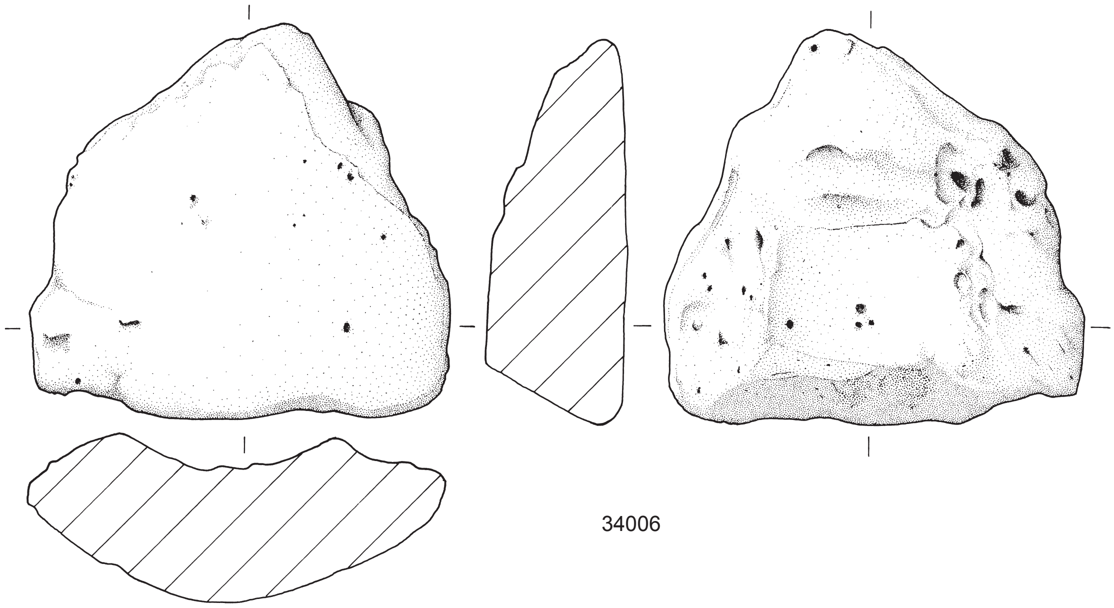


33905

0 3cm



33985



34006

0 10cm

Figure II.35. Jar seals.

Object 32393 Square K80 Unit 7969
Material 1 Clay
Length 69.00 Breadth 68.00 Thickness 23.50
Object type Jar Seal
Figure II.34.
Fragment of unfired mud jar seal. Dark grey in colour, very crumbly, triangular—like shape, possibly of the type that ran down exterior of a vessel neck, this may be a fragment from the bottom that would rest against the jar (COA Type A). Various holes—probably caused by insect activity. Organic matter still present in some places—straw?

Object 33902 Square K85 Unit 10210
Material 1 Clay
Length 103.00 Breadth 102.00 Thickness 29.00
Object type Jar Seal
Figure II.34.
Fragment of a mud jar seal, brown slightly friable texture fine grain material. Circular pits on outside surface, due to insect activity. Thicker lower edge, following the profile of the original jar, tapering in shape towards the upper end. On the inside some shallow string impressions. COA Type A.
Would have sealed a vessel with exterior diameter of neck 100mm. 23% of diameter preserved.

Object 33905 Square M85 Unit 10221
Material 1 Clay
Length 17.50 Breadth 21.00 Thickness 10.50
Object type Jar Seal
Figure II.35.
Fragment of a mud seal, brown in colour. Part of a stamp left on the seal, hieroglyphs in cartouche, probably to be read as "nfr atn". On the back and just above the cartouche, on the left side, some darker spots (soot?). This is probably not a jar seal as such, but rather a seal which was attached to string. It may well be a horizontally written variant of that given by Fairman (1951:182) as his Fig. 23D, bearing the name of Nefertiti, but this is uncertain and has not been checked by Dr. Leahy.

Object 33985 Square K85 Unit 10200
Material 1 Clay
Length 113.00 Breadth 98.00 Thickness 35.00
Object type Jar Seal
Figure II.35.
Fragment of a mud jar seal, brown slightly friable texture. Small holes on both surfaces, due to insects. Thicker lower edge, following the profile of the original jar, tapering in shape towards upper end. On the inside some indentations/striations. Fine gritty fabric. Chamfered lower edge where it would have been in contact with the shoulders of the vessel. COA Type A.
Would have sealed a vessel with exterior diameter of neck 100mm. 25% of diameter preserved.

Object 34006 Square K85 Unit 10200
Material 1 Clay
Length 101.00 Breadth 110.00 Thickness 34.00
Object type Jar Seal
Figure II.35.
Fragment of a mud jar seal, brown to light brown, slightly friable texture. Small holes on inner surface, due to insect activity. Thicker lower edge, tapering in shape towards upper end. Gritty fabric. Chamfered lower edge from where it would have been in contact with the shoulders of the vessel. Interior has string/vessel rim impression. COA Type A.
Would have sealed a vessel with exterior diameter of neck 80mm. 25% of diameter preserved.

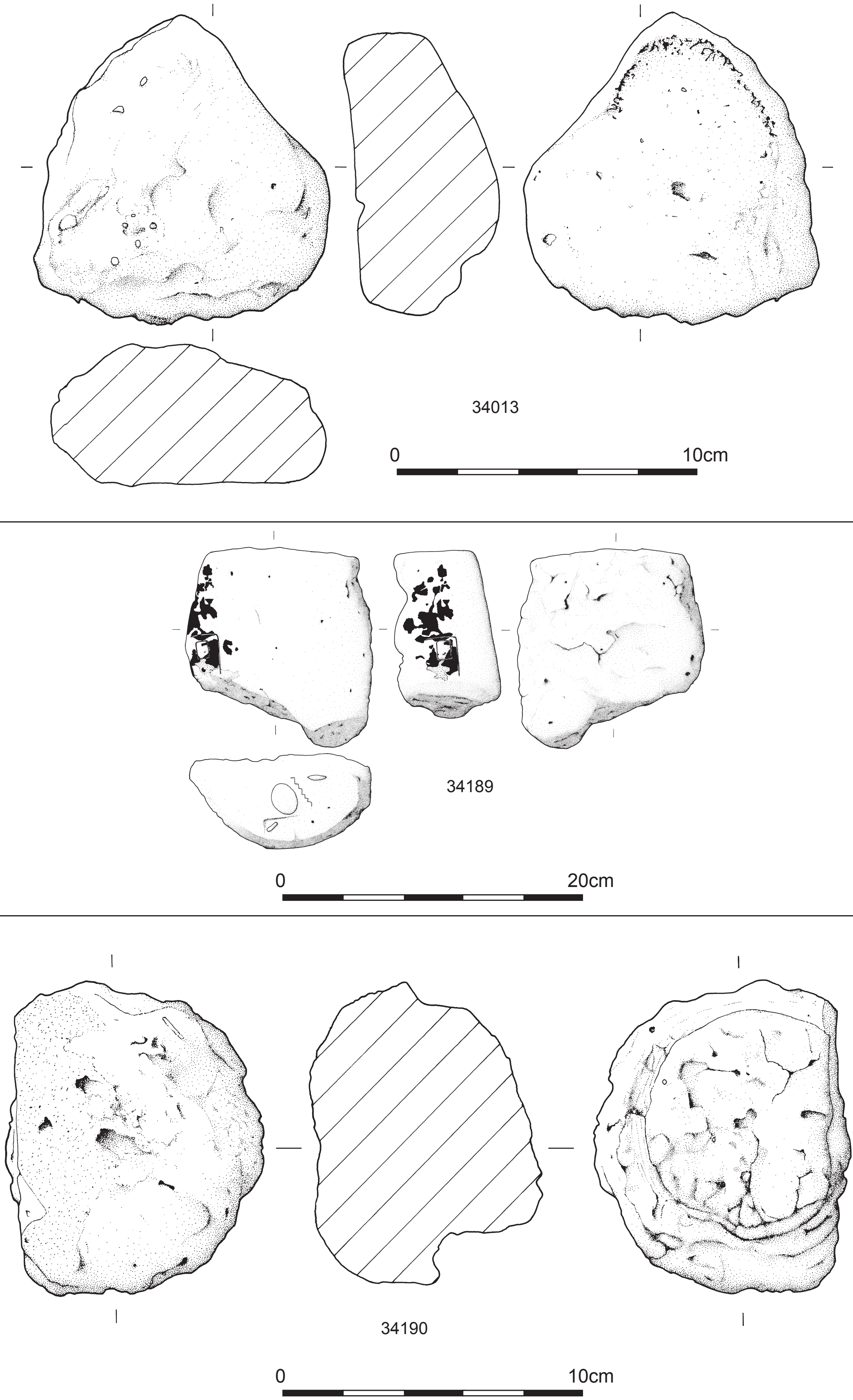


Figure II.36. Jar seals.

Object 34013 Square K85 Unit 10200
Material 1 Clay
Length 93.00 Breadth 97.00 Thickness 48.00
Object type Jar Seal
Figure II.36.
Fragment of jar seal. Brown-reddish in colour, lump. No distinct features. Has been burnt at some time. Uncertainty as to type of seal.

Object 34156 Square L75 Unit 9019
Material 1 Clay
Length 60.00 Breadth 48.31 Thickness 16.40
Object type Jar Seal
Unfired clay with impressions of plant material on the inside. Inside also has splashes of red pigment. Smooth exterior. Uncertain as to type.

Object 34189 Square L75 Unit 9020
Material 1 Clay
Length 129.43 Breadth 122.35 Thickness 67.93
Object type Jar Seal
Figure II.36.
From upper part of jar seal. Approx. 50% of the top part of the seal remains but is so shallowly impressed and badly preserved that it cannot be read, and is barely visible even in raking light. No inclusions in matrix. Finger prints in upper surface. COA Type A.

Object 34190 Square L75 Unit 9020
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 73.81 Diameter 102.79
Object type Jar Seal
Figure II.36.
Upper part of jar sealing. Sand adhering especially to broken edge. Mushroom shaped. COA Type B.
Would have sealed a vessel with exterior diameter of neck 77mm. 100% of diameter preserved.

Object 34258 Square L75 Unit 9020
Material 1 Clay
Length 0.00 Breadth 0.00 Thickness 0.00
Object type Jar Seal
Figure II.37.
Fragment of jar sealing of Type A in a fine, gritty fabric. The lowermost edge is chamfered where it was in contact with the vessel shoulders. COA Type A. Would have sealed a vessel with exterior diameter of neck 100mm. 15% of diameter preserved.

Object 30615 Square M75 Unit 8981
Material 1 Clay
Length 33.00 Breadth 24.00 Thickness 6.20
Object type Seal
Flattish fragment of mud seal. Brown slightly friable texture. Flat surface parallel to surface with finger impressions on it. Irregular, but possibly slightly rounded edges. Type uncertain.

Object 33864 Square L85 Unit 10199
Material 1 Clay
Length 24.00 Breadth 22.00 Thickness 10.00
Object type Seal
Fragment of a mud seal, dark-brown to black in colour. Rounded edges, slightly concave/convex. Fingerprint on concave surface.

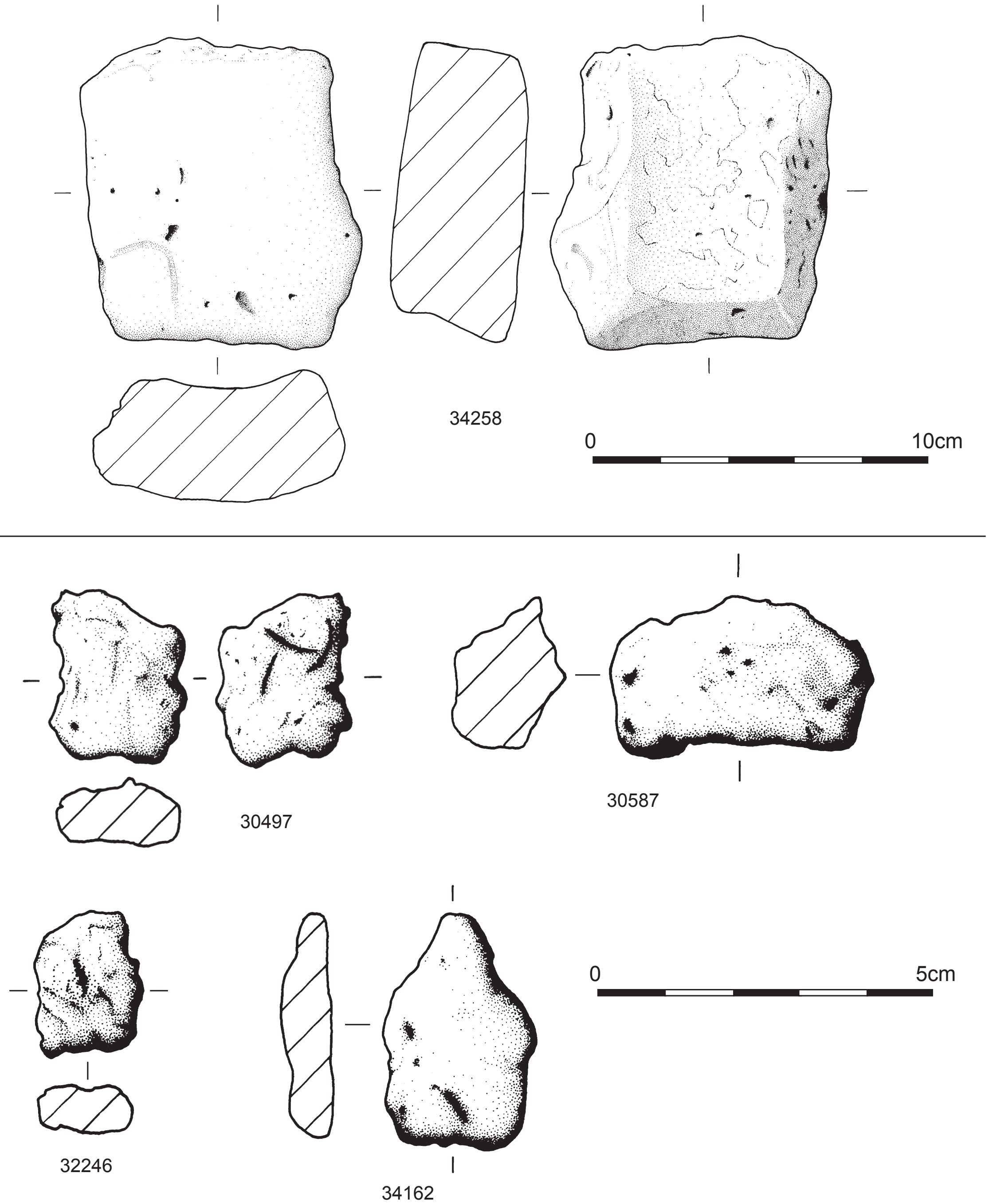


Figure II.37. Jar seal and dockets.

Object 33540 Square M85 Unit 10179
Material 1 Mud
Length 24.00 Breadth 21.00 Thickness 8.00
Object type Seal
Fragment of mud or clay seal? Not completely fired, compacted clay. Dark brown in colour.

Object 30497 Square K80 Unit 7963
Material 1 Clay
Length 24.60 Breadth 19.80 Thickness 9.20
Object type Seal (Docket)
Figure II.37.
Solid black matrix. One smooth surface showing up incised decoration consisting of 3 lines making a curved triangle. With one other deeper lines coming from one of the corners of the triangle. Lower surface uneven. Docket type seals.

Object 30587 Square M75 Unit 8981
Material 1 Clay
Length 38.00 Breadth 21.40 Thickness 14.80
Object type Seal (Docket)
Figure II.37.
Fragment of mud/clay seal. Layer of poorly compacted clay, greyish in colour, with layer of harder and darker coloured material adjoining which has circular indentations and shallow striations on it.

Object 32246 Square M80 Unit 9006
Material 1 Clay
Length 21.00 Breadth 15.00 Thickness 7.00
Object type Seal (Docket)
Figure II.37.
Rectangular shaped docket seal fragment made of fine dark brown unfired clay.

Object 34162 Square L75 Unit 9001
Material 1 Clay
Length 33.97 Breadth 21.76 Thickness 8.85
Object type Seal (Docket)
Figure II.37.
Fragment of seal in fine gritty clay. Interior surface has traces of cord impressions.

Worked Sherds

This category of objects comprises sherds which have been shaped in some way. Small rounded examples are often regarded as "gaming counters" but could also be used as lids for small vessels, or have been used as weights or numerous other purposes.

Object 30577 Square M75 Unit 8979
Material 1 Ceramic
Length 0.00 Breadth 0.00 Thickness 10.90 Diameter 24.20
Object type Sherd—worked
Silt ceramic (fabric I:1) which has been low fired. Roughly circular gaming counter or lid. Greyish-brown. Edges have been slightly smoothed and rounded. Quite fine grained.

Object 31815 Square J80 Unit 9446
Material 1 Ceramic—silt
Length 38.70 Breadth 30.20 Thickness 7.90
Object type Sherd—worked
Silt ceramic (fabric I:4) sherd which has possibly been worked into a roughly circular shape for use as a gaming counter. Originally part of a vessel which was decorated with cream-coloured slip, red and blue paint.

Object 33780 Square K90 Unit 10185
Material 1 Ceramic—silt
Length 52.00 Breadth 45.00 Thickness 11.50
Object type Sherd—worked
Sherd from red Nile silt, roughly round in shape. Possibly a lid or gaming counter.

Environmental

Included here are only a couple of those items from what is broadly described as “environmental” artefacts. These include items such as insect cases, plant remains, unworked stone (which includes stones which although not local have no remaining signs of working on them) etc.

Object 33877 Square L85 Unit 10194
Material 1 Plant fibre
Length 25.00 Breadth 16.00 Thickness 6.00
Object type Ball
Oval fibre ball, light-brown in colour.

Object 33948 Square K115 Unit 10207
Material 1 Plant fibre
Length 61.00 Breadth 38.00 Thickness 17.00
Object type Ball
“Cluster” of plant fibres, light brown in colour.

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30351	Plaster	Fragment	
30352	Glass	Drip	
30353	Faience	Tile fragment	
30354	Slag	Droplet	
30355	Faience	Ring fragment	
30356	Slag	Fragment	
30357	Glass	Fragment	
30358	Stone - sandstone	Fragment	
30359	Faience	Ring fragment	
30360	Glass	Fragment	
30361	Glass	Fragment	
30362	Glass	Ring fragment	
30363	Stone - sandstone	Fragment	
30364	Faience	Bead	
30365	Faience	Bead	
30366	Faience	Bead	
30367	Faience	Bead fragment	
30368	Faience	Bead	
30369	Glass	Fragment	
30370	Glass	Drip	
30371	Frit	Fragment	
30372	Glass	Fragment	
30373	Faience	Tile fragment	
30374	Stone - sandstone	Fragment	
30375	Faience	Ring fragment	
30376	Plaster	Fragment	
30377	Faience	Bead	
30378	Faience	Bead	
30379	Glass	Bead	
30380	Faience	Bead	
30381	Faience	Drip	
30382	Faience	Bead	
30383	Glass	Tile fragment	
30384	Metal - copper/copper alloy	Fragment	
30385	Faience	Bead	
30386	Faience	Bead	
30387	Faience	Tile fragment	
30388	Faience	Bead	
30389	Faience	Bead	
30390	Faience	Bead fragment	
30391	Faience	Bead	
30392	Faience	Bead	
30393	Stone - sandstone	Fragment	
30394	Faience	Strip	
30395	Glass	Bead	
30396	Glass	Fragment	
30397	Faience	Bead	
30398	Ceramic	Sherd	
30399	Frit	Fragment	
30400	Glass	Rod	
30401	Faience	Bead	
30402	Plaster - lime	Tray	
30403	Glass	Fragment	
30404	Ceramic	Fragment	
30405	Faience	Bead fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30406	Faience	Bead	
30407	Slag	Fragment	
30408	Faience	Bead	
30409	Metal - copper/copper alloy	Amulet	
30410	Faience	Tile fragment	
30411	Glass	Fragment	
30412	Plaster - lime	Tray	
30413	Glass	Fragment	
30414	Stone - sandstone	Fragment	
30415	Stone - sandstone	Fragment	
30416	Faience	Tile fragment	
30417	Glass	Fragment	
30418	Faience	Bead	
30419	Stone - sandstone	Fragment	
30420	Faience	Bead	
30421	Faience	Bead	
30422	Stone - sandstone	Fragment	
30423	Stone	Fragment	
30424	Slag	Fragment	
30425	Stone - sandstone	Fragment	
30426	Faience	Tile fragment	
30427	Stone - sandstone	Fragment	
30428	Glass	Fragment	
30429	Stone - sandstone	Fragment	
30430	Ceramic	Fragment	
30431	Faience	Bead fragment	
30432	Glass	Bead	
30433	Glass	Fragment	
30434	Faience	Ring fragment	
30435	Metal - copper/copper alloy	Bullet	
30436	Slag	Droplet	
30437	Metal - copper/copper alloy	Strip	
30438	Faience	Bead	
30439	Faience	Tile fragment	
30440	Faience	Fragment	
30441	Frit	Fragment	
30442	Stone - carnelian	Bead	
30443	Ceramic	Fragment	
30444	Faience	Bead	
30445	Faience	Tile fragment	
30446	Faience	Bead	
30447	Slag	Fragment	
30448	Agglomerate	Fragment	
30449	Faience	Bead	
30450	Faience	Bead	
30451	Faience	Pendant fragment	
30452	Faience	Tile fragment	
30453	Faience	Pendant fragment	
30454	Plaster - yellow	Fragment	
30455	Glass	Fragments	
30456	Plaster - yellow	Fragment	
30457	Faience	Bead	
30458	Faience	Bead	
30459	Metal - copper/copper alloy	Strip	
30460	Metal - iron	Nail	
30461	Slag	Fragment	
30462	Stone - flint	Fragment	
30463	Metal - copper/copper alloy	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30464	Plaster - yellow	Fragment	
30465	Faience	Tile fragment	
30466	Faience	Bead	
30467	Plaster	Fragment	
30468	Stone - sandstone	Fragment	
30469	Stone - quartz	Pebble	
30470	Glass	Fragment	
30471	Plaster - lime	Tray	
30472	Faience	Bead	
30473	Faience	Ring fragment	
30474	Glass	Bead	
30475	Faience	Bead fragment	
30476	Ceramic	Sherd	
30477	Stone - sandstone	Fragment	
30478	Clay	Kiln furniture	
30479	Clay	Kiln furniture	
30480	Faience	Bead	
30481	Ceramic	Sherd	
30482	Metal - copper/copper alloy	Fragment	
30483	Glass	Fragment	
30484	Faience	Bead	
30485	Stone - sandstone	Fragment	
30486	Glass	Strip	
30487	Faience	Bead	
30488	Glass	Fragment	
30489	Mud brick	Fragment	
30490	Faience	Fragment	
30491	Glass	Fragment	
30492	Mud brick	Fragment	
30493	Faience	Tile fragment	
30494	Faience	Inlay fragment	
30495	Faience	Tile fragment	
30496	Plaster	Fragment	
30497	Clay	Seal (Docket)	
30498	Plaster	Fragment	
30499	Slag	Fragment	
30500	Faience	Tile fragment	
30501	Faience	Bead	
30502	Faience	Bead	
30503	Faience	Bead fragment	
30504	Faience	Ring fragment	
30505	Faience	Ring fragment	
30506	Faience	Bead	
30507	Metal - copper/copper alloy	Strip	
30508	Faience	Bead fragment	
30509	Faience	Tile fragment	
30510	Plaster - yellow	Fragment	
30511	Ceramic	Fragment	
30512	Faience	Tile fragment	
30513	Plaster	Fragment	
30514	Metal - copper/copper alloy	Fragment	
30515	Frit	Fragment	
30516	Plaster - yellow	Fragment	
30517	Plaster	Fragment	
30518	Faience	Tile fragment	
30519	Faience	Bead fragment	
30520	Faience	Ring fragment	
30521	Faience	Bead fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30522	Faience	Bead fragment	
30523	Pigment	Fragment	
30524	Faience	Bead	
30525	Glass	Fragment	
30526	Glass	Ring fragment	
30527	Faience	Tile fragment	
30528	Faience	Bead	
30529	Glass	Bead	
30530	Stone - sandstone	Fragment	
30531	Frit	Fragment	
30532	Faience	Tile fragment	
30533	Frit	Fragment	
30534	Slag	Fragment	
30535	Glass	Ring fragment	
30536	Metal - copper/copper alloy	Fragment	
30537	Slag	Fragment	
30538	Frit	Fragment	
30539	Faience	Bead fragment	
30540	Ceramic	Mould	
30541	Faience	Ring fragment	
30542	Faience	Pendant fragment	
30543	Faience	Pendant	
30544	Metal - copper/copper alloy	Fragment	
30545	Metal - copper/copper alloy	Fragment	
30546	Plaster - yellow	Fragment	
30547	Ceramic	Mould	94/12
30548	Ceramic	Mould	
30549	Ceramic	Mould	
3055?	Faience	Amulet	
30550	Ceramic	Cylindrical Vessel	
30551	Faience	Amulet	
30552	Faience	Amulet	
30553	Faience	Ring fragment	
30554	Plaster - lime	Tray	
30555	Faience	Tile fragment	
30556	Plaster - lime	Tray	
30557	Glass	Fragment	
30558	Faience	Tile fragment	
30559	Metal - copper/copper alloy	Fragment	
30560	Glass	Fragment	
30561	Faience	Bead fragment	
30562	Stone - sandstone	Fragment	
30563	Metal - copper/copper alloy	Fragment	
30564	Faience	Tile fragment	
30565	Faience	Bead	
30566	Faience	Tile fragment	
30567	Stone - sandstone	Fragment	
30568	Stone - sandstone	Fragment	
30569	Faience	Ring fragment	
30570	Clay	Jar Seal	2004/1
30571	Stone - sandstone	Fragment	
30572	Stone - sandstone	Fragment	
30573	Stone - sandstone	Fragment	
30574	Plaster - lime	Tray	
30575	Stone - quartzite	Fragment	
30576	Ceramic	Sherd - worked	
30577	Ceramic	Sherd - worked	
30578	Plaster - lime	Tray	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30579	Stone - sandstone	Fragment	
30580	Ceramic	Sherd - worked	
30581	Stone - granite	Quernstone fragment(s)	
30582	Plaster - yellow	Fragment	
30583	Slag	Fragment	
30584	Stone - sandstone	Fragment	
30585	Stone - sandstone	Fragment	
30586	Stone - sandstone	Fragment	
30587	Clay	Seal (Docket)	
30588	Stone - sandstone	Fragment	
30589	Slag	Fragment	
30590	Stone - sandstone	Fragment	
30591	Ceramic	Fragment	
30592	Plaster - lime	Tray	
30593	Ceramic	Sherd - worked	
30594	Cement	Fragment	
30595	Faience	Tile fragment	
30596	Faience	Ring fragment	
30597	Faience	Pendant fragment	
30598	Glass	Fragment	
30599	Metal - copper/copper alloy	Fragment	
30600	Glass	Fragment	
30601	Glass	Fragment	
30602	Plaster - yellow	Fragment	
30603	Faience	Ring fragment	
30604	Glass	Glass Vessel Fragment	
30605	Faience	Pendant fragment	
30606	Faience	Ring fragment	
30607	Glass	Ring fragment	
30608	Faience	Tile fragment	
30609	Metal - iron	Nail	
30610	Stone - alabaster	Stopper/Lid	
30611	Plaster - yellow	Fragment	
30612	Ceramic	Sherd - worked	
30613	Plaster - lime	Tray	
30614	Stone - sandstone	Fragment	
30615	Clay	Seal	
30616	Ceramic	Sherd	
30617	Faience	Tile fragment	
30618	Glass	Fragment	
30619	Faience	Bead	
30620	Glass	Bead fragment	
30621	Faience	Bead fragment	
30622	Glass	Bead	
30623	Glass	Bead	
30624	Glass	Bead	
30625	Glass	Strip	
30626	Glass	Fragment	
30627	Stone - calcite	Fragment	
30628	Glass	Bead	
30629	Faience	Bead	
30630	Faience	Bead	
30631	Faience	Bead	
30632	Stone - sandstone	Fragment	
30633	Plaster - yellow	Fragment	
30634	Faience	Inlay fragment	
30635	Faience	Tile fragment	
30636	Metal - copper/copper alloy	Strip	

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List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30637	Ceramic	Mould	
30638	Frit	Fragment	
30639	Slag	Fragment	
30640	Stone - sandstone	Fragment	
30641	Glass	Fragment	
30642	Glass	Strip	
30643	Glass	Fragment	
30644	Plaster - yellow	Fragment	
30645	Stone - sandstone	Tool	
30646	Stone - sandstone	Fragment	
30647	Ceramic	Mould	
30648	Ceramic	Mould	
30649	Ceramic	Mould	
30650	Ceramic	Mould	
30651	Faience	Tile fragment	
30652	Plaster	Fragment	
30653	Stone - sandstone	Fragment	
30654	Frit	Fragment	
30655	Ceramic	Cylindrical Vessel	
30656	Ceramic - silt	Cylindrical Vessel	
30657	Ceramic	Sherd - worked	
30658	Ceramic	Crucible fragment	
30659	Faience	Bead	
30660	Faience	Tile fragment	
30661	Faience	Bead	
30662	Stone - sandstone	Fragment	
30663	Stone - sandstone	Fragment	
30664	Metal - copper/copper alloy	Fragment	
30665	Glass	Fragment	
30666	Glass	Fragment	
30667	Faience	Drip	
30668	Faience	Bead	
30669	Glass	Fragment	
30670	Faience	Bead	
30671	Faience	Bead fragment	
30672	Glass	Bead fragment	
30673	Faience	Bead	
30674	Glass	Fragment	
30675	Glass	Rod	
30676	Stone - sandstone	Fragment	
30677	Glass	Rod	
30678	Metal - copper/copper alloy	Fragment	
30679	Glass	Fragment	
30680	Glass	Fragment	
30681	Faience	Bead	
30682	Faience	Bead	
30683	Plaster - yellow	Fragment	
30684	Faience	Inlay fragment	
30685	Stone - sandstone	Fragment	
30686	Glass	Bead	
30687	Glass	Bead fragment	
30688	Ceramic	Sherd - worked	
30689	Clay	Lime matrix	
30690	Glass	Fragment	
30691	Stone - alabaster	Fragment	
30692	Faience	Bead	
30693	Faience	Bead	
30694	Ceramic	Sherd - worked	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30695	Plaster - lime	Tray	
30696	Glass	Strip	
30697	Faience	Tile fragment	
30698	Stone - sandstone	Fragment	
30699	Ceramic - silt	Fragment	
30700	Calcareous matrix	Fragment	
30701	Slag	Fragment	
30702	Metal - copper/copper alloy	Fragment	
30703	Plaster - yellow	Fragment	
30704	Glass	Bead	
30705	Faience	Ring fragment	
30706	Faience	Bead	
30707	Clay	Bead	
30708	Glass	Fragment	
30709	Faience	Bead	
30710	Glass	Fragment	
30728	Ceramic	Mould	
30729	Ceramic	Mould	
30730	Metal - silver	Fragment	
30731	Stone (sandstone)	Fragment	
30732	Slag	Fragment	
30733	Stone (sandstone)	Fragment	
30734	Glass	Strip	
30735	Glass	Fragment	
30736	Glass	Drip	
30737	Glass	Fragment	
30738	Faience	Bead	
30739	Faience	Bead fragment	
30740	Faience	Bead	
30741	Faience	Bead	
30742	Calcareous matrix	Fragment	
30743	Stone - sandstone	Fragment	
30744	Faience	Bead fragment	
30745	Faience	Bead	
30746	Faience	Tile fragment	
30747	Glass	Fragment	
30748	Stone - limestone	Sculpture(s)	
30749	Ceramic	Mould	
30750	Faience	Bead	
30751	Faience	Tile fragment	
30752	Plaster - yellow	Fragment	
30753	Metal - copper/copper alloy	Fragment	
30754	Glass	Fragment	
30755	Glass	Fragment	
30756	Metal - copper/copper alloy	Tube	
30757	Faience	Bead	
30758	Faience	Tile fragment	
30759	Faience	Bead	
30760	Stone - sandstone	Fragment	
30761	Glass	Fragment	
30762	Frit	Fragment	
30763	Glass	Fragment	
30764	Faience	Pendant fragment	
30765	Stone - sandstone	Fragment	
30766	Plaster - yellow	Fragment	
30767	Metal - copper/copper alloy	Fragment	
30768	Faience	Bead	
30769	Faience	Bead fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30770	Faience	Tile fragment	
30771	Faience	Pendant fragment	
30772	Faience	Bead	
30773	Faience	Bead	
30774	Faience	Bead	
30775	Faience	Bead	
30776	Glass	Fragment	
30777	Slag	Fragment	
30778	Frit	Fragment	
30779	Faience	Bead	
30780	Glass	Fragment	
30781	Plaster - yellow	Fragment	
30782	Plaster - lime	Tray	
30783	Faience	Pendant fragment	
30784	Faience	Bead	
30785	Faience	Tile fragment	
30786	Plaster - lime	Tray	
30787	Plaster - yellow	Fragment	
30788	Glass	Rod	
30789	Clay	Jar Seal	94/14
30790	Glass	Fragments	
30791	Glass	Fragment	
30792	Glass	Droplet	
30793	Frit	Fragment	
30794	Glass	Fragment	
30795	Stone - sandstone	Fragment	
30796	Ceramic	Tool	
30797	Metal - copper/copper alloy	Fragment	
30798	Faience	Tile fragment	
30799	Plaster - yellow	Fragment	
30800	Faience	Bead	
30801	Clay	Bead	
30802	Faience	Bead	
30803	Faience	Bead	
30804	Glass	Bead	
30805	Faience	Bead	
30806	Glass	Bead	
30807	Glass	Bead	
30808	Faience	Bead	
30809	Faience	Pendant fragment	
30810	Faience	Drip	
30811	Faience	Fragment	
30812	Faience	Tile fragment	
30813	Glass	Fragment	
30814	Plaster - yellow	Fragment	
30815	Plaster - yellow	Fragments	
30816	Glass	Fragment	
30817	Glass	Fragment	
30818	Metal - copper/copper alloy	Fragment	
30819	Metal - copper/copper alloy	Fragment	
30820	Glass	Fragment	
30821	Glass	Fragment	
30822	Clay	Fragment	
30823	Metal - copper/copper alloy	Fragment	
30824	Glass	Fragment	
30825	Glass	Fragment	
30826	Glass	Rod	
30827	Glass	Pendant fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
30828	Glass	Fragment	
30829	Glass	Fragment	
30830	Glass	Fragment	
30831	Faience	Bead fragment	
30832	Faience	Bead	
30833	Faience	Bead	
30834	Faience	Drip	
30835	Faience	Bead	
30836	Calcareous matrix	Fragment	
30837	Ceramic	Mould	
30838	Clay	Jar Seal	94/14
30839	Clay	Jar Seal	2004/2
30840	Clay	Jar Seal	
30841	Clay	Jar Seal	
30842	Plaster - lime	Tray	
30843	Faience	Tile fragment	
30844	Faience	Tile fragment	
30845	Faience	Bead	
30846	Paper	Cigarette wrapper(s)	
30847	Faience	Tile fragment	
30848	Glass	Bead	
30849	Glass	Fragment	
30850	Faience	Bead spacer	
30851	Stone - sandstone	Fragment	
30852	Stone - sandstone	Fragment	
30853	Metal - copper/copper alloy	Fragment	
30854	Ceramic - silt	Sherd	
30855	Faience	Tile fragment	
30856	Glass	Fragment	
30857	Faience	Bead	
30858	Metal - copper/copper alloy	Wire	
30859	Metal - copper/copper alloy	Strip	
30860	Faience	Bead	
30861	Glass	Strip	
30862	Glass	Fragment	
30894	Faience	Tile fragment	
31466	Ceramic	Sherd - worked	
31467	Stone - alabaster	Fragment	
31468	Plaster - lime	Tray	
31469	Ceramic	Sherd - worked	
31470	Faience	Tile fragment	
31471	Metal - copper/copper alloy	Strip	
31472	Ceramic	Fragment	
31473	Plaster - yellow	Fragment	
31474	Plaster - yellow	Fragment	
31475	Metal - copper/copper alloy	Fragment	
31476	Metal - copper/copper alloy	Fragment	
31477	Ceramic	Fragment	
31478	Plaster - yellow	Fragment	
31479	Metal - copper/copper alloy	Fragment	
31480	Stone - sandstone	Fragment	
31481	Ceramic	Fragment	
31482	Ceramic	Sherd - worked	
31483	Plaster	Fragment	
31484	Plaster - yellow	Fragment	
31485	Plaster	Fragment	
31486	Plaster - yellow	Fragment	
31487	Faience	Tile fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31488	Stone - quartz	Stone	
31489	Stone - chert	Fragment	
31490	Glass	Fragment	
31491	Glass	Fragment	
31492	Glass	Fragment	
31493	Glass	Fragment	
31494	Plaster	Fragment	
31495	Plaster - yellow	Fragment	
31496	Ceramic	Fragment	
31497	Stone - sandstone	Fragment	
31498	Plaster - yellow	Fragment	
31499	Plaster - yellow	Fragment	
31500	Plaster - yellow	Fragment	
31501	Stone - limestone	Fragment	
31502	Stone - sandstone	Ball	
31503	Plaster - yellow	Fragment	
31504	Plaster - yellow	Fragment	
31505	Plaster - yellow	Fragment	
31506	Plaster - yellow	Fragment	
31507	Plaster - lime	Tray	
31508	Plaster - lime	Tray	
31509	Plaster - lime	Tray	
31510	Slag	Fragment	
31511	Plaster - yellow	Fragment	
31512	Faience	Bead fragment	
31513	Faience	Tile fragment	
31514	Clay	Ball	
31515	Plaster - lime	Tray	
31516	Plaster - yellow	Fragment	
31517	Ceramic	Sherd - worked	
31518	Sand	Fragment	
31519	Frit	Fragment	
31520	Pigment	Fragment	
31521	Pigment	Fragment	
31522	Metal - copper/copper alloy	Fragment	
31523	Pigment	Fragment	
31524	Plaster - lime	Tray	
31525	Plaster - yellow	Fragment	
31526	Plaster - yellow	Fragment	
31527	Plaster - yellow	Fragment	
31528	Plaster	Fragment	
31529	Glass	Fragment	
31530	Plaster - yellow	Fragment	
31531	Plaster - yellow	Fragment	
31532	Plaster - yellow	Fragment	
31533	Plaster - yellow	Fragment	
31534	Faience	Tile fragment	
31535	Faience	Bead	
31536	Faience	Bead	
31537	Metal - copper/copper alloy	Fragment	
31538	Faience	Bead	
31539	Stone - alabaster	Fragment	
31540	Faience	Tile fragment	
31541	Faience	Bead	
31542	Faience	Bead	
31543	Faience	Bead	
31544	Faience	Bead	
31545	Faience	Bead	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31546	Faience	Tile fragment	
31547	Faience	Tile fragment	
31548	Faience	Bead fragment	
31549	Faience	Bead	
31550	Glass	Fragment	
31551	Faience	Bead	
31552	Faience	Bead	
31553	Faience	Bead	
31554	Faience	Bead	
31555	Pigment	Fragment	
31556	Stone - sandstone	Fragment	
31557	Glass	Fragment	
31558	Faience	Pendant fragment	
31559	Stone - sandstone	Fragment	
31560	Stone - sandstone	Fragment	
31561	Stone - sandstone	Fragment	
31562	Stone - sandstone	Fragment	
31563	Glass	Fragment	
31564	Glass	Fragment	
31565	Glass	Fragment	
31566	Glass	Fragment	
31567	Glass	Fragment	
31568	Metal - copper/copper alloy	Fragment	
31569	Glass	Fragment	
31570	Frit	Fragment	
31571	Plaster (yellow)	Fragment	
31572	Plaster - lime	Tray	
31573	Faience	Fragment	
31574	Plaster - lime	Tray	
31575	Glass	Fragment	
31576	Plaster - yellow	Fragment	
31577	Glass	Fragment	
31578	Glass	Rod	
31579	Faience	Tile fragment	
31580	Faience	Bead	
31581	Faience	Bead	
31582	Metal - copper/copper alloy	Fragment	
31583	Faience	Bead	
31584	Glass	Pincer piece	
31585	Glass	Fragment	
31586	Faience	Tile fragment	
31587	Ceramic	Sherd	
31588	Plaster - yellow	Fragment	
31589	Plaster - yellow	Fragment	
31590	Stone - sandstone	Fragment	
31591	Stone - sandstone	Ball	
31592	Plaster - yellow	Fragment	
31593	Plaster - yellow	Fragment	
31594	Plaster - yellow	Fragment	
31595	Plaster - yellow	Fragment	
31596	Lime	Fragment	
31597	Plaster - yellow	Fragment	
31598	Plaster - yellow	Fragment	
31599	Stone - sandstone	Fragment	
31600	Plaster - yellow	Fragment	
31601	Frit	Fragment	
31602	Plaster - yellow	Fragment	
31603	Faience	Tile fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31604	Glass	Fragment	
31605	Faience	Bead	
31606	Plaster - lime	Tray	
31607	Ceramic	Sherd - worked	
31608	Ceramic	Sherd - worked	
31609	Ceramic	Sherd - worked	
31610	Ceramic - silt	Sherd - worked	
31611	Ceramic	Sherd - worked	
31612	Ceramic - silt	Sherd - worked	
31613	Ceramic - silt	Sherd - worked	
31614	Ceramic - silt	Sherd - worked	
31615	Ceramic	Sherd - worked	
31616	Plaster - lime	Tray	
31617	Ceramic	Fragment	
31618	Ceramic	Fragment	
31619	Ceramic - silt	Sherd - worked	
31620	Ceramic	Fragment	
31621	Plaster - yellow	Fragment	
31622	Faience	Tile fragment	
31623	Ceramic	Sherd	
31624	Faience	Bead	
31625	Faience	Bead	
31626	Faience	Bead	
31627	Glass	Inlay fragment	
31628	Faience	Tile fragment	
31629	Faience	Tile fragment	
31630	Ceramic	Sherd	
31631	Pigment	Fragment	
31632	Stone - chert	Fragment	
31633	Ceramic	Fragment	
31634	Glass	Fragment	
31635	Ceramic	Sherd - worked	
31636	Clay	Sherd	
31637	Faience	Tile fragment	
31638	Faience	Tile fragment	
31639	Pigment	Fragment	
31640	Ceramic - silt	Fragment	
31641	Faience	Bead	
31642	Glass	Bead	
31643	Faience	Inlay fragment	
31644	Glass	Strip	
31645	Faience	Bead	
31646	Faience	Bead fragment	
31647	Ceramic - silt	Sherd - worked	
31648	Plaster - yellow	Fragment	
31649	Stone - limestone	Fragment	
31650	Ceramic	Cylindrical Vessel	
31651	Glass	Fragment	
31652	Stone - limestone	Spindle whorl fragment(s)	
31653	Frit	Fragment	
31654	Plaster - yellow	Fragment	
31655	Ceramic - marl	Sherd - worked	
31656	Ceramic	Fragment	
31657	Ceramic	Sherd	
31658	Ceramic	Fragment	
31659	Clay - silt	Fragment	
31660	Ceramic	Mould	
31661	Ceramic	Cylindrical Vessel	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31662	Plaster - yellow	Fragment	
31663	Faience	Tile fragment	
31664	Metal - copper/copper alloy	Rod	
31665	Plaster - yellow	Fragment	
31666	Faience	Tile fragment	
31667	Faience	Bead	
31668	Faience	Bead	
31669	Faience	Bead	
31670	Faience	Bead fragment	
31671	Faience	Bead fragment	
31672	Faience	Bead	
31673	Faience	Bead	
31674	Faience	Bead	
31675	Faience	Ring Fragment	
31676	Faience	Tile fragment	
31677	Faience	Ring fragment	
31678	Clay - silt	Fragment	
31679	Ceramic	Cylindrical Vessel	
31680	Plaster - yellow	Fragment	
31681	Ceramic - silt	Cylindrical Vessel	
31682	Ceramic	Cylindrical Vessel	
31683	Pigment	Fragment	
31684	Glass	Rod	
31685	Faience	Tile fragment	
31686	Plaster - yellow	Fragment	
31687	Pigment	Fragment	
31688	Metal - copper/copper alloy	Fragment	
31689	Ceramic - silt	Sherd - worked	
31690	Stone - chert	Flake	
31691	Ceramic	Cylindrical Vessel	
31692	Ceramic	Crucible fragment	
31693	Faience	Inlay fragment	
31694	Plaster - yellow	Fragment	
31695	Faience	Tile fragment	
31696	Faience	Ring fragment	
31697	Faience	Bead	
31698	Frit	Fragment	
31699	Glass	Inlay fragment	
31700	Glass	Fragment	
31701	Faience	Bead	
31702	Faience	Bead	
31703	Metal - copper/copper alloy	Rod	
31704	Clay - unfired	Fragment	
31705	Ceramic - silt	Sherd - worked	
31706	Ceramic - silt	Sherd - worked	
31707	Ceramic - silt	Sherd - worked	
31708	Ceramic - marl	Sherd - worked	
31709	Stone - sandstone	Fragment	
31710	Faience	Tile fragment	
31711	Glass	Fragment	
31712	Faience	Earring fragment	
31713	Plaster - yellow	Fragment	
31714	Glass	Fragment	
31715	Faience	Bead fragment	
31716	Glass	Bead fragment	
31717	Frit	Fragment	
31718	Glass	Fragment	
31719	Faience	Tile fragment	

Find No	Material 1	Object type	Antiq no
31720	Faience	Ring fragment	
31721	Faience	Bead fragment	
31722	Faience	Bead	
31723	Faience	Tile fragment	
31724	Faience	Bead	
31725	Ceramic	Mould	
31726	Faience	Tile fragment	
31727	Faience	Tile fragment	
31728	Pigment	Fragment	
31729	Slag	Fragment	
31730	Glass	Rod	
31731	Ceramic	Crucible fragment	
31732	Glaze	Fragment	
31733	Plaster - yellow	Fragment	
31734	Ceramic - silt	Sherd - worked	
31735	Faience	Tile fragment	
31736	Faience	Tile fragment	
31737	Faience	Bead	
31738	Glass	Fragment	
31739	Metal - copper/copper alloy	Strip	
31740	Pigment	Fragment	
31741	Frit	Fragment	
31742	Glass	Fragment	
31743	Plaster - yellow	Fragment	
31744	Plaster - yellow	Fragment	
31745	Plaster - yellow	Fragment	
31746	Ceramic	Mould	
31747	Glass	Fragment	
31748	Glass	Fragment	
31749	Plaster - yellow	Fragment	
31750	Slag	Fragment	
31751	Glass	Bead fragment	
31752	Ceramic	Mould	6/98
31753	Clay - unfired	Sherd	
31754	Ceramic	Fragment	
31755	Faience	Tile fragment	
31756	Faience	Bead	
31757	Faience	Bead fragment	
31758	Slag	Fragment	
31759	Ceramic	Fragment	
31760	Plaster	Fragment	
31761	Faience	Tile fragment	
31762	Faience	Inlay fragment	
31763	Faience	Vessel fragment	
31764	Plaster - yellow	Fragment	
31765	Ceramic - silt	Sherd - worked	
31766	Plaster - yellow	Fragment	
31767	Plaster - yellow	Fragment	
31768	Glass	Fragment	
31769	Metal - tin	Wire	
31770	Slag	Fragment	
31771	Slag	Fragment	
31772	Faience	Ring fragment	
31773	Metal - copper/copper alloy	Fragment	
31774	Ceramic	Crucible fragment	
31775	Stone - sandstone	Fragment	
31776	Ceramic	Fragment	
31777	Ceramic - silt	Cylindrical Vessel	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31778	Plaster - yellow	Fragment	
31779	Stone - carnelian	Fragment	
31780	Stone - sandstone	Tool	
31781	Frit	Fragment	
31782	Slag	Fragment	
31783	Ceramic	Sherd	
31784	Ceramic - marl	Sherd - worked	
31785	Glass	Fragment	
31786	Glass	Fragment	
31787	Glass	Fragment	
31788	Glass	Fragment	
31789	Plaster - yellow	Fragment	
31790	Rope	Knot	
31791	Glass	Fragment	
31792	Ceramic - silt	Cylindrical Vessel	
31793	Clay - unfired	Fragment	
31794	Ceramic	Mould	
31795	Ceramic	Mould	
31796	Faience	Tile fragment	
31797	Plaster - yellow	Fragment	
31798	Plaster- yellow	Fragment	
31799	Plaster - yellow	Fragment	
31800	Plaster - yellow	Fragment	
31801	Plaster - yellow	Fragment	
31802	Plaster - yellow	Fragment	
31803	Plaster	Fragment	
31804	Ceramic	Mould	7/98
31805	Glass	Glass Vessel Fragment	
31806	Faience	Vessel fragment	
31807	Faience	Tile fragment	
31808	Metal - copper/copper alloy	Fragment	
31809	Slag	Fragment	
31810	Glass	Rod	
31811	Plaster - yellow	Fragment	
31812	Faience	Pendant fragment	
31813	Pigment	Fragment	
31814	Plaster - yellow	Fragment	
31815	Ceramic - silt	Sherd - worked	
31816	Ceramic - silt	Cylindrical Vessel	
31817	Ceramic	Cylindrical Vessel	
31818	Ceramic	Sherd	
31819	Faience	Tile fragment	
31820	Plaster - yellow	Fragment	
31821	Glass	Fragment	
31822	Faience	Tile fragment	
31823	Faience	Ring fragment	
31824	Faience	Bead	
31825	Faience	Tile fragment	
31826	Ceramic	Mould	
31827	Ceramic	Fragment	
31828	Pigment	Fragment	
31829	Glass	Strip	
31830	Ceramic	Mould	
31831	Faience	Bead	
31832	Faience	Tile fragment	
31833	Pigment	Fragment	
31834	Frit	Fragment	
31835	Ceramic	Fragment	

Find No	Material 1	Object type	Antiq no
31836	Stone - basalt	Pounder	
31837	Ceramic	Vessel fragment	
31838	Stone - quartzite	Fragment	
31839	Plaster - yellow	Vitrified fragment	
31840	Slag	Fragment	
31841	Slag	Fragment	
31842	Plaster - yellow	Fragment	
31843	Ceramic	Crucible fragment	
31844	Plaster - yellow	Fragment	
31845	Pigment	Fragment	
31846	Stone - gypsum	Cast	
31847	Ceramic	Crucible fragment	
31848	Frit	Fragment	
31849	Faience	Tile fragment	
31850	Plaster - yellow	Fragment	
31851	Glass	Fragment	
31852	Slag	Fragment	
31853	Ceramic	Cylindrical Vessel	
31854	Slag	Fragment	
31855	Slag	Fragment	
31856	Plaster - yellow	Fragment	
31857	Faience	Tile fragment	
31858	Slag	Fragment	
31859	Faience	Tile fragment	
31860	Glass	Strip	
31861	Glass	Rod	
31862	Plaster - yellow	Fragment	
31863	Metal - copper/copper alloy	Fragment	
31864	Frit	Fragment	
31865	Faience	Ring fragment	
31866	Ceramic	Sherd	
31867	Plaster - yellow	Fragment	
31868	Glass	Fragment	
31869	Ceramic	Cylindrical Vessel	
31870	Faience	Ring fragment	
31871	Faience	Bead	
31872	Plaster - yellow	Fragment	
31873	Faience	Bead fragment	
31874	Faience	Tile fragment	
31875	Metal - copper/copper alloy	Sheet/strip fragment	
31876	Faience	Amulet	
31877	Clay	Sherd	
31878	Ceramic	Fragment	
31879	Ceramic - silt	Sherds - worked	
31880	Plaster - yellow	Fragment	
31881	Plaster - yellow	Fragment	
31882	Ceramic	Cylindrical Vessel	
31883	Ceramic	Fragment	
31884	Stone - limestone	Fragment	
31885	Stone - limestone	Statue fragment	
31886	Clay	Jar Seal	
31887	Clay	Jar Seal	
31888	Clay	Jar Seal	
31889	Ceramic	Cylindrical Vessel	
31890	Plaster - lime	Tray	
31891	Ceramic	Sherd - worked	
31892	Stone - quartzite	Fragment	
31893	Clay	Jar Seal	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31894	Ceramic	Cylindrical Vessel	
31895	Clay	Sherd	
31896	Ceramic	Sherd - worked	
31897	Faience	Tile fragment	
31898	Pigment	Fragment	
31899	Faience	Tile fragment	
31900	Faience	Tile fragment	
31901	Pigment	Fragments	
31902	Ceramic	Fragment	
31903	Faience	Pendant fragment	
31904	Plaster - yellow	Fragment	
31905	Glass	Fragment	
31906	Metal - copper/copper alloy	Fragment	
31907	Faience	Beads	
31908	Glass	Strip	
31909	Faience	Bead fragment	
31910	Plaster	Fragment	
31911	Plaster - yellow	Fragment	
31912	Faience	Tile fragment	
31913	Slag	Fragment	
31914	Faience	Tile fragment	
31915	Ceramic	Mould	8/98
31916	Pigment	Fragment	
31917	Ceramic	Mould	9/98
31918	Ceramic	Fragment	
31919	Slag	Fragment	
31920	Metal - copper/copper alloy	Fragment	
31921	Plaster - yellow	Fragment	
31922	Slag	Fragment	
31923	Clay	Sherd	
31924	Plaster - yellow	Fragment	
31925	Faience	Ring fragment	
31926	Faience	Tile fragment	
31927	Faience	Bead	
31928	Frit	Fragment	
31929	Slag	Fragment	
31930	Glass	Fragment	
31931	Clay	Fragment- unfired	
31932	Glass	Fragment	
31933	Frit	Fragments	
31934	Ceramic	Mould	
31935	Faience	Bead	
31936	Faience	Bead	
31937	Slag	Fragment	
31938	Stone - malachite	Fragment	
31939	Glass	Bead	
31940	Ceramic	Fragment	
31941	Stone	Fragment	
31942	Glass	Fragment	
31943	Ceramic	Cylindrical Vessel	
31944	Plaster- white	Sculpture(s)	
31945	Metal - copper/copper alloy	Fragment	
31946	Slag	Fragment	
31947	Faience	Tile fragment	
31948	Ceramic - silt	Sherd - worked	
31949	Mortar	Fragment	
31950	Lime	Cast	
31951	Faience	Bead	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
31952	Metal - copper/copper alloy	Rod	
31953	Faience	Fragment	
31954	Metal - copper/copper alloy	Fragment	
31955	Faience	Tile fragment	
31956	Plaster - yellow	Fragments	
31957	Faience	Tile fragment	
31958	Clay	Sherd	
31959	Plaster - yellow	Fragment	
31960	Ceramic	Mould	
31961	Ceramic	Fragment	
31962	Ceramic	Crucible fragment	
31963	Ceramic	Cylindrical vessel	
31964	Clay	Sherd	
31965	Ceramic	Sherds - worked	
31966	Ceramic	Sherd	
31967	Stone - malachite	Fragment	
31968	Plaster - yellow	Fragment	
31969	Stone - limestone	Fragment	
31970	Plaster - yellow	Fragment	
31971	Slag	Fragment	
31972	Plaster	Fragments	
31973	Clay	Mould	
31974	Ceramic	Sherd- worked	
31975	Glass	Fragment	
31976	Plaster	Fragment	
31977	Slag	Fragment	
31978	Glass	Rod	
31979	Ceramic	Mould	9/98
31980	Stone - alabaster	Statue fragment	
31981	Pigment	Fragments	
31982	Plaster - lime	Tray	
31983	Plaster - yellow	Fragment	
31984	Stone - sandstone	Fragment	
31985	Stone - basalt	Pounder	
31986	Faience	Tile fragment	
31987	Faience	Tile fragment	
31988	Stone - chert	Fragment	
31989	Ceramic	Sherd	
31990	Ceramic	Crucible fragment	
31991	Pigment	Fragment	
31992	Ceramic	Sherd	
31993	Plaster - yellow	Fragment	
31994	Plaster - yellow	Fragment	
31995	Slag	Fragment	
31996	Pigment	Fragment	
31997	Frit	Fragment	
31998	Faience	Tile fragment	
31999	Faience	Tile fragment	
32000	Glass	Bead	
32094	Plaster - yellow	Fragment	
32095	Plaster - yellow	Fragment	
32096	Plaster - yellow	Fragment	
32097	Slag	Fragment	
32098	Faience	Tile fragment	
32099	Faience	Ring fragment	
32100	Slag	Fragments	
32101	Faience	Bead fragment	
32102	Frit	Fragment	

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List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
32103	Glass	Fragment	
32104	Glass	Rod	
32105	Faience	Tile fragment	
32106	Faience	Bead fragment	
32107	Faience	Ring fragment	
32108	Slag	Droplet	
32109	Pigment	Fragment	
32110	Plaster - yellow	Fragment	
32111	Faience	Ring fragment	
32112	Faience	Tile fragment	
32113	Faience	Bead	
32114	Faience	Tile fragment	
32115	Glass	Fragment	
32116	Stone - sandstone	Fragment	
32117	Pigment	Fragment	
32118	Stone - basalt	Tool	
32119	Pigment	Fragment	
32120	Pigment	Fragment	
32121	Stone	Tool	
32122	Ceramic	Sherd - worked	
32123	Ceramic	Fragment	
32124	Plaster - lime	Tray	
32125	Plaster - lime	Tray	
32126	Stone - sandstone	Fragment	
32127	Metal - copper/copper alloy	Fragment	
32128	Plaster - yellow	Fragment	
32129	Plaster - yellow	Fragment	
32130	Ceramic	Fragment	
32131	Slag	Fragment	
32132	Slag	Fragment	
32133	Plaster - yellow	Fragment	
32134	Plaster - lime	Tray	
32135	Slag	Fragment	
32136	Pigment	Fragment	
32137	Plaster - yellow	Fragment	
32138	Plaster - lime	Tray	
32139	Stone - sandstone	Fragment	
32140	Ceramic	Fragment	
32141	Faience	Pendant fragment	
32142	Metal - copper/copper alloy	Fragment	
32143	Plaster - lime	Tray	
32144	Stone - sandstone	Fragment	
32145	Stone - sandstone	Fragment	
32146	Plaster - yellow	Fragment	
32147	Plaster - yellow	Fragment	
32148	Pigment	Fragment	
32149	Glass	Fragment	
32150	Metal - copper/copper alloy	Fragment	
32151	Slag	Fragment	
32152	Faience	Tile fragment	
32153	Faience	Bead	
32154	Frit	Fragment	
32155	Stone (Calcite/travertine)	Fragment	
32156	Stone - sandstone	Fragment	
32157	Slag	Fragment	
32158	Slag	Fragment	
32159	Stone - sandstone	Fragment	
32160	Slag	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
32161	Slag	Fragment	
32162	Glass	Fragment	
32163	Glass	Fragment	
32164	Faience	Bead	
32165	Stone - sandstone	Fragment	
32166	Plaster - yellow	Fragment	
32167	Copper Corrosion	Fragment	
32168	Slag	Fragment	
32169	Plaster	Fragment	
32170	Ceramic	Sherd- worked	
32171	Clay	Jar Seal	
32172	Clay	Jar Seal	
32173	Clay	Fragment	
32174	Calcareous Matrix	Fragment	
32175	Pigment	Fragment	
32176	Ceramic	Fragment	
32177	Stone - quartzite	Fragment	
32178	Ceramic	Sherds - worked	
32179	Plaster - lime	Tray	
32180	Plaster - yellow	Fragment	
32181	Plaster - yellow	Fragment	
32182	Clay	Jar Seal	
32183	Ceramic	Sherds - worked	
32184	Stone - quartzite breccia	Fragment	
32185	Ceramic	Sherd	
32186	Stone - sandstone	Fragment	
32187	Plaster - lime	Tray	
32188	Stone - sandstone	Fragment	
32189	Stone - quartzite schist	Fragment	
32190	Stone - flint	Worked Stone	
32191	Plaster - lime	Tray	
32192	Ceramic	Sherd - worked	
32193	Ceramic	Cylindrical Vessel	
32194	Stone - sandstone	Fragments	
32195	Stone - sandstone	Fragment	
32196	Stone - sandstone	Fragment	
32197	Stone - sandstone	Fragment	
32198	Stone - sandstone	Fragment	
32199	Plaster - lime	Fragment	
32200	Ceramic	Sherd - worked	
32201	Slag	Fragment	
32202	Ceramic	Cylindrical Vessel	
32203	Ceramic	Cylindrical Vessel	
32204	Stone - quartzite	Fragment	
32205	Stone - sandstone	Fragment	
32206	Ceramic	Sherds	
32207	Ceramic	Sherd- worked	
32208	Ceramic	Sherd - worked	
32209	Slag	Fragment	
32210	Stone - limestone	Fragment	
32211	Stone - granite	Fragment	
32212	Mud	Fragment	
32213	Stone - granite	Fragment	
32214	Stone - basalt	Pounder	
32215	Stone - quartzite	Fragment	
32216	Stone - granite	Fragment	
32217	Stone - sandstone	Fragment	
32218	Clay	Jar Seal	2004/3

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
32219	Stone - sandstone	Fragment	
32220	Mud	Brick	
32221	Ceramic	Sherd - worked	
32222	Stone - granite	Fragment	
32223	Ceramic	Sherd - worked	
32224	Ceramic	Sherd - worked	
32225	Ceramic	Sherd	
32226	Plaster - lime	Fragment	
32227	Stone - granite	Fragment	
32228	Stone - sandstone	Fragment	
32229	Ceramic	Sherd - worked	
32230	Stone - sandstone	Fragment	
32231	Clay	Jar Seal	
32232	Stone - quartzite	Fragment	
32233	Ceramic	Sherd	
32234	Ceramic	Sherd	
32235	Ceramic	Sherd	
32236	Clay	Fragment	
32237	Plaster	Fragment	
32238	Ceramic	Cylindrical Vessel	
32239	Ceramic	Fragment	
32240	Slag	Fragment	
32241	Plaster - lime	Tray	
32242	Stone - granite	Fragment	
32243	Plaster - yellow	Fragment	
32244	Calcareous matrix	Fragment	
32245	Concretion	Fragment	
32246	Clay	Seal (Docket)	
32247	Stone - quartzite	Fragment	
32248	Stone - sandstone	Fragment	
32249	Stone - sandstone	Fragment	
32250	Stone - sandstone	Fragment	
32251	Slag	Fragment	
32252	Plaster	Fragment	
32253	Glass	Fragment	
32254	Metal - copper/copper alloy	Fragment	
32255	Plaster - yellow	Fragment	
32256	Faience	Tile fragment	
32257	Stone (sandstone)	Fragment	
32258	Frit	Fragment	
32259	Glass	Fragment	
32260	Faience	Tile fragment	
32261	Slag	Fragment	
32262	Frit	Fragment	
32263	Metal - copper/copper alloy	Fragment	
32264	Ceramic	Mould	6/93
32265	Ceramic	Mould	6/93
32266	Ceramic	Mould	6/93
32267	Ceramic	Mould	6/93
32268	Ceramic	Mould	6/93
32269	Ceramic	Mould	6/93
32270	Ceramic	Mould	6/93
32271	Ceramic	Mould	6/93
32272	Faience	Amulet	5/93
32273	Ceramic	Mould	6/93
32274	Ceramic	Mould	6/93
32275	Ceramic	Mould	6/93
32276	Ceramic	Mould	6/93

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
32277	Ceramic	Mould	6/93
32278	Ceramic	Mould	6/93
32279	Ceramic	Mould	6/93
32280	Ceramic	Ostracon	4/93
32281	Ceramic	Sherd - worked	
32282	Ceramic	Sherd - worked	
32283	Faience	Bead	
32284	Clay	Jar Seal	
32285	Ceramic	Sherd	
32286	Ceramic	Sherd - worked	
32287	Ceramic	Sherd	
32288	Ceramic	Sherd - worked	
32289	Plaster - lime	Tray	
32290	Stone - sandstone	Fragment	
32291	Stone - sandstone	Fragment	
32292	Plaster - yellow	Fragment	
32293	Frit	Fragment	
32294	Slag	Fragment	
32295	Faience	Bead fragment	
32296	Faience	Tile fragment	
32297	Plaster - yellow	Fragment	
32298	Frit	Fragment	
32299	Slag	Fragment	
32300	Metal - copper/copper alloy	Fragment	
32301	Faience	Bead fragment	
32302	Faience	Bead	
32303	Faience	Bead	
32304	Faience	Bead	
32305	Slag	Fragments	
32306	Metal - copper/copper alloy	Fragment	
32307	Slag	Fragment	
32308	Faience	Tile fragment	
32309	Glass	Fragment	
32310	Plaster - lime	Tray	
32311	Plaster - yellow	Fragment	
32312	Frit	Fragment	
32313	Glass	Fragment	
32314	Mud	Fragment	
32315	Stone - sandstone	Fragment	
32316	Stone - sandstone	Fragment	
32317	Stone - sandstone	Fragment	
32318	Stone - quartzite	Fragment	
32319	Plaster	Fragment	
32320	Sand	Fragment	
32321	Plaster - lime	Tray	
32322	Plaster - yellow	Fragment	
32323	Faience	Bead fragment	
32324	Stone (sandstone)	Fragment	
32325	Metal - copper/copper alloy	Fragment	
32326	Calcareous matrix	Fragment	
32327	Glass	Fragment	
32328	Ceramic	Fragment	
32329	Clay	Kiln Furniture	
32330	Ceramic	Sherd - worked	
32331	Slag	Fragment	
32332	Plaster - yellow	Fragment	
32333	Ceramic	Fragment	
32334	Ceramic	Bat Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
32335	Ceramic	Crucible fragment	
32336	Plaster - yellow	Fragment	
32337	Slag	Fragment	
32338	Ceramic	Crucible fragment	
32339	Plaster	Fragment	
32340	Ceramic	Fragment	
32341	Ceramic	Cylindrical Vessel	
32342	Ceramic	Cylindrical Vessel	
32343	Ceramic	Cylindrical Vessel	
32344	Ceramic	Crucible fragment	
32345	Ceramic	Crucible fragment	
32346	Ceramic	Cylindrical Vessel	
32347	Ceramic	Cylindrical Vessel	
32348	Ceramic	Crucible fragment	
32349	Ceramic	Fragment	
32350	Ceramic	Cylindrical Vessel	
32351	Ceramic	Cylindrical Vessel	
32352	Ceramic	Crucible fragment	
32353	Ceramic	Fragment	
32354	Ceramic	Crucible fragment	
32355	Ceramic	Crucible fragment	
32356	Stone - quartzite	Fragment	
32357	Plaster	Fragment	
32358	Ceramic	Sherd - worked	
32359	Pigment	Fragment	
32360	Ceramic	Mould	
32361	Stone - sandstone	Fragment	
32362	Ceramic	Fragment	
32363	Stone - sandstone	Fragment	
32364	Stone - alabaster	Fragment	
32365	Stone - alabaster	Fragment	
32366	Stone - alabaster	Fragment	
32367	Stone - Banded Sandstone	Fragment	
32368	Stone - alabaster	Fragment	
32369	Stone - quartzite	Fragment	
32370	Stone - quartzite	Fragment	
32371	Stone - sandstone	Fragment	
32372	Stone - quartzite breccia	Fragment	
32373	Pigment	Fragment	
32374	Pigment	Fragment	
32375	Stone - basalt	Pounder fragment	
32376	Stone - basalt	Pounder	
32377	Faience	Tile fragment	
32378	Ceramic	Fragment	
32379	Slag	Fragment	
32380	Slag	Fragment	
32381	Clay	Jar Seal	
32382	Clay	Jar Seal	
32383	Plaster - yellow	Fragment	
32384	Glass	Fragment	
32385	Plaster - yellow	Fragment	
32386	Faience	Tile fragment	
32387	Ceramic	Fragment	
32388	Wood	Fragment	
32389	Stone - sandstone	Fragment	
32390	Slag	Fragment	
32391	Stone - sandstone	Fragment	
32392	Clay	Jar Seal	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
32393	Clay	Jar Seal	
32394	Ceramic	Sherd	
32395	Ceramic	Sherd	
32396	Ceramic	Sherds	
32397	Ceramic	Sherd	
32398	Stone - sandstone	Fragment	
32399	Ceramic	Sherd	
32400	Ceramic	Sherd	
32401	Plaster - lime	Tray	
32402	Stone - sandstone	Fragment	
32403	Ceramic	Sherd	
32404	Ceramic	Sherd	
32405	Ceramic	Sherd - worked	
32406	Ceramic	Sherd - worked	
32407	Stone - granite	Fragment	
32408	Plaster - lime	Tray	
32409	Ceramic	Sherd	
32410	Stone - sandstone	Fragment	
32411	Stone - quartzite	Fragment	
32412	Stone - basalt	Pounder fragment	
32413	Stone - sandstone	Fragment	
32414	Stone - sandstone	Fragment	
32415	Stone - sandstone	Fragment	
32416	Stone - sandstone	Fragment	
32417	Stone - sandstone	Fragment	
32418	Plaster - lime	Tray	
32419	Ceramic	Fragment	
32420	Ceramic	Sherd	
32421	Plaster - lime	Tray	
32422	Stone - sandstone	Fragment	
32423	Stone - sandstone	Fragment	
32424	Stone - sandstone	Fragment	
32425	Ceramic	Sherd - worked	
32426	Plaster - yellow	Fragment	
32427	Ceramic	Cylindrical Vessel	
32428	Ceramic	Fragment	
32429	Ceramic	Beer jar	
32430	Ceramic	Crucible fragment	
33373	Faience	Pendant fragment	
33374	Faience	Bead	
33375	Faience	Bead	
33376	Faience	Bead	
33377	Faience	Bead	
33378	Faience	Bead	
33379	Faience	Bead	
33380	Faience	Bead	
33381	Faience	Bead	
33382	Faience	Bead	
33383	Faience	Inlay fragment	
33384	Faience	Inlay fragment	
33385	Bone	Fragment	
33386	Shell	Fragment	
33387	Faience	Bead	
33388	Faience	Pendant fragment	
33389	Faience	Ring fragment	
33390	Faience	Fragment	
33391	Glass	Fragment	
33392	Stone - calcite	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33393	Clay	Sherd	
33394	Ceramic	Cylindrical Vessel	
33395	Ceramic	Sherd	
33396	Faience	Pendant fragment	
33397	Bone	Fragment	
33398	Stone - alabaster	Fragment	
33399	Bone	Fragment	
33400	Glass	Rod	
33401	Faience	Bead	
33402	Faience	Inlay fragment	
33403	Faience	Inlay fragment	
33404	Faience	Inlay fragment	
33405	Glass	Bead	
33406	Bone	Fragment	
33407	Shell	Fragment	
33408	Metal - copper/copper alloy	Fragment	
33409	Frit	Fragment	
33410	Stone - sandstone	Fragment	
33411	Stone - sandstone	Fragment	
33412	Faience	Bead	
33413	Glass	Fragment	
33414	Faience	Inlay fragment	
33415	Glass	Fragment	
33416	Faience	Inlay fragment	
33417	Faience	Inlay fragment	
33418	Faience	Fragment	
33419	Faience	Fragment	
33420	Faience	Inlay fragment	
33421	Faience	Fragment	
33422	Ceramic - silt	Sherd	
33423	Bone	Fragment	
33424	Faience	Inlay fragment	
33425	Faience	Ring fragment	
33426	Faience	Ring fragment	
33427	Bone	Fragment	
33428	Faience	Bead	
33429	Faience	Bead	
33430	Glass	Fragment	
33431	Glass	Rod	
33432	Glass	Fragment	
33433	Faience	Fragment	
33434	Stone - limestone	Fragment	
33435	Slag (metal)	Fragment	
33436	Bone	Fragment	
33437	Faience	Bead	
33438	Faience	Bead	
33439	Faience	Inlay fragment	
33440	Faience	Inlay fragment	
33441	Faience	Tile fragment	
33442	Stone - sandstone	Fragment	
33443	Metal - copper/copper alloy	Fragment	
33444	Faience	Bead	
33445	Ceramic	Sherd - worked	
33446	Slag	Fragment	
33447	Charcoal	Fragment	
33448	Slag	Fragment	
33449	Bone	Fragment	
33450	Ceramic	Sherd	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33451	Ceramic	Fragment	
33452	Faience	Fragment	
33453	Faience	Inlay fragment	
33454	Faience	Inlay fragment	
33455	Faience	Tile fragment	
33456	Glass	Fragment	
33457	Plaster - lime	Tray	
33458	Plaster - lime	Tray	
33459	Plaster	Fragment	
33460	Ceramic	Cylindrical Vessel	
33461	Ceramic	Cylindrical Vessel	
33462	Ceramic	Cylindrical Vessel	
33463	Charcoal	Fragment	
33464	Shell	Fragment	
33465	Bone	Fragment	
33466	Faience	Inlay fragment	
33467	Faience	Inlay fragment	
33468	Faience	Bead fragment	
33469	Faience	Bead	
33470	Faience	Bead fragment	
33471	Faience	Pendant fragment	
33472	Slag	Fragment	
33473	Metal - copper/copper alloy	Fragment	
33474	Stone - basalt	Pounder	
33475	Charcoal	Fragments	
33476	Bone	Fragment	
33477	Bone	Fragment	
33478	Bone	Fragment	
33479	Shell	Fragment	
33480	Stone - sandstone	Fragment	
33481	Stone - calcareous	Bead	
33482	Ceramic - marl	Sherd - worked	
33483	Metal - copper/copper alloy	Fragment	
33484	Stone	Fragment	
33485	Brick - fired	Fragment	
33486	Ceramic	Crucible fragment	
33487	Faience	Ring fragment	
33488	Faience	Fragment	
33489	Faience	Inlay fragment	
33490	Faience	Inlay fragment	
33491	Faience	Fragment	
33492	Faience	Bead spacer	
33493	Ceramic	Mould	2003/2
33494	Ceramic	Mould	
33495	Ceramic	Mould	2003/3
33496	Ceramic	Fragment	
33497	Ceramic	Cylindrical Vessel	
33498	Stone - quartzite	Fragment	
33499	Stone - quartzite	Fragment	
33500	Ceramic	Fragment	
33501	Stone - quartzite	Fragment	
33502	Stone - quartzite	Fragment	
33503	Charcoal	Fragment	
33504	Shell	Fragment	
33505	Bone	Fragment	
33506	Bone	Tooth	
33507	Stone - granite	Fragment	
33508	Plaster - yellow	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33509	Plaster - yellow	Fragment	
33510	Plaster - yellow	Fragment	
33511	Plaster - yellow	Fragment	
33512	Metal - lead	Battery	
33513	Paper	Postage stamp	
33514	Slag	Fragment	
33515	Metal - copper/copper alloy	Fragment	
33516	Ceramic	Sherd - worked	
33517	Glass	Fragment	
33518	Ceramic	Mould	
33519	Ceramic	Mould	
33520	Faience	Inlay fragment	
33521	Faience	Tile fragment	
33522	Faience	Vessel fragment	
33523	Faience	Tile fragment	
33524	Faience	Inlay fragment	
33525	Faience	Inlay fragment	
33526	Faience	Fragment	
33527	Faience	Tile fragment	
33528	Faience	Ring fragment	
33529	Ceramic - marl	Ostracon	2003/1
33530	Metal - copper/copper alloy	Fragment	
33531	Glass	Fragment	
33532	Shell	Fragment	
33533	Bone	Fragment	
33534	Bone	Fragment	
33535	Bone	Fragment	
33536	Bone	Fragment	
33537	Charcoal	Fragment	
33538	Plaster - yellow	Fragment	
33539	Plaster - yellow	Fragment	
33540	Mud	Seal	
33541	Glass	Fragment	
33542	Glass	Drip	
33543	Plaster - lime	Tray	
33544	Ceramic - silt	Sherd - worked	
33545	Clay - marl	Fragment	
33546	Ceramic	Cylindrical Vessel	
33547	Stone	Undetermined	
33548	Ceramic	Mould	
33549	Stone - carnelian	Fragment	
33550	Stone - carnelian	Fragment	
33551	Slag	Fragment	
33552	Slag	Fragment	
33553	Slag	Fragment	
33554	Slag	Fragment	
33555	Stone - sandstone	Fragment	
33556	Stone - sandstone	Fragment	
33557	Frit	Fragment	
33558	Frit	Fragment	
33559	Frit	Fragment	
33560	Frit	Fragment	
33561	Faience	Bead fragment	
33562	Faience	Bead	
33563	Faience	Tile fragment	
33564	Faience	Tile fragment	
33565	Faience	Fragment	
33566	Faience	Inlay fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33567	Faience	Inlay fragment	
33568	Faience	Tile fragment	
33569	Faience	Fragment	
33570	Faience	Inlay fragment	
33571	Faience	Ring fragment	
33572	Faience	Pendant fragment	
33573	Faience	Pendant fragment	
33574	Bone	Fragment	
33575	Coprolite	Fragment	
33576	Botanical	Fruit	
33577	Botanical	Fruit	
33578	Stone - limestone	Fragment	
33579	Incense	Fragment	
33580	Plaster - yellow	Fragment	
33581	Faience	Bead	
33582	Faience	Bead	
33583	Faience	Bead	
33584	Faience	Bead	
33585	Faience	Bead fragment	
33586	Faience	Bead	
33587	Faience	Bead	
33588	Faience	Bead	
33589	Faience	Bead	
33590	Faience	Bead	
33591	Faience	Bead	
33592	Faience	Bead	
33593	Faience	Bead	
33594	Faience	Bead	
33595	Stone - sandstone	Fragment	
33596	Faience	Pendant fragment	
33597	Faience	Pendant fragment	
33598	Faience	Bead spacer	
33599	Faience	Inlay fragment	
33600	Faience	Inlay fragment	
33601	Faience	Inlay fragment	
33602	Faience	Inlay fragment	
33603	Faience	Inlay fragment	
33604	Faience	Inlay fragment	
33605	Ochre	Fragment	
33606	Frit	Fragment	
33607	Frit	Fragment	
33608	Glass	Glass Fragment	
33609	Glass	Fragment	
33610	Glass	Drip	
33611	Glass	Drip	
33612	Glass	Rod	
33613	Metal - copper/copper alloy	Fragment	
33614	Metal - copper/copper alloy	Fragment	
33615	Glass	Fragment	
33616	Faience	Ring fragment	
33617	Faience	Ring fragment	
33618	Faience	Ring fragment	
33619	Stone - sandstone	Fragment	
33620	Stone - sandstone	Fragment	
33621	Stone - sandstone	Fragment	
33622	Stone - sandstone	Fragment	
33623	Stone - sandstone	Fragment	
33624	Stone - sandstone	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33625	Bone	Fragment	
33626	Bone	Fragment	
33627	Lime	Fragment	
33628	Plaster - yellow	Fragment	
33629	Plaster - yellow	Fragment	
33630	Stone - sandstone	Fragment	
33631	Stone - sandstone	Fragment	
33632	Stone - sandstone	Fragment	
33633	Stone - sandstone	Fragment	
33634	Stone - sandstone	Fragment	
33635	Stone - sandstone	Fragment	
33636	Stone - sandstone	Fragment	
33637	Plaster	Fragment	
33638	Textile	Fragment	
33639	Insect	Fragment	
33640	Stone - sandstone	Fragment	
33641	Slag	Fragment	
33642	Metal - copper/copper alloy	Fragment	
33643	Glass	Rod	
33644	Plaster - lime	Tray	
33645	Clay	Sherd	
33646	Faience	Tile fragment	
33647	Faience	Tile fragment	
33648	Faience	Tile fragment	
33649	Faience	Tile fragment	
33650	Faience	Tile fragment	
33651	Faience	Fragment	
33652	Faience	Ring fragment	
33653	Ceramic	Cylindrical Vessel	
33654	Stone - sandstone	Fragment	
33655	Stone - basalt	Statue fragment	
33656	Stone - sandstone	Fragment	
33657	Bone	Fragment	
33658	Slag	Fragment	
33659	Plaster - yellow	Fragment	
33660	Faience	Ring fragment	
33661	Faience	Fragment	
33662	Faience	Inlay fragment	
33663	Faience	Inlay fragment	
33664	Plaster - yellow	Fragment	
33665	Slag	Fragment	
33666	Charcoal	Fragment	
33667	Stone - sandstone	Fragment	
33668	Stone - sandstone	Fragment	
33669	Plaster - yellow	Fragment	
33670	Slag	Fragment	
33671	Faience	Tile fragment	
33672	Ceramic	Mould	2003/4
33673	Ceramic	Mould	
33674	Ceramic	Mould	
33675	Ceramic	Mould	2003/5
33676	Ceramic	Mould	
33677	Ceramic	Mould	
33678	Ceramic	Mould	2003/6
33679	Bone	Fragment	
33680	Bone	Fragment	
33681	Bone	Fragment	
33682	Bone	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33683	Charcoal	Fragment	
33684	Wood	Fragment	
33685	Shell	Fragment	
33686	Plant fibre	Ball	
33687	Mortar	Fragment	
33688	Stone - sandstone	Fragment	
33689	Stone - granite	Fragment	
33690	Slag	Fragment	
33691	Slag	Fragment	
33692	Frit	Fragment	
33693	Glass	Fragment	
33694	Plaster - yellow	Fragment	
33695	Plaster - yellow	Fragment	
33696	Plaster - yellow	Fragment	
33697	Stone - sandstone	Fragment	
33698	Stone - calcite	Fragment	
33699	Stone - sandstone	Fragment	
33700	Stone - sandstone	Fragment	
33701	Ceramic	Mould	2003/7
33702	Ceramic	Mould	2003/8
33703	Faience	Bead	
33704	Faience	Bead	
33705	Faience	Bead	
33706	Faience	Bead	
33707	Faience	Bead	
33708	Faience	Inlay fragment	
33709	Faience	Inlay fragment	
33710	Faience	Inlay fragment	
33711	Faience	Bead	
33712	Glass	Fragment	
33713	Glass	Fragment	
33714	Glass	Strip	
33715	Glass	Glass Vessel Fragment	
33716	Glass	Strip	
33717	Bone	Fragment	
33718	Bone	Fragment	
33719	Bone	Fragment	
33720	Charcoal	Fragment	
33721	Charcoal	Fragment	
33722	Plant fibre	Ball	
33723	Mortar	Fragment	
33724	Stone - limestone	Fragment	
33725	Stone	Fragment	
33726	Stone	Fragment	
33727	Faience	Bead	
33728	Faience	Inlay fragment	
33729	Glass	Fragment	
33730	Glass	Fragment	
33731	Glass	Fragment	
33732	Metal - copper/copper alloy	Fragment	
33733	Metal - copper/copper alloy	Fragment	
33734	Stone - sandstone	Fragment	
33735	Stone - sandstone	Fragment	
33736	Stone - sandstone	Fragment	
33737	Plaster - yellow	Fragment	
33738	Plaster - yellow	Fragment	
33739	Ceramic - silt	Sherd - worked	
33740	Slag	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33741	Slag	Fragment	
33742	Clay	Pivot	
33743	Faience	Ring fragment	
33744	Glass	Fragment	
33745	Charcoal	Fragment	
33746	Charcoal	Fragment	
33747	Bone	Fragment	
33748	Bone	Fragment	
33749	Bone	Fragment	
33750	Bone	Fragment	
33751	Bone	Fragment	
33752	Glass	Bead	
33753	Faience	Ring fragment	
33754	Faience	Inlay fragment	
33755	Faience	Bead	
33756	Faience	Inlay fragment	
33757	Faience	Inlay fragment	
33758	Faience	Tile fragment	
33759	Faience	Bead	
33760	Faience	Bead	
33761	Faience	Inlay fragment	
33762	Faience	Ring fragment	
33763	Plaster - lime	Tray	
33764	Plaster - lime	Tray	
33765	Plaster - yellow	Fragment	
33766	Plaster - yellow	Fragment	
33767	Orpiment	Fragment	
33768	Stone - quartz	Pebble	
33769	Glass	Fragment	
33770	Ceramic	Mould	
33771	Ceramic	Fragment	
33772	Stone - sandstone	Fragment	
33773	Ceramic	Pendant fragment	
33774	Bone	Fragment	
33775	Charcoal	Fragment	
33776	Wood	Fragment	
33777	Plastic	Bead	
33778	Stone	Pebble	
33779	Stone - quartz	Pebble	
33780	Ceramic - silt	Sherd - worked	
33781	Glass	Strip	
33782	Glass	Rod	
33783	Plastic	Spool	
33784	Stone - sandstone	Fragment	
33785	Ceramic	Mould	
33786	Ceramic - silt	Sherd - worked	
33787	Plastic	Fragment	
33788	Stone - sandstone	Fragment	
33789	Plaster - yellow	Fragment	
33790	Plaster - yellow	Fragment	
33791	Metal - copper/copper alloy	Nail	
33792	Ceramic	Fragment	
33793	Stone - limestone	Fragment	
33794	Agglomerate	Fragment	
33795	Stone - sandstone	Unworked	
33796	Stone - sandstone	Fragment	
33797	Faience	Inlay fragment	
33798	Faience	Inlay fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33799	Faience	Inlay fragment	
33800	Faience	Inlay fragment	
33801	Faience	Inlay fragment	
33802	Faience	Inlay fragment	
33803	Slag	Fragment	
33804	Slag	Fragment	
33805	Stone - sandstone	Fragment	
33806	Stone - sandstone	Fragment	
33807	Shell	Fragment	
33808	Charcoal	Fragment	
33809	Bone	Fragment	
33810	Bone	Fragment	
33811	Bone	Fragment	
33812	Bone	Fragment	
33813	Bone	Fragment	
33814	Bone	Fragment	
33815	Stone - granite	Fragment	
33816	Stone - sandstone	Fragment	
33817	Plaster - yellow	Fragment	
33818	Plaster - lime	Tray	
33819	Plaster - lime	Tray	
33820	Ceramic - silt	Sherd - worked	
33821	Slag	Fragment	
33822	Glass	Fragment	
33823	Ceramic	Mould	
33824	Ceramic	Sherd	
33825	Clay	Undetermined	
33826	Clay	Undetermined	
33827	Clay	Undetermined	
33828	Stone - limestone	Sample	
33829	Clay	Hearth	
33830	Faience	Bead	
33831	Faience	Inlay fragment	
33832	Faience	Inlay fragment	
33833	Faience	Inlay fragment	
33834	Faience	Inlay fragment	
33835	Faience	Tile fragment	
33836	Stone - sandstone	Fragment	
33837	Stone - sandstone	Fragment	
33838	Ceramic	Cylindrical Vessel	
33839	Ceramic	Cylindrical Vessel	
33840	Charcoal	Fragment	
33841	Charcoal	Fragment	
33842	Charcoal	Fragment	
33843	Slag	Fragment	
33844	Slag	Fragment	
33845	Bone	Fragment	
33846	Bone	Fragment	
33847	Bone	Fragment	
33848	Bone	Fragment	
33849	Stone - limestone	Fragment	
33850	Soil	Sample	
33851	Faience	Bead	
33852	Faience	Bead	
33853	Faience	Inlay fragment	
33854	Faience	Inlay fragment	
33855	Insect	Insect Remains	
33856	Plaster - lime	Tray	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33857	Stone - granite	Unworked	
33858	Ceramic	Mould	
33859	Metal - copper/copper alloy	Fragment	
33860	Metal - copper/copper alloy	Needle	
33861	Metal - copper/copper alloy	Fragment	
33862	Plaster - yellow	Fragment	
33863	Clay	Sherd	
33864	Clay	Seal	
33865	Stone - sandstone	Fragment	
33866	Ceramic	Fragment	
33867	Ceramic - silt	Sherd	
33868	Ceramic	Sherd	
33869	Bone	Fragment	
33870	Bone	Fragment	
33871	Bone	Fragment	
33872	Bone	Fragment	
33873	Charcoal	Fragment	
33874	Charcoal	Fragment	
33875	Wood	Fragment	
33876	Feather	Fragment	
33877	Plant fibre	Ball	
33878	Plaster - yellow	Fragment	
33879	Plaster - yellow	Fragment	
33880	Plaster - yellow	Fragment	
33881	Coprolite	Fragment	
33882	Plaster - lime	Tray	
33883	Plaster - lime	Tray	
33884	Metal - copper/copper alloy	Strip	
33885	Metal - copper/copper alloy	Fragment	
33886	Metal - copper/copper alloy	Fragment	
33887	Stone - granite	Fragment	
33888	Stone - sandstone	Fragment	
33889	Frit	Fragment	
33890	Frit	Fragment	
33891	Glass	Rod	
33892	Faience	Bead spacer	
33893	Faience	Bead spacer	
33894	Faience	Inlay fragment	
33895	Faience	Inlay fragment	
33896	Ceramic - marl	Sherd - worked	
33897	Ceramic	Sherd	
33898	Stone - sandstone	Fragment	
33899	Stone	Pebble	
33900	Slag	Fragment	
33901	Stone	Unworked	
33902	Clay	Jar Seal	
33903	Faience	Inlay fragment	2003/9
33904	Faience	Inlay fragment	2003/9
33905	Clay	Jar Seal	2003/10
33906	Faience	Pendant fragment	2003/11
33907	Stone - limestone	Fossil	2003/12
33908	Faience	Inlay fragment	
33909	Bone	Fragment	
33910	Bone	Fragment	
33911	Bone	Fragment	
33912	Bone	Fragment	
33913	Bone	Fragment	
33914	Bone	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33915	Bone	Fragment	
33916	Charcoal	Fragment	
33917	Charcoal	Fragment	
33918	Charcoal	Fragment	
33919	Charcoal	Fragment	
33920	Charcoal	Fragment	
33921	Faience	Bead	
33922	Faience	Bead	
33923	Faience	Bead	
33924	Faience	Bead	
33925	Faience	Bead	
33926	Faience	Bead	
33927	Faience	Bead	
33928	Faience	Fragment	
33929	Faience	Fragment	
33930	Faience	Pendant fragment	
33931	Faience	Pendant fragment	
33932	Faience	Inlay fragment	
33933	Glass	Rod	
33934	Glass	Rod	
33935	Stone - red quartzite	Fragment	
33936	Stone - sandstone	Fragment	
33937	Slag	Fragment	
33938	Charcoal	Fragment	
33939	Charcoal	Fragment	
33940	Charcoal	Fragment	
33941	Charcoal	Fragment	
33942	Bone	Fragment	
33943	Bone	Fragment	
33944	Bone	Fragment	
33945	Bone	Fragment	
33946	Bone	Fragment	
33947	Slag	Fragment	
33948	Plant fibre	Ball	
33949	Insect	Insect Remains	
33950	Insect	Insect Remains	
33951	Frit	Fragment	
33952	Clay	Fragment	
33953	Agglomerate	Fragment	
33954	Agglomerate	Fragment	
33955	Ceramic	Mould	
33956	Stone - sandstone	Unworked	
33957	Stone - sandstone	Fragment	
33958	Stone - quartz	Pebbles	
33959	Glaze	Fragment	
33960	Stone - quartzite	Worked	
33961	Stone - quartzite	Fragment	
33962	Slag	Fragment	
33963	Stone - sandstone	Worked	
33964	Stone - sandstone	Fragment	
33965	Stone - sandstone	Fragment	
33966	Stone - sandstone	Fragment	
33967	Stone - sandstone	Fragment	
33968	Stone - sandstone	Fragment	
33969	Metal - copper/copper alloy	Fragment	
33970	Metal - copper/copper alloy	Fragment	
33971	Metal - copper/copper alloy	Fragment	
33972	Metal - copper/copper alloy	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
33973	Metal - copper/copper alloy	Fragment	
33974	Metal - copper/copper alloy	Fragment	
33975	Metal - copper/copper alloy	Sheet(s)	
33976	Metal - copper/copper alloy	Rod	
33977	Glass	Bead	
33978	Faience	Bead	
33979	Stone	Fossil	
33980	Faience	Inlay fragment	
33981	Ceramic	Cylindrical Vessel	
33982	Plaster - lime	Tray	
33983	Plaster - lime	Tray	
33984	Plaster - yellow	Fragment	
33985	Clay	Jar Seal	
33986	Bone	Fragment	
33987	Bone	Fragment	
33988	Bone	Fragment	
33989	Charcoal	Fragment	
33990	Charcoal	Fragment	
33991	Glass	Bead	
33992	Glass	Fragment	
33993	Glass	Rod	
33994	Stone - quartzite	Fragment	
33995	Stone - sandstone	Fragment	
33996	Faience	Bead	
33997	Faience	Bead	
33998	Faience	Inlay fragment	
33999	Faience	Inlay fragment	
34000	Plaster - yellow	Fragment	
34001	Plaster - yellow	Fragment	
34002	Plaster - yellow	Fragment	
34003	Plaster - yellow	Fragment	
34004	Plaster - yellow	Fragment	
34005	Plaster - yellow	Fragment	
34006	Clay	Jar Seal	
34007	Charcoal	Fragment	
34008	Bone	Fragment	
34009	Bone	Fragment	
34010	Charcoal	Fragment	
34011	Coprolite	Fragment	
34012	Bone	Fragment	
34013	Clay	Jar Seal	
34014	Wood	Fragment	
34015	Hair	Strands	
34016	Frit	Fragment	
34017	Wood	Fragment	
34018	Shell	Fragment	
34019	Stone - sandstone	Fragment	
34020	Glass	Fragment	
34021	Glass	Fragment	
34022	Faience	Bead	
34023	Faience	Bead	
34024	Faience	Ring fragment	
34025	Faience	Inlay fragment	
34026	Faience	Inlay fragment	
34027	Faience	Ring fragment	
34028	Bone	Fragment	
34029	Bone	Fragment	
34030	Bone	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
34031	Skin	Fragment	
34032	Ceramic	Sherd	
34033	Stone - limestone	Fragment	
34034	Stone - limestone	Fragment	
34035	Clay	Fragment	
34036	Glass	Fragment	
34037	Bone	Fragment	
34038	Bone	Fragment	
34039	Bone	Fragment	
34040	Bone	Fragment	
34041	Bone	Fragment	
34042	Bone	Fragment	
34043	Bone	Fragment	
34044	Charcoal	Fragment	
34045	Charcoal	Fragment	
34046	Charcoal	Fragment	
34047	Charcoal	Fragment	
34048	Charcoal	Fragment	
34049	Charcoal	Fragment	
34050	Charcoal	Fragment	
34051	Charcoal	Fragment	
34052	Charcoal	Fragment	
34053	Wood	Fragment	
34054	Wood	Fragment	
34055	Wood	Fragment	
34056	Wood	Fragment	
34057	Wood	Fragment	
34058	Glass	Fragment	
34059	Stone - quartz	Pebble	
34060	Stone - granite	Fragment	
34061	Faience	Inlay fragment	
34062	Faience	Inlay fragment	
34063	Slag	Fragment	
34064	Frit	Fragment	
34065	Frit	Fragment	
34066	Metal - copper/copper alloy	Fragment	
34067	Metal - copper/copper alloy	Fragment	
34068	Metal - copper/copper alloy	Rod	
34069	Plaster - yellow	Fragment	
34070	Plaster - yellow	Fragment	
34071	Plaster - yellow	Fragment	
34072	Stone - sandstone	Fragment	
34073	Stone - sandstone	Fragment	
34074	Metal - copper/copper alloy	Fragment	
34075	Metal - copper/copper alloy	Fragment	
34076	Metal - copper/copper alloy	Fragment	
34077	Ceramic	Cylindrical Vessel	
34078	Stone - sandstone	Fragment	
34079	Plaster - lime	Tray	
34080	Plaster	Fragment	
34081	Plaster - yellow	Fragment	
34082	Plaster - lime	Tray	
34083	Stone - sandstone	Fragment	
34084	Stone - sandstone	Fragment	
34085	Stone - sandstone	Fragment	
34086	Stone - sandstone	Fragment	
34087	Stone - sandstone	Fragment	
34088	Stone - sandstone	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
34089	Stone - sandstone	Fragment	
34090	Stone - quartzite	Worked	
34155	Clay	Fragment	
34156	Clay	Jar Seal	
34157	Ceramic	Sherd	
34158	Ceramic	Sherd	
34159	Ceramic	Sherd	
34160	Ceramic	Sherd	
34161	Clay	Fragment	
34162	Clay	Seal (Docket)	
34163	Clay	Fragment	
34164	Stone - sandstone	Fragment	
34165	Ceramic	Mould	
34166	Ceramic	Mould	
34167	Plaster - yellow	Fragment	
34168	Ceramic	Kiln lining	
34169	Ceramic	Kiln Lining	
34170	Ceramic	Kiln Lining	
34171	Ceramic	Kiln Lining	
34172	Ceramic	Kiln Lining	
34173	Ceramic	Kiln Lining	
34174	Ceramic	Kiln Lining	
34175	Ceramic	Kiln Lining	
34176	Ceramic	Kiln Lining	
34177	Bone	Fragment	
34178	Charcoal	Charcoal	
34179	Stone - Alabaster	Fragment	
34180	Bone	Fragment	
34181	Charcoal	Fragment	
34182	Bone	Fragment	
34183	Charcoal	Fragment	
34184	Charcoal	Fragment	
34185	Charcoal	Charcoal	
34186	Glass	Fragment	
34187	Faience	Bead fragment	
34188	Metal - copper/copper alloy	Fragment	
34189	Clay	Jar Seal	2004/4
34190	Clay	Jar Seal	
34191	Ceramic	Cylindrical Vessel	
34192	Stone - calcite	Fragment	
34195	Stone - limestone	Fragment	
34196	Stone - basalt	Fragment	
34197	Stone - red quartzite	Fragment	
34198	Stone - alabaster	Fragment	
34199	Stone - quartzite	Fragment	
34200	Stone - quartzite	Fragment	
34201	Stone - quartzite	Fragment	
34202	Stone - basalt	Fragment	
34203	Stone - basalt	Fragment	
34204	Stone - granite	Fragment	
34205	Stone - basalt	Fragment	
34206	Plaster - lime	Tray	
34207	Plaster - yellow	Fragment	
34208	Ceramic	Cylindrical Vessel	
34209	Stone - steatite	Fragment	
34210	Metal - copper/copper alloy	Nail	
34211	Slag	Fragment	
34212	Metal - copper/copper alloy	Fragment	

List of finds in numerical order.

Find No	Material 1	Object type	Antiq no
34213	Slag	Fragment	
34214	Frit	Fragment	
34215	Stone - basalt	Pounder	
34216	Plaster	Fragment	
34217	Stone - basalt	Pounder	
34218	Ceramic	Cylindrical Vessel	
34219	Ceramic	Cylindrical Vessel	
34220	Ceramic	Cylindrical vessel	
34221	Ceramic	Crucible fragment	
34222	Plaster - yellow	Fragment	
34223	Ceramic	Crucible fragment	
34224	Ceramic	Fragment	
34225	Metal - copper/copper alloy	Fragment	
34226	Ceramic	Fragment	
34227	Faience	Tile fragment	
34228	Faience	Tile fragment	
34229	Faience	Bead	
34230	Frit	Fragment	
34231	Faience	Bead	
34232	Faience	Amulet	
34233	Plaster - lime	Tray	
34234	Faience	Ring bezel	
34235	Ceramic	Mould	
34236	Ceramic	Mould	
34237	Ceramic	Mould	
34238	Ceramic	Mould	
34239	Ceramic	Mould	
34240	Ceramic	Mould	
34241	Ceramic	Cylindrical Vessel	
34242	Ceramic	Cylindrical Vessel	
34243	Ceramic	Cylindrical Vessel	
34244	Stone - sandstone	Fragment	
34245	Ceramic	Crucible fragment	
34246	Stone - aggregate	Fragment	
34247	Stone - quartz	Fragment	
34248	Stone - quartzite	Fragment	
34249	Faience	Beads	
34250	Faience	Tile fragment	
34251	Faience	Tile fragment	
34252	Stone (sandstone)	Fragment	
34253	Ceramic	Sherd - worked	
34254	Plaster - lime	Tray	
34255	Slag	Fragment	
34256	Clay	Fragment	
34257	Slag	Fragment	
34258	Clay	Jar Seal	
34259	Stone - sandstone	Fragment	
34260	Plaster - yellow	Fragment	
34261	Ceramic	Cylindrical Vessel	
34262	Slag	Fragment	
34263	Slag	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30448	Agglomerate	Fragment	
33794	Agglomerate	Fragment	
33953	Agglomerate	Fragment	
33954	Agglomerate	Fragment	
33385	Bone	Fragment	
33397	Bone	Fragment	
33399	Bone	Fragment	
33406	Bone	Fragment	
33423	Bone	Fragment	
33427	Bone	Fragment	
33436	Bone	Fragment	
33449	Bone	Fragment	
33465	Bone	Fragment	
33476	Bone	Fragment	
33477	Bone	Fragment	
33478	Bone	Fragment	
33505	Bone	Fragment	
33506	Bone	Tooth	
33533	Bone	Fragment	
33534	Bone	Fragment	
33535	Bone	Fragment	
33536	Bone	Fragment	
33574	Bone	Fragment	
33625	Bone	Fragment	
33626	Bone	Fragment	
33657	Bone	Fragment	
33679	Bone	Fragment	
33680	Bone	Fragment	
33681	Bone	Fragment	
33682	Bone	Fragment	
33717	Bone	Fragment	
33718	Bone	Fragment	
33719	Bone	Fragment	
33747	Bone	Fragment	
33748	Bone	Fragment	
33749	Bone	Fragment	
33750	Bone	Fragment	
33751	Bone	Fragment	
33774	Bone	Fragment	
33809	Bone	Fragment	
33810	Bone	Fragment	
33811	Bone	Fragment	
33812	Bone	Fragment	
33813	Bone	Fragment	
33814	Bone	Fragment	
33845	Bone	Fragment	
33846	Bone	Fragment	
33847	Bone	Fragment	
33848	Bone	Fragment	
33869	Bone	Fragment	
33870	Bone	Fragment	
33871	Bone	Fragment	
33872	Bone	Fragment	
33909	Bone	Fragment	
33910	Bone	Fragment	
33911	Bone	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33912	Bone	Fragment	
33913	Bone	Fragment	
33914	Bone	Fragment	
33915	Bone	Fragment	
33942	Bone	Fragment	
33943	Bone	Fragment	
33944	Bone	Fragment	
33945	Bone	Fragment	
33946	Bone	Fragment	
33986	Bone	Fragment	
33987	Bone	Fragment	
33988	Bone	Fragment	
34008	Bone	Fragment	
34009	Bone	Fragment	
34012	Bone	Fragment	
34028	Bone	Fragment	
34029	Bone	Fragment	
34030	Bone	Fragment	
34037	Bone	Fragment	
34038	Bone	Fragment	
34039	Bone	Fragment	
34040	Bone	Fragment	
34041	Bone	Fragment	
34042	Bone	Fragment	
34043	Bone	Fragment	
34177	Bone	Fragment	
34180	Bone	Fragment	
34182	Bone	Fragment	
33576	Botanical	Fruit	
33577	Botanical	Fruit	
33485	Brick - fired	Fragment	
30700	Calcareous matrix	Fragment	
30742	Calcareous matrix	Fragment	
30836	Calcareous matrix	Fragment	
32174	Calcareous Matrix	Fragment	
32244	Calcareous matrix	Fragment	
32326	Calcareous matrix	Fragment	
30594	Cement	Fragment	
30398	Ceramic	Sherd	
30404	Ceramic	Fragment	
30430	Ceramic	Fragment	
30443	Ceramic	Fragment	
30476	Ceramic	Sherd	
30481	Ceramic	Sherd	
30511	Ceramic	Fragment	
30540	Ceramic	Mould	
30547	Ceramic	Mould	94/12
30548	Ceramic	Mould	
30549	Ceramic	Mould	
30550	Ceramic	Cylindrical Vessel	
30576	Ceramic	Sherd - worked	
30577	Ceramic	Sherd - worked	
30580	Ceramic	Sherd - worked	
30591	Ceramic	Fragment	
30593	Ceramic	Sherd - worked	
30612	Ceramic	Sherd - worked	
30616	Ceramic	Sherd	
30637	Ceramic	Mould	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30647	Ceramic	Mould	
30648	Ceramic	Mould	
30649	Ceramic	Mould	
30650	Ceramic	Mould	
30655	Ceramic	Cylindrical Vessel	
30657	Ceramic	Sherd - worked	
30658	Ceramic	Crucible fragment	
30688	Ceramic	Sherd - worked	
30694	Ceramic	Sherd - worked	
30711	Ceramic	Ostracon	93/4
30713	Ceramic	Mould	93/6
30714	Ceramic	Mould	93/6
30715	Ceramic	Mould	6/93
30716	Ceramic	Mould	93/6
30717	Ceramic	Mould	93/6
30718	Ceramic	Mould	93/6
30719	Ceramic	Mould	93/6
30720	Ceramic	Mould	93/6
30721	Ceramic	Mould	93/6
30722	Ceramic	Mould	93/6
30723	Ceramic	Mould	93/6
30724	Ceramic	Mould	93/6
30725	Ceramic	Mould	93/6
30726	Ceramic	Mould	93/6
30727	Ceramic	Mould	93/6
30728	Ceramic	Mould	
30729	Ceramic	Mould	
30749	Ceramic	Mould	
30796	Ceramic	Tool	
30837	Ceramic	Mould	
31466	Ceramic	Sherd - worked	
31469	Ceramic	Sherd - worked	
31472	Ceramic	Fragment	
31477	Ceramic	Fragment	
31481	Ceramic	Fragment	
31482	Ceramic	Sherd - worked	
31496	Ceramic	Fragment	
31517	Ceramic	Sherd - worked	
31587	Ceramic	Sherd	
31607	Ceramic	Sherd - worked	
31608	Ceramic	Sherd - worked	
31609	Ceramic	Sherd - worked	
31611	Ceramic	Sherd - worked	
31615	Ceramic	Sherd - worked	
31617	Ceramic	Fragment	
31618	Ceramic	Fragment	
31620	Ceramic	Fragment	
31623	Ceramic	Sherd	
31630	Ceramic	Sherd	
31633	Ceramic	Fragment	
31635	Ceramic	Sherd - worked	
31650	Ceramic	Cylindrical Vessel	
31656	Ceramic	Fragment	
31657	Ceramic	Sherd	
31658	Ceramic	Fragment	
31660	Ceramic	Mould	
31661	Ceramic	Cylindrical Vessel	
31679	Ceramic	Cylindrical Vessel	
31682	Ceramic	Cylindrical Vessel	

Find No	Material 1	Object type	Antiq no
31691	Ceramic	Cylindrical Vessel	
31692	Ceramic	Crucible fragment	
31725	Ceramic	Mould	
31731	Ceramic	Crucible fragment	
31746	Ceramic	Mould	
31752	Ceramic	Mould	6/98
31754	Ceramic	Fragment	
31759	Ceramic	Fragment	
31774	Ceramic	Crucible fragment	
31776	Ceramic	Fragment	
31783	Ceramic	Sherd	
31794	Ceramic	Mould	
31795	Ceramic	Mould	
31804	Ceramic	Mould	7/98
31817	Ceramic	Cylindrical Vessel	
31818	Ceramic	Sherd	
31826	Ceramic	Mould	
31827	Ceramic	Fragment	
31830	Ceramic	Mould	
31835	Ceramic	Fragment	
31837	Ceramic	Vessel fragment	
31843	Ceramic	Crucible fragment	
31847	Ceramic	Crucible fragment	
31853	Ceramic	Cylindrical Vessel	
31866	Ceramic	Sherd	
31869	Ceramic	Cylindrical Vessel	
31878	Ceramic	Fragment	
31882	Ceramic	Cylindrical Vessel	
31883	Ceramic	Fragment	
31889	Ceramic	Cylindrical Vessel	
31891	Ceramic	Sherd - worked	
31894	Ceramic	Cylindrical Vessel	
31896	Ceramic	Sherd - worked	
31902	Ceramic	Fragment	
31915	Ceramic	Mould	8/98
31917	Ceramic	Mould	98/9
31918	Ceramic	Fragment	
31934	Ceramic	Mould	
31940	Ceramic	Fragment	
31943	Ceramic	Cylindrical Vessel	
31960	Ceramic	Mould	
31961	Ceramic	Fragment	
31962	Ceramic	Crucible fragment	
31963	Ceramic	Cylindrical vessel	
31965	Ceramic	Sherds - worked	
31966	Ceramic	Sherd	
31974	Ceramic	Sherd- worked	
31979	Ceramic	Mould	9/98
31989	Ceramic	Sherd	
31990	Ceramic	Crucible fragment	
31992	Ceramic	Sherd	
32122	Ceramic	Sherd - worked	
32123	Ceramic	Fragment	
32130	Ceramic	Fragment	
32140	Ceramic	Fragment	
32170	Ceramic	Sherd- worked	
32176	Ceramic	Fragment	
32178	Ceramic	Sherds - worked	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
32183	Ceramic	Sherds - worked	
32185	Ceramic	Sherd	
32192	Ceramic	Sherd - worked	
32193	Ceramic	Cylindrical Vessel	
32200	Ceramic	Sherd - worked	
32202	Ceramic	Cylindrical Vessel	
32203	Ceramic	Cylindrical Vessel	
32206	Ceramic	Sherds	
32207	Ceramic	Sherd- worked	
32208	Ceramic	Sherd - worked	
32221	Ceramic	Sherd - worked	
32223	Ceramic	Sherd - worked	
32224	Ceramic	Sherd - worked	
32225	Ceramic	Sherd	
32229	Ceramic	Sherd - worked	
32233	Ceramic	Sherd	
32234	Ceramic	Sherd	
32235	Ceramic	Sherd	
32238	Ceramic	Cylindrical Vessel	
32239	Ceramic	Fragment	
32264	Ceramic	Mould	6/93
32265	Ceramic	Mould	6/93
32266	Ceramic	Mould	6/93
32267	Ceramic	Mould	6/93
32268	Ceramic	Mould	6/93
32269	Ceramic	Mould	6/93
32270	Ceramic	Mould	6/93
32271	Ceramic	Mould	6/93
32273	Ceramic	Mould	6/93
32274	Ceramic	Mould	6/93
32275	Ceramic	Mould	6/93
32276	Ceramic	Mould	6/93
32277	Ceramic	Mould	6/93
32278	Ceramic	Mould	6/93
32279	Ceramic	Mould	6/93
32280	Ceramic	Ostracon	4/93
32281	Ceramic	Sherd - worked	
32282	Ceramic	Sherd - worked	
32285	Ceramic	Sherd	
32286	Ceramic	Sherd - worked	
32287	Ceramic	Sherd	
32288	Ceramic	Sherd - worked	
32328	Ceramic	Fragment	
32330	Ceramic	Sherd - worked	
32333	Ceramic	Fragment	
32334	Ceramic	Bat Fragment	
32335	Ceramic	Crucible fragment	
32338	Ceramic	Crucible fragment	
32340	Ceramic	Fragment	
32341	Ceramic	Cylindrical Vessel	
32342	Ceramic	Cylindrical Vessel	
32343	Ceramic	Cylindrical Vessel	
32344	Ceramic	Crucible fragment	
32345	Ceramic	Crucible fragment	
32346	Ceramic	Cylindrical Vessel	
32347	Ceramic	Cylindrical Vessel	
32348	Ceramic	Crucible fragment	
32349	Ceramic	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
32350	Ceramic	Cylindrical Vessel	
32351	Ceramic	Cylindrical Vessel	
32352	Ceramic	Crucible fragment	
32353	Ceramic	Fragment	
32354	Ceramic	Crucible fragment	
32355	Ceramic	Crucible fragment	
32358	Ceramic	Sherd - worked	
32360	Ceramic	Mould	
32362	Ceramic	Fragment	
32378	Ceramic	Fragment	
32387	Ceramic	Fragment	
32394	Ceramic	Sherd	
32395	Ceramic	Sherd	
32396	Ceramic	Sherds	
32397	Ceramic	Sherd	
32399	Ceramic	Sherd	
32400	Ceramic	Sherd	
32403	Ceramic	Sherd	
32404	Ceramic	Sherd	
32405	Ceramic	Sherd - worked	
32406	Ceramic	Sherd - worked	
32409	Ceramic	Sherd	
32419	Ceramic	Fragment	
32420	Ceramic	Sherd	
32425	Ceramic	Sherd - worked	
32427	Ceramic	Cylindrical Vessel	
32428	Ceramic	Fragment	
32429	Ceramic	Beer jar	
32430	Ceramic	Crucible fragment	
33394	Ceramic	Cylindrical Vessel	
33395	Ceramic	Sherd	
33445	Ceramic	Sherd - worked	
33450	Ceramic	Sherd	
33451	Ceramic	Fragment	
33460	Ceramic	Cylindrical Vessel	
33461	Ceramic	Cylindrical Vessel	
33462	Ceramic	Cylindrical Vessel	
33486	Ceramic	Crucible fragment	
33493	Ceramic	Mould	2003/2
33494	Ceramic	Mould	
33495	Ceramic	Mould	2003/3
33496	Ceramic	Fragment	
33497	Ceramic	Cylindrical Vessel	
33500	Ceramic	Fragment	
33516	Ceramic	Sherd - worked	
33518	Ceramic	Mould	
33519	Ceramic	Mould	
33546	Ceramic	Cylindrical Vessel	
33548	Ceramic	Mould	
33653	Ceramic	Cylindrical Vessel	
33672	Ceramic	Mould	2003/4
33673	Ceramic	Mould	
33674	Ceramic	Mould	
33675	Ceramic	Mould	2003/5
33676	Ceramic	Mould	
33677	Ceramic	Mould	
33678	Ceramic	Mould	2003/6
33701	Ceramic	Mould	2003/7

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33702	Ceramic	Mould	2003/8
33770	Ceramic	Mould	
33771	Ceramic	Fragment	
33773	Ceramic	Pendant fragment	
33785	Ceramic	Mould	
33792	Ceramic	Fragment	
33823	Ceramic	Mould	
33824	Ceramic	Sherd	
33838	Ceramic	Cylindrical Vessel	
33839	Ceramic	Cylindrical Vessel	
33858	Ceramic	Mould	
33866	Ceramic	Fragment	
33868	Ceramic	Sherd	
33897	Ceramic	Sherd	
33955	Ceramic	Mould	
33981	Ceramic	Cylindrical Vessel	
34032	Ceramic	Sherd	
34077	Ceramic	Cylindrical Vessel	
34157	Ceramic	Sherd	
34158	Ceramic	Sherd	
34159	Ceramic	Sherd	
34160	Ceramic	Sherd	
34165	Ceramic	Mould	
34166	Ceramic	Mould	
34168	Ceramic	Kiln lining	
34169	Ceramic	Kiln Lining	
34170	Ceramic	Kiln Lining	
34171	Ceramic	Kiln Lining	
34172	Ceramic	Kiln Lining	
34173	Ceramic	Kiln Lining	
34174	Ceramic	Kiln Lining	
34175	Ceramic	Kiln Lining	
34176	Ceramic	Kiln Lining	
34191	Ceramic	Cylindrical Vessel	
34208	Ceramic	Cylindrical Vessel	
34218	Ceramic	Cylindrical Vessel	
34219	Ceramic	Cylindrical Vessel	
34220	Ceramic	Cylindrical vessel	
34221	Ceramic	Crucible fragment	
34223	Ceramic	Crucible fragment	
34224	Ceramic	Fragment	
34226	Ceramic	Fragment	
34235	Ceramic	Mould	
34236	Ceramic	Mould	
34237	Ceramic	Mould	
34238	Ceramic	Mould	
34239	Ceramic	Mould	
34240	Ceramic	Mould	
34241	Ceramic	Cylindrical Vessel	
34242	Ceramic	Cylindrical Vessel	
34243	Ceramic	Cylindrical Vessel	
34245	Ceramic	Crucible fragment	
34253	Ceramic	Sherd - worked	
34261	Ceramic	Cylindrical Vessel	
31655	Ceramic - marl	Sherd - worked	
31708	Ceramic - marl	Sherd - worked	
31784	Ceramic - marl	Sherd - worked	
33482	Ceramic - marl	Sherd - worked	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33529	Ceramic - marl	Ostracon	2003/1
33896	Ceramic - marl	Sherd - worked	
30656	Ceramic - silt	Cylindrical Vessel	
30699	Ceramic - silt	Fragment	
30854	Ceramic - silt	Sherd	
31610	Ceramic - silt	Sherd - worked	
31612	Ceramic - silt	Sherd - worked	
31613	Ceramic - silt	Sherd - worked	
31614	Ceramic - silt	Sherd - worked	
31619	Ceramic - silt	Sherd - worked	
31640	Ceramic - silt	Fragment	
31647	Ceramic - silt	Sherd - worked	
31681	Ceramic - silt	Cylindrical Vessel	
31689	Ceramic - silt	Sherd - worked	
31705	Ceramic - silt	Sherd - worked	
31706	Ceramic - silt	Sherd - worked	
31707	Ceramic - silt	Sherd - worked	
31734	Ceramic - silt	Sherd - worked	
31765	Ceramic - silt	Sherd - worked	
31777	Ceramic - silt	Cylindrical Vessel	
31792	Ceramic - silt	Cylindrical Vessel	
31815	Ceramic - silt	Sherd - worked	
31816	Ceramic - silt	Cylindrical Vessel	
31879	Ceramic - silt	Sherds - worked	
31948	Ceramic - silt	Sherd - worked	
33422	Ceramic - silt	Sherd	
33544	Ceramic - silt	Sherd - worked	
33739	Ceramic - silt	Sherd - worked	
33780	Ceramic - silt	Sherd - worked	
33786	Ceramic - silt	Sherd - worked	
33820	Ceramic - silt	Sherd - worked	
33867	Ceramic - silt	Sherd	
33447	Charcoal	Fragment	
33463	Charcoal	Fragment	
33475	Charcoal	Fragments	
33503	Charcoal	Fragment	
33537	Charcoal	Fragment	
33666	Charcoal	Fragment	
33683	Charcoal	Fragment	
33720	Charcoal	Fragment	
33721	Charcoal	Fragment	
33745	Charcoal	Fragment	
33746	Charcoal	Fragment	
33775	Charcoal	Fragment	
33808	Charcoal	Fragment	
33840	Charcoal	Fragment	
33841	Charcoal	Fragment	
33842	Charcoal	Fragment	
33873	Charcoal	Fragment	
33874	Charcoal	Fragment	
33916	Charcoal	Fragment	
33917	Charcoal	Fragment	
33918	Charcoal	Fragment	
33919	Charcoal	Fragment	
33920	Charcoal	Fragment	
33938	Charcoal	Fragment	
33939	Charcoal	Fragment	
33940	Charcoal	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33941	Charcoal	Fragment	
33989	Charcoal	Fragment	
33990	Charcoal	Fragment	
34007	Charcoal	Fragment	
34010	Charcoal	Fragment	
34044	Charcoal	Fragment	
34045	Charcoal	Fragment	
34046	Charcoal	Fragment	
34047	Charcoal	Fragment	
34048	Charcoal	Fragment	
34049	Charcoal	Fragment	
34050	Charcoal	Fragment	
34051	Charcoal	Fragment	
34052	Charcoal	Fragment	
34178	Charcoal	Charcoal	
34181	Charcoal	Fragment	
34183	Charcoal	Fragment	
34184	Charcoal	Fragment	
34185	Charcoal	Charcoal	
30478	Clay	Kiln furniture	
30479	Clay	Kiln furniture	
30497	Clay	Seal (Docket)	
30570	Clay	Jar Seal	2004/1
30587	Clay	Seal (Docket)	
30615	Clay	Seal	
30689	Clay	Lime matrix	
30707	Clay	Bead	
30789	Clay	Jar Seal	94/14
30801	Clay	Bead	
30822	Clay	Fragment	
30838	Clay	Jar Seal	94/13
30839	Clay	Jar Seal	2004/2
30840	Clay	Jar Seal	
30841	Clay	Jar Seal	
31514	Clay	Ball	
31636	Clay	Sherd	
31877	Clay	Sherd	
31886	Clay	Jar Seal	
31887	Clay	Jar Seal	
31888	Clay	Jar Seal	
31893	Clay	Jar Seal	
31895	Clay	Sherd	
31923	Clay	Sherd	
31931	Clay	Fragment- unfired	
31958	Clay	Sherd	
31964	Clay	Sherd	
31973	Clay	Mould	
32171	Clay	Jar Seal	
32172	Clay	Jar Seal	
32173	Clay	Fragment	
32182	Clay	Jar Seal	
32218	Clay	Jar Seal	2004/3
32231	Clay	Jar Seal	
32236	Clay	Fragment	
32246	Clay	Seal (Docket)	
32284	Clay	Jar Seal	
32329	Clay	Kiln Furniture	
32381	Clay	Jar Seal	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
32382	Clay	Jar Seal	
32392	Clay	Jar Seal	
32393	Clay	Jar Seal	
33393	Clay	Sherd	
33645	Clay	Sherd	
33742	Clay	Pivot	
33825	Clay	Undetermined	
33826	Clay	Undetermined	
33827	Clay	Undetermined	
33829	Clay	Hearth	
33863	Clay	Sherd	
33864	Clay	Seal	
33902	Clay	Jar Seal	
33905	Clay	Jar Seal	2003/10
33952	Clay	Fragment	
33985	Clay	Jar Seal	
34006	Clay	Jar Seal	
34013	Clay	Jar Seal	
34035	Clay	Fragment	
34155	Clay	Fragment	
34156	Clay	Jar Seal	
34161	Clay	Fragment	
34162	Clay	Seal (Docket)	
34163	Clay	Fragment	
34189	Clay	Jar Seal	2004/4
34190	Clay	Jar Seal	
34256	Clay	Fragment	
34258	Clay	Jar Seal	
33545	Clay - marl	Fragment	
31659	Clay - silt	Fragment	
31678	Clay - silt	Fragment	
31704	Clay - unfired	Fragment	
31753	Clay - unfired	Sherd	
31793	Clay - unfired	Fragment	
32245	Concretion	Fragment	
32167	Copper Corrosion	Fragment	
33575	Coprolite	Fragment	
33881	Coprolite	Fragment	
34011	Coprolite	Fragment	
3055?	Faience	Amulet	
30353	Faience	Tile fragment	
30355	Faience	Ring fragment	
30359	Faience	Ring fragment	
30364	Faience	Bead	
30365	Faience	Bead	
30366	Faience	Bead	
30367	Faience	Bead fragment	
30368	Faience	Bead	
30373	Faience	Tile fragment	
30375	Faience	Ring fragment	
30377	Faience	Bead	
30378	Faience	Bead	
30380	Faience	Bead	
30381	Faience	Drip	
30382	Faience	Bead	
30385	Faience	Bead	
30386	Faience	Bead	
30387	Faience	Tile fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30388	Faience	Bead	
30389	Faience	Bead	
30390	Faience	Bead fragment	
30391	Faience	Bead	
30392	Faience	Bead	
30394	Faience	Strip	
30397	Faience	Bead	
30401	Faience	Bead	
30405	Faience	Bead fragment	
30406	Faience	Bead	
30408	Faience	Bead	
30410	Faience	Tile fragment	
30416	Faience	Tile fragment	
30418	Faience	Bead	
30420	Faience	Bead	
30421	Faience	Bead	
30426	Faience	Tile fragment	
30431	Faience	Bead fragment	
30434	Faience	Ring fragment	
30438	Faience	Bead	
30439	Faience	Tile fragment	
30440	Faience	Fragment	
30444	Faience	Bead	
30445	Faience	Tile fragment	
30446	Faience	Bead	
30449	Faience	Bead	
30450	Faience	Bead	
30451	Faience	Pendant fragment	
30452	Faience	Tile fragment	
30453	Faience	Pendant fragment	
30457	Faience	Bead	
30458	Faience	Bead	
30465	Faience	Tile fragment	
30466	Faience	Bead	
30472	Faience	Bead	
30473	Faience	Ring fragment	
30475	Faience	Bead fragment	
30480	Faience	Bead	
30484	Faience	Bead	
30487	Faience	Bead	
30490	Faience	Fragment	
30493	Faience	Tile fragment	
30494	Faience	Inlay fragment	
30495	Faience	Tile fragment	
30500	Faience	Tile fragment	
30501	Faience	Bead	
30502	Faience	Bead	
30503	Faience	Bead fragment	
30504	Faience	Ring fragment	
30505	Faience	Ring fragment	
30506	Faience	Bead	
30508	Faience	Bead fragment	
30509	Faience	Tile fragment	
30512	Faience	Tile fragment	
30518	Faience	Tile fragment	
30519	Faience	Bead fragment	
30520	Faience	Ring fragment	
30521	Faience	Bead fragment	

Find No	Material 1	Object type	Antiq no
30522	Faience	Bead fragment	
30524	Faience	Bead	
30527	Faience	Tile fragment	
30528	Faience	Bead	
30532	Faience	Tile fragment	
30539	Faience	Bead fragment	
30541	Faience	Ring fragment	
30542	Faience	Pendant fragment	
30543	Faience	Pendant	
30551	Faience	Amulet	
30552	Faience	Amulet	
30553	Faience	Ring fragment	
30555	Faience	Tile fragment	
30558	Faience	Tile fragment	
30561	Faience	Bead fragment	
30564	Faience	Tile fragment	
30565	Faience	Bead	
30566	Faience	Tile fragment	
30569	Faience	Ring fragment	
30595	Faience	Tile fragment	
30596	Faience	Ring fragment	
30597	Faience	Pendant fragment	
30603	Faience	Ring fragment	
30605	Faience	Pendant fragment	
30606	Faience	Ring fragment	
30608	Faience	Tile fragment	
30617	Faience	Tile fragment	
30619	Faience	Bead	
30621	Faience	Bead fragment	
30629	Faience	Bead	
30630	Faience	Bead	
30631	Faience	Bead	
30634	Faience	Inlay fragment	
30635	Faience	Tile fragment	
30651	Faience	Tile fragment	
30659	Faience	Bead	
30660	Faience	Tile fragment	
30661	Faience	Bead	
30667	Faience	Drip	
30668	Faience	Bead	
30670	Faience	Bead	
30671	Faience	Bead fragment	
30673	Faience	Bead	
30681	Faience	Bead	
30682	Faience	Bead	
30684	Faience	Inlay fragment	
30692	Faience	Bead	
30693	Faience	Bead	
30697	Faience	Tile fragment	
30705	Faience	Ring fragment	
30706	Faience	Bead	
30709	Faience	Bead	
30712	Faience	Amulet	93/5
30738	Faience	Bead	
30739	Faience	Bead fragment	
30740	Faience	Bead	
30741	Faience	Bead	
30744	Faience	Bead fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30745	Faience	Bead	
30746	Faience	Tile fragment	
30750	Faience	Bead	
30751	Faience	Tile fragment	
30757	Faience	Bead	
30758	Faience	Tile fragment	
30759	Faience	Bead	
30764	Faience	Pendant fragment	
30768	Faience	Bead	
30769	Faience	Bead fragment	
30770	Faience	Tile fragment	
30771	Faience	Pendant fragment	
30772	Faience	Bead	
30773	Faience	Bead	
30774	Faience	Bead	
30775	Faience	Bead	
30779	Faience	Bead	
30783	Faience	Pendant fragment	
30784	Faience	Bead	
30785	Faience	Tile fragment	
30798	Faience	Tile fragment	
30800	Faience	Bead	
30802	Faience	Bead	
30803	Faience	Bead	
30805	Faience	Bead	
30808	Faience	Bead	
30809	Faience	Pendant fragment	
30810	Faience	Drip	
30811	Faience	Fragment	
30812	Faience	Tile fragment	
30831	Faience	Bead fragment	
30832	Faience	Bead	
30833	Faience	Bead	
30834	Faience	Drip	
30835	Faience	Bead	
30843	Faience	Tile fragment	
30844	Faience	Tile fragment	
30845	Faience	Bead	
30847	Faience	Tile fragment	
30850	Faience	Bead spacer	
30855	Faience	Tile fragment	
30857	Faience	Bead	
30860	Faience	Bead	
30894	Faience	Tile fragment	
31470	Faience	Tile fragment	
31487	Faience	Tile fragment	
31512	Faience	Bead fragment	
31513	Faience	Tile fragment	
31534	Faience	Tile fragment	
31535	Faience	Bead	
31536	Faience	Bead	
31538	Faience	Bead	
31540	Faience	Tile fragment	
31541	Faience	Bead	
31542	Faience	Bead	
31543	Faience	Bead	
31544	Faience	Bead	
31545	Faience	Bead	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
31546	Faience	Tile fragment	
31547	Faience	Tile fragment	
31548	Faience	Bead fragment	
31549	Faience	Bead	
31551	Faience	Bead	
31552	Faience	Bead	
31553	Faience	Bead	
31554	Faience	Bead	
31558	Faience	Pendant fragment	
31573	Faience	Fragment	
31579	Faience	Tile fragment	
31580	Faience	Bead	
31581	Faience	Bead	
31583	Faience	Bead	
31586	Faience	Tile fragment	
31603	Faience	Tile fragment	
31605	Faience	Bead	
31622	Faience	Tile fragment	
31624	Faience	Bead	
31625	Faience	Bead	
31626	Faience	Bead	
31628	Faience	Tile fragment	
31629	Faience	Tile fragment	
31637	Faience	Tile fragment	
31638	Faience	Tile fragment	
31641	Faience	Bead	
31643	Faience	Inlay fragment	
31645	Faience	Bead	
31646	Faience	Bead fragment	
31663	Faience	Tile fragment	
31666	Faience	Tile fragment	
31667	Faience	Bead	
31668	Faience	Bead	
31669	Faience	Bead	
31670	Faience	Bead fragment	
31671	Faience	Bead fragment	
31672	Faience	Bead	
31673	Faience	Bead	
31674	Faience	Bead	
31675	Faience	Ring Fragment	
31676	Faience	Tile fragment	
31677	Faience	Ring fragment	
31685	Faience	Tile fragment	
31693	Faience	Inlay fragment	
31695	Faience	Tile fragment	
31696	Faience	Ring fragment	
31697	Faience	Bead	
31701	Faience	Bead	
31702	Faience	Bead	
31710	Faience	Tile fragment	
31712	Faience	Earring fragment	
31715	Faience	Bead fragment	
31719	Faience	Tile fragment	
31720	Faience	Ring fragment	
31721	Faience	Bead fragment	
31722	Faience	Bead	
31723	Faience	Tile fragment	
31724	Faience	Bead	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
31726	Faience	Tile fragment	
31727	Faience	Tile fragment	
31735	Faience	Tile fragment	
31736	Faience	Tile fragment	
31737	Faience	Bead	
31755	Faience	Tile fragment	
31756	Faience	Bead	
31757	Faience	Bead fragment	
31761	Faience	Tile fragment	
31762	Faience	Inlay fragment	
31763	Faience	Vessel fragment	
31772	Faience	Ring fragment	
31796	Faience	Tile fragment	
31806	Faience	Vessel fragment	
31807	Faience	Tile fragment	
31812	Faience	Pendant fragment	
31819	Faience	Tile fragment	
31822	Faience	Tile fragment	
31823	Faience	Ring fragment	
31824	Faience	Bead	
31825	Faience	Tile fragment	
31831	Faience	Bead	
31832	Faience	Tile fragment	
31849	Faience	Tile fragment	
31857	Faience	Tile fragment	
31859	Faience	Tile fragment	
31865	Faience	Ring fragment	
31870	Faience	Ring fragment	
31871	Faience	Bead	
31873	Faience	Bead fragment	
31874	Faience	Tile fragment	
31876	Faience	Amulet	
31897	Faience	Tile fragment	
31899	Faience	Tile fragment	
31900	Faience	Tile fragment	
31903	Faience	Pendant fragment	
31907	Faience	Beads	
31909	Faience	Bead fragment	
31912	Faience	Tile fragment	
31914	Faience	Tile fragment	
31925	Faience	Ring fragment	
31926	Faience	Tile fragment	
31927	Faience	Bead	
31935	Faience	Bead	
31936	Faience	Bead	
31947	Faience	Tile fragment	
31951	Faience	Bead	
31953	Faience	Fragment	
31955	Faience	Tile fragment	
31957	Faience	Tile fragment	
31986	Faience	Tile fragment	
31987	Faience	Tile fragment	
31998	Faience	Tile fragment	
31999	Faience	Tile fragment	
32098	Faience	Tile fragment	
32099	Faience	Ring fragment	
32101	Faience	Bead fragment	
32105	Faience	Tile fragment	

Find No	Material 1	Object type	Antiq no
32106	Faience	Bead fragment	
32107	Faience	Ring fragment	
32111	Faience	Ring fragment	
32112	Faience	Tile fragment	
32113	Faience	Bead	
32114	Faience	Tile fragment	
32141	Faience	Pendant fragment	
32152	Faience	Tile fragment	
32153	Faience	Bead	
32164	Faience	Bead	
32256	Faience	Tile fragment	
32260	Faience	Tile fragment	
32272	Faience	Amulet	5/93
32283	Faience	Bead	
32295	Faience	Bead fragment	
32296	Faience	Tile fragment	
32301	Faience	Bead fragment	
32302	Faience	Bead	
32303	Faience	Bead	
32304	Faience	Bead	
32308	Faience	Tile fragment	
32323	Faience	Bead fragment	
32377	Faience	Tile fragment	
32386	Faience	Tile fragment	
33373	Faience	Pendant fragment	
33374	Faience	Bead	
33375	Faience	Bead	
33376	Faience	Bead	
33377	Faience	Bead	
33378	Faience	Bead	
33379	Faience	Bead	
33380	Faience	Bead	
33381	Faience	Bead	
33382	Faience	Bead	
33383	Faience	Inlay fragment	
33384	Faience	Inlay fragment	
33387	Faience	Bead	
33388	Faience	Pendant fragment	
33389	Faience	Ring fragment	
33390	Faience	Fragment	
33396	Faience	Pendant fragment	
33401	Faience	Bead	
33402	Faience	Inlay fragment	
33403	Faience	Inlay fragment	
33404	Faience	Inlay fragment	
33412	Faience	Bead	
33414	Faience	Inlay fragment	
33416	Faience	Inlay fragment	
33417	Faience	Inlay fragment	
33418	Faience	Fragment	
33419	Faience	Fragment	
33420	Faience	Inlay fragment	
33421	Faience	Fragment	
33424	Faience	Inlay fragment	
33425	Faience	Ring fragment	
33426	Faience	Ring fragment	
33428	Faience	Bead	
33429	Faience	Bead	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33433	Faience	Fragment	
33437	Faience	Bead	
33438	Faience	Bead	
33439	Faience	Inlay fragment	
33440	Faience	Inlay fragment	
33441	Faience	Tile fragment	
33444	Faience	Bead	
33452	Faience	Fragment	
33453	Faience	Inlay fragment	
33454	Faience	Inlay fragment	
33455	Faience	Tile fragment	
33466	Faience	Inlay fragment	
33467	Faience	Inlay fragment	
33468	Faience	Bead fragment	
33469	Faience	Bead	
33470	Faience	Bead fragment	
33471	Faience	Pendant fragment	
33487	Faience	Ring fragment	
33488	Faience	Fragment	
33489	Faience	Inlay fragment	
33490	Faience	Inlay fragment	
33491	Faience	Fragment	
33492	Faience	Bead spacer	
33520	Faience	Inlay fragment	
33521	Faience	Tile fragment	
33522	Faience	Vessel fragment	
33523	Faience	Tile fragment	
33524	Faience	Inlay fragment	
33525	Faience	Inlay fragment	
33526	Faience	Fragment	
33527	Faience	Tile fragment	
33528	Faience	Ring fragment	
33561	Faience	Bead fragment	
33562	Faience	Bead	
33563	Faience	Tile fragment	
33564	Faience	Tile fragment	
33565	Faience	Fragment	
33566	Faience	Inlay fragment	
33567	Faience	Inlay fragment	
33568	Faience	Tile fragment	
33569	Faience	Fragment	
33570	Faience	Inlay fragment	
33571	Faience	Ring fragment	
33572	Faience	Pendant fragment	
33573	Faience	Pendant fragment	
33581	Faience	Bead	
33582	Faience	Bead	
33583	Faience	Bead	
33584	Faience	Bead	
33585	Faience	Bead fragment	
33586	Faience	Bead	
33587	Faience	Bead	
33588	Faience	Bead	
33589	Faience	Bead	
33590	Faience	Bead	
33591	Faience	Bead	
33592	Faience	Bead	
33593	Faience	Bead	

Find No	Material 1	Object type	Antiq no
33594	Faience	Bead	
33596	Faience	Pendant fragment	
33597	Faience	Pendant fragment	
33598	Faience	Bead spacer	
33599	Faience	Inlay fragment	
33600	Faience	Inlay fragment	
33601	Faience	Inlay fragment	
33602	Faience	Inlay fragment	
33603	Faience	Inlay fragment	
33604	Faience	Inlay fragment	
33616	Faience	Ring fragment	
33617	Faience	Ring fragment	
33618	Faience	Ring fragment	
33646	Faience	Tile fragment	
33647	Faience	Tile fragment	
33648	Faience	Tile fragment	
33649	Faience	Tile fragment	
33650	Faience	Tile fragment	
33651	Faience	Fragment	
33652	Faience	Ring fragment	
33660	Faience	Ring fragment	
33661	Faience	Fragment	
33662	Faience	Inlay fragment	
33663	Faience	Inlay fragment	
33671	Faience	Tile fragment	
33703	Faience	Bead	
33704	Faience	Bead	
33705	Faience	Bead	
33706	Faience	Bead	
33707	Faience	Bead	
33708	Faience	Inlay fragment	
33709	Faience	Inlay fragment	
33710	Faience	Inlay fragment	
33711	Faience	Bead	
33727	Faience	Bead	
33728	Faience	Inlay fragment	
33743	Faience	Ring fragment	
33753	Faience	Ring fragment	
33754	Faience	Inlay fragment	
33755	Faience	Bead	
33756	Faience	Inlay fragment	
33757	Faience	Inlay fragment	
33758	Faience	Tile fragment	
33759	Faience	Bead	
33760	Faience	Bead	
33761	Faience	Inlay fragment	
33762	Faience	Ring fragment	
33797	Faience	Inlay fragment	
33798	Faience	Inlay fragment	
33799	Faience	Inlay fragment	
33800	Faience	Inlay fragment	
33801	Faience	Inlay fragment	
33802	Faience	Inlay fragment	
33830	Faience	Bead	
33831	Faience	Inlay fragment	
33832	Faience	Inlay fragment	
33833	Faience	Inlay fragment	
33834	Faience	Inlay fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33835	Faience	Tile fragment	
33851	Faience	Bead	
33852	Faience	Bead	
33853	Faience	Inlay fragment	
33854	Faience	Inlay fragment	
33892	Faience	Bead spacer	
33893	Faience	Bead spacer	
33894	Faience	Inlay fragment	
33895	Faience	Inlay fragment	
33903	Faience	Inlay fragment	2003/9
33904	Faience	Inlay fragment	2003/9
33906	Faience	Pendant fragment	2003/11
33908	Faience	Inlay fragment	
33921	Faience	Bead	
33922	Faience	Bead	
33923	Faience	Bead	
33924	Faience	Bead	
33925	Faience	Bead	
33926	Faience	Bead	
33927	Faience	Bead	
33928	Faience	Fragment	
33929	Faience	Fragment	
33930	Faience	Pendant fragment	
33931	Faience	Pendant fragment	
33932	Faience	Inlay fragment	
33978	Faience	Bead	
33980	Faience	Inlay fragment	
33996	Faience	Bead	
33997	Faience	Bead	
33998	Faience	Inlay fragment	
33999	Faience	Inlay fragment	
34022	Faience	Bead	
34023	Faience	Bead	
34024	Faience	Ring fragment	
34025	Faience	Inlay fragment	
34026	Faience	Inlay fragment	
34027	Faience	Ring fragment	
34061	Faience	Inlay fragment	
34062	Faience	Inlay fragment	
34187	Faience	Bead fragment	
34227	Faience	Tile fragment	
34228	Faience	Tile fragment	
34229	Faience	Bead	
34231	Faience	Bead	
34232	Faience	Amulet	
34234	Faience	Ring bezel	
34249	Faience	Beads	
34250	Faience	Tile fragment	
34251	Faience	Tile fragment	
33876	Feather	Fragment	
30371	Frit	Fragment	
30399	Frit	Fragment	
30441	Frit	Fragment	
30515	Frit	Fragment	
30531	Frit	Fragment	
30533	Frit	Fragment	
30538	Frit	Fragment	
30638	Frit	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30654	Frit	Fragment	
30762	Frit	Fragment	
30778	Frit	Fragment	
30793	Frit	Fragment	
31519	Frit	Fragment	
31570	Frit	Fragment	
31601	Frit	Fragment	
31653	Frit	Fragment	
31698	Frit	Fragment	
31717	Frit	Fragment	
31741	Frit	Fragment	
31781	Frit	Fragment	
31834	Frit	Fragment	
31848	Frit	Fragment	
31864	Frit	Fragment	
31928	Frit	Fragment	
31933	Frit	Fragments	
31997	Frit	Fragment	
32102	Frit	Fragment	
32154	Frit	Fragment	
32258	Frit	Fragment	
32262	Frit	Fragment	
32293	Frit	Fragment	
32298	Frit	Fragment	
32312	Frit	Fragment	
33409	Frit	Fragment	
33557	Frit	Fragment	
33558	Frit	Fragment	
33559	Frit	Fragment	
33560	Frit	Fragment	
33606	Frit	Fragment	
33607	Frit	Fragment	
33692	Frit	Fragment	
33889	Frit	Fragment	
33890	Frit	Fragment	
33951	Frit	Fragment	
34016	Frit	Fragment	
34064	Frit	Fragment	
34065	Frit	Fragment	
34214	Frit	Fragment	
34230	Frit	Fragment	
30352	Glass	Drip	
30357	Glass	Fragment	
30360	Glass	Fragment	
30361	Glass	Fragment	
30362	Glass	Ring fragment	
30369	Glass	Fragment	
30370	Glass	Drip	
30372	Glass	Fragment	
30379	Glass	Bead	
30383	Glass	Tile fragment	
30395	Glass	Bead	
30396	Glass	Fragment	
30400	Glass	Rod	
30403	Glass	Fragment	
30411	Glass	Fragment	
30413	Glass	Fragment	
30417	Glass	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30428	Glass	Fragment	
30432	Glass	Bead	
30433	Glass	Fragment	
30455	Glass	Fragments	
30470	Glass	Fragment	
30474	Glass	Bead	
30483	Glass	Fragment	
30486	Glass	Strip	
30488	Glass	Fragment	
30491	Glass	Fragment	
30525	Glass	Fragment	
30526	Glass	Ring fragment	
30529	Glass	Bead	
30535	Glass	Ring fragment	
30557	Glass	Fragment	
30560	Glass	Fragment	
30598	Glass	Fragment	
30600	Glass	Fragment	
30601	Glass	Fragment	
30604	Glass	Glass Vessel Fragment	
30607	Glass	Ring fragment	
30618	Glass	Fragment	
30620	Glass	Bead fragment	
30622	Glass	Bead	
30623	Glass	Bead	
30624	Glass	Bead	
30625	Glass	Strip	
30626	Glass	Fragment	
30628	Glass	Bead	
30641	Glass	Fragment	
30642	Glass	Strip	
30643	Glass	Fragment	
30665	Glass	Fragment	
30666	Glass	Fragment	
30669	Glass	Fragment	
30672	Glass	Bead fragment	
30674	Glass	Fragment	
30675	Glass	Rod	
30677	Glass	Rod	
30679	Glass	Fragment	
30680	Glass	Fragment	
30686	Glass	Bead	
30687	Glass	Bead fragment	
30690	Glass	Fragment	
30696	Glass	Strip	
30704	Glass	Bead	
30708	Glass	Fragment	
30710	Glass	Fragment	
30734	Glass	Strip	
30735	Glass	Fragment	
30736	Glass	Drip	
30737	Glass	Fragment	
30747	Glass	Fragment	
30754	Glass	Fragment	
30755	Glass	Fragment	
30761	Glass	Fragment	
30763	Glass	Fragment	
30776	Glass	Fragment	

Find No	Material 1	Object type	Antiq no
30780	Glass	Fragment	
30788	Glass	Rod	
30790	Glass	Fragments	
30791	Glass	Fragment	
30792	Glass	Droplet	
30794	Glass	Fragment	
30804	Glass	Bead	
30806	Glass	Bead	
30807	Glass	Bead	
30813	Glass	Fragment	
30816	Glass	Fragment	
30817	Glass	Fragment	
30820	Glass	Fragment	
30821	Glass	Fragment	
30824	Glass	Fragment	
30825	Glass	Fragment	
30826	Glass	Rod	
30827	Glass	Pendant fragment	
30828	Glass	Fragment	
30829	Glass	Fragment	
30830	Glass	Fragment	
30848	Glass	Bead	
30849	Glass	Fragment	
30856	Glass	Fragment	
30861	Glass	Strip	
30862	Glass	Fragment	
31490	Glass	Fragment	
31491	Glass	Fragment	
31492	Glass	Fragment	
31493	Glass	Fragment	
31529	Glass	Fragment	
31550	Glass	Fragment	
31557	Glass	Fragment	
31563	Glass	Fragment	
31564	Glass	Fragment	
31565	Glass	Fragment	
31566	Glass	Fragment	
31567	Glass	Fragment	
31569	Glass	Fragment	
31575	Glass	Fragment	
31577	Glass	Fragment	
31578	Glass	Rod	
31584	Glass	Pincer piece	
31585	Glass	Fragment	
31604	Glass	Fragment	
31627	Glass	Inlay fragment	
31634	Glass	Fragment	
31642	Glass	Bead	
31644	Glass	Strip	
31651	Glass	Fragment	
31684	Glass	Rod	
31699	Glass	Inlay fragment	
31700	Glass	Fragment	
31711	Glass	Fragment	
31714	Glass	Fragment	
31716	Glass	Bead fragment	
31718	Glass	Fragment	
31730	Glass	Rod	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
31738	Glass	Fragment	
31742	Glass	Fragment	
31747	Glass	Fragment	
31748	Glass	Fragment	
31751	Glass	Bead fragment	
31768	Glass	Fragment	
31785	Glass	Fragment	
31786	Glass	Fragment	
31787	Glass	Fragment	
31788	Glass	Fragment	
31791	Glass	Fragment	
31805	Glass	Glass Vessel Fragment	
31810	Glass	Rod	
31821	Glass	Fragment	
31829	Glass	Strip	
31851	Glass	Fragment	
31860	Glass	Strip	
31861	Glass	Rod	
31868	Glass	Fragment	
31905	Glass	Fragment	
31908	Glass	Strip	
31930	Glass	Fragment	
31932	Glass	Fragment	
31939	Glass	Bead	
31942	Glass	Fragment	
31975	Glass	Fragment	
31978	Glass	Rod	
32000	Glass	Bead	
32103	Glass	Fragment	
32104	Glass	Rod	
32115	Glass	Fragment	
32149	Glass	Fragment	
32162	Glass	Fragment	
32163	Glass	Fragment	
32253	Glass	Fragment	
32259	Glass	Fragment	
32309	Glass	Fragment	
32313	Glass	Fragment	
32327	Glass	Fragment	
32384	Glass	Fragment	
33391	Glass	Fragment	
33400	Glass	Rod	
33405	Glass	Bead	
33413	Glass	Fragment	
33415	Glass	Fragment	
33430	Glass	Fragment	
33431	Glass	Rod	
33432	Glass	Fragment	
33456	Glass	Fragment	
33517	Glass	Fragment	
33531	Glass	Fragment	
33541	Glass	Fragment	
33542	Glass	Drip	
33608	Glass	Fragment	
33609	Glass	Fragment	
33610	Glass	Drip	
33611	Glass	Drip	
33612	Glass	Rod	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33615	Glass	Fragment	
33643	Glass	Rod	
33693	Glass	Fragment	
33712	Glass	Fragment	
33713	Glass	Fragment	
33714	Glass	Strip	
33715	Glass	Glass Vessel Fragment	
33716	Glass	Strip	
33729	Glass	Fragment	
33730	Glass	Fragment	
33731	Glass	Fragment	
33744	Glass	Fragment	
33752	Glass	Bead	
33769	Glass	Fragment	
33781	Glass	Strip	
33782	Glass	Rod	
33822	Glass	Fragment	
33891	Glass	Rod	
33933	Glass	Rod	
33934	Glass	Rod	
33977	Glass	Bead	
33991	Glass	Bead	
33992	Glass	Fragment	
33993	Glass	Rod	
34020	Glass	Fragment	
34021	Glass	Fragment	
34036	Glass	Fragment	
34058	Glass	Fragment	
34186	Glass	Fragment	
31732	Glaze	Fragment	
33959	Glaze	Fragment	
34015	Hair	Strands	
33579	Incense	Fragment	
33639	Insect	Fragment	
33855	Insect	Insect Remains	
33949	Insect	Insect Remains	
33950	Insect	Insect Remains	
31596	Lime	Fragment	
31950	Lime	Cast	
33627	Lime	Fragment	
30384	Metal - copper/copper alloy	Fragment	
30409	Metal - copper/copper alloy	Amulet	
30435	Metal - copper/copper alloy	Bullet	
30437	Metal - copper/copper alloy	Strip	
30459	Metal - copper/copper alloy	Strip	
30463	Metal - copper/copper alloy	Fragment	
30482	Metal - copper/copper alloy	Fragment	
30507	Metal - copper/copper alloy	Strip	
30514	Metal - copper/copper alloy	Fragment	
30536	Metal - copper/copper alloy	Fragment	
30544	Metal - copper/copper alloy	Fragment	
30545	Metal - copper/copper alloy	Fragment	
30559	Metal - copper/copper alloy	Fragment	
30563	Metal - copper/copper alloy	Fragment	
30599	Metal - copper/copper alloy	Fragment	
30636	Metal - copper/copper alloy	Strip	
30664	Metal - copper/copper alloy	Fragment	
30678	Metal - copper/copper alloy	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30702	Metal - copper/copper alloy	Fragment	
30753	Metal - copper/copper alloy	Fragment	
30756	Metal - copper/copper alloy	Tube	
30767	Metal - copper/copper alloy	Fragment	
30797	Metal - copper/copper alloy	Fragment	
30818	Metal - copper/copper alloy	Fragment	
30819	Metal - copper/copper alloy	Fragment	
30823	Metal - copper/copper alloy	Fragment	
30853	Metal - copper/copper alloy	Fragment	
30858	Metal - copper/copper alloy	Wire	
30859	Metal - copper/copper alloy	Strip	
31471	Metal - copper/copper alloy	Strip	
31475	Metal - copper/copper alloy	Fragment	
31476	Metal - copper/copper alloy	Fragment	
31479	Metal - copper/copper alloy	Fragment	
31522	Metal - copper/copper alloy	Fragment	
31537	Metal - copper/copper alloy	Fragment	
31568	Metal - copper/copper alloy	Fragment	
31582	Metal - copper/copper alloy	Fragment	
31664	Metal - copper/copper alloy	Rod	
31688	Metal - copper/copper alloy	Fragment	
31703	Metal - copper/copper alloy	Rod	
31739	Metal - copper/copper alloy	Strip	
31773	Metal - copper/copper alloy	Fragment	
31808	Metal - copper/copper alloy	Fragment	
31863	Metal - copper/copper alloy	Fragment	
31875	Metal - copper/copper alloy	Sheet/strip fragment	
31906	Metal - copper/copper alloy	Fragment	
31920	Metal - copper/copper alloy	Fragment	
31945	Metal - copper/copper alloy	Fragment	
31952	Metal - copper/copper alloy	Rod	
31954	Metal - copper/copper alloy	Fragment	
32127	Metal - copper/copper alloy	Fragment	
32142	Metal - copper/copper alloy	Fragment	
32150	Metal - copper/copper alloy	Fragment	
32254	Metal - copper/copper alloy	Fragment	
32263	Metal - copper/copper alloy	Fragment	
32300	Metal - copper/copper alloy	Fragment	
32306	Metal - copper/copper alloy	Fragment	
32325	Metal - copper/copper alloy	Fragment	
33408	Metal - copper/copper alloy	Fragment	
33443	Metal - copper/copper alloy	Fragment	
33473	Metal - copper/copper alloy	Fragment	
33483	Metal - copper/copper alloy	Fragment	
33515	Metal - copper/copper alloy	Fragment	
33530	Metal - copper/copper alloy	Fragment	
33613	Metal - copper/copper alloy	Fragment	
33614	Metal - copper/copper alloy	Fragment	
33642	Metal - copper/copper alloy	Fragment	
33732	Metal - copper/copper alloy	Fragment	
33733	Metal - copper/copper alloy	Fragment	
33791	Metal - copper/copper alloy	Nail	
33859	Metal - copper/copper alloy	Fragment	
33860	Metal - copper/copper alloy	Needle	
33861	Metal - copper/copper alloy	Fragment	
33884	Metal - copper/copper alloy	Strip	
33885	Metal - copper/copper alloy	Fragment	
33886	Metal - copper/copper alloy	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33969	Metal - copper/copper alloy	Fragment	
33970	Metal - copper/copper alloy	Fragment	
33971	Metal - copper/copper alloy	Fragment	
33972	Metal - copper/copper alloy	Fragment	
33973	Metal - copper/copper alloy	Fragment	
33974	Metal - copper/copper alloy	Fragment	
33975	Metal - copper/copper alloy	Sheet(s)	
33976	Metal - copper/copper alloy	Rod	
34066	Metal - copper/copper alloy	Fragment	
34067	Metal - copper/copper alloy	Fragment	
34068	Metal - copper/copper alloy	Rod	
34074	Metal - copper/copper alloy	Fragment	
34075	Metal - copper/copper alloy	Fragment	
34076	Metal - copper/copper alloy	Fragment	
34188	Metal - copper/copper alloy	Fragment	
34210	Metal - copper/copper alloy	Nail	
34212	Metal - copper/copper alloy	Fragment	
34225	Metal - copper/copper alloy	Fragment	
30460	Metal - iron	Nail	
30609	Metal - iron	Nail	
33512	Metal - lead	Battery	
30730	Metal - silver	Fragment	
31769	Metal - tin	Wire	
31949	Mortar	Fragment	
33687	Mortar	Fragment	
33723	Mortar	Fragment	
32212	Mud	Fragment	
32220	Mud	Brick	
32314	Mud	Fragment	
33540	Mud	Seal	
30489	Mud brick	Fragment	
30492	Mud brick	Fragment	
33605	Ochre	Fragment	
33767	Orpiment	Fragment	
30846	Paper	Cigarette wrapper(s)	
33513	Paper	Postage stamp	
30523	Pigment	Fragment	
31520	Pigment	Fragment	
31521	Pigment	Fragment	
31523	Pigment	Fragment	
31555	Pigment	Fragment	
31631	Pigment	Fragment	
31639	Pigment	Fragment	
31683	Pigment	Fragment	
31687	Pigment	Fragment	
31728	Pigment	Fragment	
31740	Pigment	Fragment	
31813	Pigment	Fragment	
31828	Pigment	Fragment	
31833	Pigment	Fragment	
31845	Pigment	Fragment	
31898	Pigment	Fragment	
31901	Pigment	Fragments	
31916	Pigment	Fragment	
31981	Pigment	Fragments	
31991	Pigment	Fragment	
31996	Pigment	Fragment	
32109	Pigment	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
32117	Pigment	Fragment	
32119	Pigment	Fragment	
32120	Pigment	Fragment	
32136	Pigment	Fragment	
32148	Pigment	Fragment	
32175	Pigment	Fragment	
32359	Pigment	Fragment	
32373	Pigment	Fragment	
32374	Pigment	Fragment	
33686	Plant fibre	Ball	
33722	Plant fibre	Ball	
33877	Plant fibre	Ball	
33948	Plant fibre	Ball	
30351	Plaster	Fragment	
30376	Plaster	Fragment	
30467	Plaster	Fragment	
30496	Plaster	Fragment	
30498	Plaster	Fragment	
30513	Plaster	Fragment	
30517	Plaster	Fragment	
30652	Plaster	Fragment	
31483	Plaster	Fragment	
31485	Plaster	Fragment	
31494	Plaster	Fragment	
31528	Plaster	Fragment	
31760	Plaster	Fragment	
31803	Plaster	Fragment	
31910	Plaster	Fragment	
31972	Plaster	Fragments	
31976	Plaster	Fragment	
32169	Plaster	Fragment	
32237	Plaster	Fragment	
32252	Plaster	Fragment	
32319	Plaster	Fragment	
32339	Plaster	Fragment	
32357	Plaster	Fragment	
33459	Plaster	Fragment	
33637	Plaster	Fragment	
34080	Plaster	Fragment	
34216	Plaster	Fragment	
30402	Plaster - lime	Tray	
30412	Plaster - lime	Tray	
30471	Plaster - lime	Tray	
30554	Plaster - lime	Tray	
30556	Plaster - lime	Tray	
30574	Plaster - lime	Tray	
30578	Plaster - lime	Tray	
30592	Plaster - lime	Tray	
30613	Plaster - lime	Tray	
30695	Plaster - lime	Tray	
30782	Plaster - lime	Tray	
30786	Plaster - lime	Tray	
30842	Plaster - lime	Tray	
31468	Plaster - lime	Tray	
31507	Plaster - lime	Tray	
31508	Plaster - lime	Tray	
31509	Plaster - lime	Tray	
31515	Plaster - lime	Tray	

Find No	Material 1	Object type	Antiq no
31524	Plaster - lime	Tray	
31572	Plaster - lime	Tray	
31574	Plaster - lime	Tray	
31606	Plaster - lime	Tray	
31616	Plaster - lime	Tray	
31890	Plaster - lime	Tray	
31982	Plaster - lime	Tray	
32124	Plaster - lime	Tray	
32125	Plaster - lime	Tray	
32134	Plaster - lime	Tray	
32138	Plaster - lime	Tray	
32143	Plaster - lime	Tray	
32179	Plaster - lime	Tray	
32187	Plaster - lime	Tray	
32191	Plaster - lime	Tray	
32199	Plaster - lime	Fragment	
32226	Plaster - lime	Fragment	
32241	Plaster - lime	Tray	
32289	Plaster - lime	Tray	
32310	Plaster - lime	Tray	
32321	Plaster - lime	Tray	
32401	Plaster - lime	Tray	
32408	Plaster - lime	Tray	
32418	Plaster - lime	Tray	
32421	Plaster - lime	Tray	
33457	Plaster - lime	Tray	
33458	Plaster - lime	Tray	
33543	Plaster - lime	Tray	
33644	Plaster - lime	Tray	
33763	Plaster - lime	Tray	
33764	Plaster - lime	Tray	
33818	Plaster - lime	Tray	
33819	Plaster - lime	Tray	
33856	Plaster - lime	Tray	
33882	Plaster - lime	Tray	
33883	Plaster - lime	Tray	
33982	Plaster - lime	Tray	
33983	Plaster - lime	Tray	
34079	Plaster - lime	Tray	
34082	Plaster - lime	Tray	
34206	Plaster - lime	Tray	
34233	Plaster - lime	Tray	
34254	Plaster - lime	Tray	
30454	Plaster - yellow	Fragment	
30456	Plaster - yellow	Fragment	
30464	Plaster - yellow	Fragment	
30510	Plaster - yellow	Fragment	
30516	Plaster - yellow	Fragment	
30546	Plaster - yellow	Fragment	
30582	Plaster - yellow	Fragment	
30602	Plaster - yellow	Fragment	
30611	Plaster - yellow	Fragment	
30633	Plaster - yellow	Fragment	
30644	Plaster - yellow	Fragment	
30683	Plaster - yellow	Fragment	
30703	Plaster - yellow	Fragment	
30752	Plaster - yellow	Fragment	
30766	Plaster - yellow	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30781	Plaster - yellow	Fragment	
30787	Plaster - yellow	Fragment	
30799	Plaster - yellow	Fragment	
30814	Plaster - yellow	Fragment	
30815	Plaster - yellow	Fragments	
31473	Plaster - yellow	Fragment	
31474	Plaster - yellow	Fragment	
31478	Plaster - yellow	Fragment	
31484	Plaster - yellow	Fragment	
31486	Plaster - yellow	Fragment	
31495	Plaster - yellow	Fragment	
31498	Plaster - yellow	Fragment	
31499	Plaster - yellow	Fragment	
31500	Plaster - yellow	Fragment	
31503	Plaster - yellow	Fragment	
31504	Plaster - yellow	Fragment	
31505	Plaster - yellow	Fragment	
31506	Plaster - yellow	Fragment	
31511	Plaster - yellow	Fragment	
31516	Plaster - yellow	Fragment	
31525	Plaster - yellow	Fragment	
31526	Plaster - yellow	Fragment	
31527	Plaster - yellow	Fragment	
31530	Plaster - yellow	Fragment	
31531	Plaster - yellow	Fragment	
31532	Plaster - yellow	Fragment	
31533	Plaster - yellow	Fragment	
31576	Plaster - yellow	Fragment	
31588	Plaster - yellow	Fragment	
31589	Plaster - yellow	Fragment	
31592	Plaster - yellow	Fragment	
31593	Plaster - yellow	Fragment	
31594	Plaster - yellow	Fragment	
31595	Plaster - yellow	Fragment	
31597	Plaster - yellow	Fragment	
31598	Plaster - yellow	Fragment	
31600	Plaster - yellow	Fragment	
31602	Plaster - yellow	Fragment	
31621	Plaster - yellow	Fragment	
31648	Plaster - yellow	Fragment	
31654	Plaster - yellow	Fragment	
31662	Plaster - yellow	Fragment	
31665	Plaster - yellow	Fragment	
31680	Plaster - yellow	Fragment	
31686	Plaster - yellow	Fragment	
31694	Plaster - yellow	Fragment	
31713	Plaster - yellow	Fragment	
31733	Plaster - yellow	Fragment	
31743	Plaster - yellow	Fragment	
31744	Plaster - yellow	Fragment	
31745	Plaster - yellow	Fragment	
31749	Plaster - yellow	Fragment	
31764	Plaster - yellow	Fragment	
31766	Plaster - yellow	Fragment	
31767	Plaster - yellow	Fragment	
31778	Plaster - yellow	Fragment	
31789	Plaster - yellow	Fragment	
31797	Plaster - yellow	Fragment	

Find No	Material 1	Object type	Antiq no
31799	Plaster - yellow	Fragment	
31800	Plaster - yellow	Fragment	
31801	Plaster - yellow	Fragment	
31802	Plaster - yellow	Fragment	
31811	Plaster - yellow	Fragment	
31814	Plaster - yellow	Fragment	
31820	Plaster - yellow	Fragment	
31839	Plaster - yellow	Vitrified fragment	
31842	Plaster - yellow	Fragment	
31844	Plaster - yellow	Fragment	
31850	Plaster - yellow	Fragment	
31856	Plaster - yellow	Fragment	
31862	Plaster - yellow	Fragment	
31867	Plaster - yellow	Fragment	
31872	Plaster - yellow	Fragment	
31880	Plaster - yellow	Fragment	
31881	Plaster - yellow	Fragment	
31904	Plaster - yellow	Fragment	
31911	Plaster - yellow	Fragment	
31921	Plaster - yellow	Fragment	
31924	Plaster - yellow	Fragment	
31956	Plaster - yellow	Fragments	
31959	Plaster - yellow	Fragment	
31968	Plaster - yellow	Fragment	
31970	Plaster - yellow	Fragment	
31983	Plaster - yellow	Fragment	
31993	Plaster - yellow	Fragment	
31994	Plaster - yellow	Fragment	
32094	Plaster - yellow	Fragment	
32095	Plaster - yellow	Fragment	
32096	Plaster - yellow	Fragment	
32110	Plaster - yellow	Fragment	
32128	Plaster - yellow	Fragment	
32129	Plaster - yellow	Fragment	
32133	Plaster - yellow	Fragment	
32137	Plaster - yellow	Fragment	
32146	Plaster - yellow	Fragment	
32147	Plaster - yellow	Fragment	
32166	Plaster - yellow	Fragment	
32180	Plaster - yellow	Fragment	
32181	Plaster - yellow	Fragment	
32243	Plaster - yellow	Fragment	
32255	Plaster - yellow	Fragment	
32292	Plaster - yellow	Fragment	
32297	Plaster - yellow	Fragment	
32311	Plaster - yellow	Fragment	
32322	Plaster - yellow	Fragment	
32332	Plaster - yellow	Fragment	
32336	Plaster - yellow	Fragment	
32383	Plaster - yellow	Fragment	
32385	Plaster - yellow	Fragment	
32426	Plaster - yellow	Fragment	
33508	Plaster - yellow	Fragment	
33509	Plaster - yellow	Fragment	
33510	Plaster - yellow	Fragment	
33511	Plaster - yellow	Fragment	
33538	Plaster - yellow	Fragment	
33539	Plaster - yellow	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33580	Plaster - yellow	Fragment	
33628	Plaster - yellow	Fragment	
33629	Plaster - yellow	Fragment	
33659	Plaster - yellow	Fragment	
33664	Plaster - yellow	Fragment	
33669	Plaster - yellow	Fragment	
33694	Plaster - yellow	Fragment	
33695	Plaster - yellow	Fragment	
33696	Plaster - yellow	Fragment	
33737	Plaster - yellow	Fragment	
33738	Plaster - yellow	Fragment	
33765	Plaster - yellow	Fragment	
33766	Plaster - yellow	Fragment	
33789	Plaster - yellow	Fragment	
33790	Plaster - yellow	Fragment	
33817	Plaster - yellow	Fragment	
33862	Plaster - yellow	Fragment	
33878	Plaster - yellow	Fragment	
33879	Plaster - yellow	Fragment	
33880	Plaster - yellow	Fragment	
33984	Plaster - yellow	Fragment	
34000	Plaster - yellow	Fragment	
34001	Plaster - yellow	Fragment	
34002	Plaster - yellow	Fragment	
34003	Plaster - yellow	Fragment	
34004	Plaster - yellow	Fragment	
34005	Plaster - yellow	Fragment	
34069	Plaster - yellow	Fragment	
34070	Plaster - yellow	Fragment	
34071	Plaster - yellow	Fragment	
34081	Plaster - yellow	Fragment	
34167	Plaster - yellow	Fragment	
34207	Plaster - yellow	Fragment	
34222	Plaster - yellow	Fragment	
34260	Plaster - yellow	Fragment	
31571	Plaster (yellow)	Fragment	
31944	Plaster- white	Sculpture(s)	
31798	Plaster- yellow	Fragment	
33777	Plastic	Bead	
33783	Plastic	Spool	
33787	Plastic	Fragment	
31790	Rope	Knot	
31518	Sand	Fragment	
32320	Sand	Fragment	
33386	Shell	Fragment	
33407	Shell	Fragment	
33464	Shell	Fragment	
33479	Shell	Fragment	
33504	Shell	Fragment	
33532	Shell	Fragment	
33685	Shell	Fragment	
33807	Shell	Fragment	
34018	Shell	Fragment	
34031	Skin	Fragment	
30354	Slag	Droplet	
30356	Slag	Fragment	
30407	Slag	Fragment	
30424	Slag	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
30436	Slag	Droplet	
30447	Slag	Fragment	
30461	Slag	Fragment	
30499	Slag	Fragment	
30534	Slag	Fragment	
30537	Slag	Fragment	
30583	Slag	Fragment	
30589	Slag	Fragment	
30639	Slag	Fragment	
30701	Slag	Fragment	
30732	Slag	Fragment	
30777	Slag	Fragment	
31510	Slag	Fragment	
31729	Slag	Fragment	
31750	Slag	Fragment	
31758	Slag	Fragment	
31770	Slag	Fragment	
31771	Slag	Fragment	
31782	Slag	Fragment	
31809	Slag	Fragment	
31840	Slag	Fragment	
31841	Slag	Fragment	
31852	Slag	Fragment	
31854	Slag	Fragment	
31855	Slag	Fragment	
31858	Slag	Fragment	
31913	Slag	Fragment	
31919	Slag	Fragment	
31922	Slag	Fragment	
31929	Slag	Fragment	
31937	Slag	Fragment	
31946	Slag	Fragment	
31971	Slag	Fragment	
31977	Slag	Fragment	
31995	Slag	Fragment	
32097	Slag	Fragment	
32100	Slag	Fragments	
32108	Slag	Droplet	
32131	Slag	Fragment	
32132	Slag	Fragment	
32135	Slag	Fragment	
32151	Slag	Fragment	
32157	Slag	Fragment	
32158	Slag	Fragment	
32160	Slag	Fragment	
32161	Slag	Fragment	
32168	Slag	Fragment	
32201	Slag	Fragment	
32209	Slag	Fragment	
32240	Slag	Fragment	
32251	Slag	Fragment	
32261	Slag	Fragment	
32294	Slag	Fragment	
32299	Slag	Fragment	
32305	Slag	Fragments	
32307	Slag	Fragment	
32331	Slag	Fragment	
32337	Slag	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
32379	Slag	Fragment	
32380	Slag	Fragment	
32390	Slag	Fragment	
33446	Slag	Fragment	
33448	Slag	Fragment	
33472	Slag	Fragment	
33514	Slag	Fragment	
33551	Slag	Fragment	
33552	Slag	Fragment	
33553	Slag	Fragment	
33554	Slag	Fragment	
33641	Slag	Fragment	
33658	Slag	Fragment	
33665	Slag	Fragment	
33670	Slag	Fragment	
33690	Slag	Fragment	
33691	Slag	Fragment	
33740	Slag	Fragment	
33741	Slag	Fragment	
33803	Slag	Fragment	
33804	Slag	Fragment	
33821	Slag	Fragment	
33843	Slag	Fragment	
33844	Slag	Fragment	
33900	Slag	Fragment	
33937	Slag	Fragment	
33947	Slag	Fragment	
33962	Slag	Fragment	
34063	Slag	Fragment	
34211	Slag	Fragment	
34213	Slag	Fragment	
34255	Slag	Fragment	
34257	Slag	Fragment	
34262	Slag	Fragment	
34263	Slag	Fragment	
33435	Slag (metal)	Fragment	
33850	Soil	Sample	
30423	Stone	Fragment	
31941	Stone	Fragment	
32121	Stone	Tool	
33484	Stone	Fragment	
33547	Stone	Undetermined	
33725	Stone	Fragment	
33726	Stone	Fragment	
33778	Stone	Pebble	
33899	Stone	Pebble	
33901	Stone	Unworked	
33979	Stone	Fossil	
34246	Stone - aggregate	Fragment	
30610	Stone - alabaster	Stopper/Lid	
30691	Stone - alabaster	Fragment	
31467	Stone - alabaster	Fragment	
31539	Stone - alabaster	Fragment	
31980	Stone - alabaster	Statue fragment	
32364	Stone - alabaster	Fragment	
32365	Stone - alabaster	Fragment	
32366	Stone - alabaster	Fragment	
32368	Stone - alabaster	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33398	Stone - alabaster	Fragment	
34179	Stone - Alabaster	Fragment	
34198	Stone - alabaster	Fragment	
32367	Stone - Banded Sandstone	Fragment	
31836	Stone - basalt	Pounder	
31985	Stone - basalt	Pounder	
32118	Stone - basalt	Tool	
32214	Stone - basalt	Pounder	
32375	Stone - basalt	Pounder fragment	
32376	Stone - basalt	Pounder	
32412	Stone - basalt	Pounder fragment	
33474	Stone - basalt	Pounder	
33655	Stone - basalt	Statue fragment	
34196	Stone - basalt	Fragment	
34202	Stone - basalt	Fragment	
34203	Stone - basalt	Fragment	
34205	Stone - basalt	Fragment	
34215	Stone - basalt	Pounder	
34217	Stone - basalt	Pounder	
33481	Stone - calcareous	Bead	
30627	Stone - calcite	Fragment	
33392	Stone - calcite	Fragment	
33698	Stone - calcite	Fragment	
34192	Stone - calcite	Fragment	
30442	Stone - carnelian	Bead	
31779	Stone - carnelian	Fragment	
33549	Stone - carnelian	Fragment	
33550	Stone - carnelian	Fragment	
31489	Stone - chert	Fragment	
31632	Stone - chert	Fragment	
31690	Stone - chert	Flake	
31988	Stone - chert	Fragment	
30462	Stone - flint	Fragment	
32190	Stone - flint	Worked Stone	
30581	Stone - granite	Quernstone fragment(s)	
32211	Stone - granite	Fragment	
32213	Stone - granite	Fragment	
32216	Stone - granite	Fragment	
32222	Stone - granite	Fragment	
32227	Stone - granite	Fragment	
32242	Stone - granite	Fragment	
32407	Stone - granite	Fragment	
33507	Stone - granite	Fragment	
33689	Stone - granite	Fragment	
33815	Stone - granite	Fragment	
33857	Stone - granite	Unworked	
33887	Stone - granite	Fragment	
34060	Stone - granite	Fragment	
34204	Stone - granite	Fragment	
31846	Stone - gypsum	Cast	
30748	Stone - limestone	Sculpture(s)	
31501	Stone - limestone	Fragment	
31649	Stone - limestone	Fragment	
31652	Stone - limestone	Spindle whorl fragment(s)	
31884	Stone - limestone	Fragment	
31885	Stone - limestone	Statue fragment	
31969	Stone - limestone	Fragment	
32210	Stone - limestone	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33434	Stone - limestone	Fragment	
33578	Stone - limestone	Fragment	
33724	Stone - limestone	Fragment	
33793	Stone - limestone	Fragment	
33828	Stone - limestone	Sample	
33849	Stone - limestone	Fragment	
33907	Stone - limestone	Fossil	2003/12
34033	Stone - limestone	Fragment	
34034	Stone - limestone	Fragment	
34195	Stone - limestone	Fragment	
31938	Stone - malachite	Fragment	
31967	Stone - malachite	Fragment	
30469	Stone - quartz	Pebble	
31488	Stone - quartz	Stone	
33768	Stone - quartz	Pebble	
33779	Stone - quartz	Pebble	
33958	Stone - quartz	Pebbles	
34059	Stone - quartz	Pebble	
34247	Stone - quartz	Fragment	
30575	Stone - quartzite	Fragment	
31838	Stone - quartzite	Fragment	
31892	Stone - quartzite	Fragment	
32177	Stone - quartzite	Fragment	
32204	Stone - quartzite	Fragment	
32215	Stone - quartzite	Fragment	
32232	Stone - quartzite	Fragment	
32247	Stone - quartzite	Fragment	
32318	Stone - quartzite	Fragment	
32356	Stone - quartzite	Fragment	
32369	Stone - quartzite	Fragment	
32370	Stone - quartzite	Fragment	
32411	Stone - quartzite	Fragment	
33498	Stone - quartzite	Fragment	
33499	Stone - quartzite	Fragment	
33501	Stone - quartzite	Fragment	
33502	Stone - quartzite	Fragment	
33960	Stone - quartzite	Worked	
33961	Stone - quartzite	Fragment	
33994	Stone - quartzite	Fragment	
34090	Stone - quartzite	Worked	
34199	Stone - quartzite	Fragment	
34200	Stone - quartzite	Fragment	
34201	Stone - quartzite	Fragment	
34248	Stone - quartzite	Fragment	
32184	Stone - quartzite breccia	Fragment	
32372	Stone - quartzite breccia	Fragment	
32189	Stone - quartzite schist	Fragment	
33935	Stone - red quartzite	Fragment	
34197	Stone - red quartzite	Fragment	
30358	Stone - sandstone	Fragment	
30363	Stone - sandstone	Fragment	
30374	Stone - sandstone	Fragment	
30393	Stone - sandstone	Fragment	
30414	Stone - sandstone	Fragment	
30415	Stone - sandstone	Fragment	
30419	Stone - sandstone	Fragment	
30422	Stone - sandstone	Fragment	
30425	Stone - sandstone	Fragment	

Find No	Material 1	Object type	Antiq no
30427	Stone - sandstone	Fragment	
30429	Stone - sandstone	Fragment	
30468	Stone - sandstone	Fragment	
30477	Stone - sandstone	Fragment	
30485	Stone - sandstone	Fragment	
30530	Stone - sandstone	Fragment	
30562	Stone - sandstone	Fragment	
30567	Stone - sandstone	Fragment	
30568	Stone - sandstone	Fragment	
30571	Stone - sandstone	Fragment	
30572	Stone - sandstone	Fragment	
30573	Stone - sandstone	Fragment	
30579	Stone - sandstone	Fragment	
30584	Stone - sandstone	Fragment	
30585	Stone - sandstone	Fragment	
30586	Stone - sandstone	Fragment	
30588	Stone - sandstone	Fragment	
30590	Stone - sandstone	Fragment	
30614	Stone - sandstone	Fragment	
30632	Stone - sandstone	Fragment	
30640	Stone - sandstone	Fragment	
30645	Stone - sandstone	Tool	
30646	Stone - sandstone	Fragment	
30653	Stone - sandstone	Fragment	
30662	Stone - sandstone	Fragment	
30663	Stone - sandstone	Fragment	
30676	Stone - sandstone	Fragment	
30685	Stone - sandstone	Fragment	
30698	Stone - sandstone	Fragment	
30743	Stone - sandstone	Fragment	
30760	Stone - sandstone	Fragment	
30765	Stone - sandstone	Fragment	
30795	Stone - sandstone	Fragment	
30851	Stone - sandstone	Fragment	
30852	Stone - sandstone	Fragment	
31480	Stone - sandstone	Fragment	
31497	Stone - sandstone	Fragment	
31502	Stone - sandstone	Ball	
31556	Stone - sandstone	Fragment	
31559	Stone - sandstone	Fragment	
31560	Stone - sandstone	Fragment	
31561	Stone - sandstone	Fragment	
31562	Stone - sandstone	Fragment	
31590	Stone - sandstone	Fragment	
31591	Stone - sandstone	Ball	
31599	Stone - sandstone	Fragment	
31709	Stone - sandstone	Fragment	
31775	Stone - sandstone	Fragment	
31780	Stone - sandstone	Tool	
31984	Stone - sandstone	Fragment	
32116	Stone - sandstone	Fragment	
32126	Stone - sandstone	Fragment	
32139	Stone - sandstone	Fragment	
32144	Stone - sandstone	Fragment	
32145	Stone - sandstone	Fragment	
32156	Stone - sandstone	Fragment	
32159	Stone - sandstone	Fragment	
32165	Stone - sandstone	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
32186	Stone - sandstone	Fragment	
32188	Stone - sandstone	Fragment	
32194	Stone - sandstone	Fragments	
32195	Stone - sandstone	Fragment	
32196	Stone - sandstone	Fragment	
32197	Stone - sandstone	Fragment	
32198	Stone - sandstone	Fragment	
32205	Stone - sandstone	Fragment	
32217	Stone - sandstone	Fragment	
32219	Stone - sandstone	Fragment	
32228	Stone - sandstone	Fragment	
32230	Stone - sandstone	Fragment	
32248	Stone - sandstone	Fragment	
32249	Stone - sandstone	Fragment	
32250	Stone - sandstone	Fragment	
32290	Stone - sandstone	Fragment	
32291	Stone - sandstone	Fragment	
32315	Stone - sandstone	Fragment	
32316	Stone - sandstone	Fragment	
32317	Stone - sandstone	Fragment	
32361	Stone - sandstone	Fragment	
32363	Stone - sandstone	Fragment	
32371	Stone - sandstone	Fragment	
32389	Stone - sandstone	Fragment	
32391	Stone - sandstone	Fragment	
32398	Stone - sandstone	Fragment	
32402	Stone - sandstone	Fragment	
32410	Stone - sandstone	Fragment	
32413	Stone - sandstone	Fragment	
32414	Stone - sandstone	Fragment	
32415	Stone - sandstone	Fragment	
32416	Stone - sandstone	Fragment	
32417	Stone - sandstone	Fragment	
32422	Stone - sandstone	Fragment	
32423	Stone - sandstone	Fragment	
32424	Stone - sandstone	Fragment	
33410	Stone - sandstone	Fragment	
33411	Stone - sandstone	Fragment	
33442	Stone - sandstone	Fragment	
33480	Stone - sandstone	Fragment	
33555	Stone - sandstone	Fragment	
33556	Stone - sandstone	Fragment	
33595	Stone - sandstone	Fragment	
33619	Stone - sandstone	Fragment	
33620	Stone - sandstone	Fragment	
33621	Stone - sandstone	Fragment	
33622	Stone - sandstone	Fragment	
33623	Stone - sandstone	Fragment	
33624	Stone - sandstone	Fragment	
33630	Stone - sandstone	Fragment	
33631	Stone - sandstone	Fragment	
33632	Stone - sandstone	Fragment	
33633	Stone - sandstone	Fragment	
33634	Stone - sandstone	Fragment	
33635	Stone - sandstone	Fragment	
33636	Stone - sandstone	Fragment	
33640	Stone - sandstone	Fragment	
33654	Stone - sandstone	Fragment	

List of finds by primary material.

Find No	Material 1	Object type	Antiq no
33656	Stone - sandstone	Fragment	
33667	Stone - sandstone	Fragment	
33668	Stone - sandstone	Fragment	
33688	Stone - sandstone	Fragment	
33697	Stone - sandstone	Fragment	
33699	Stone - sandstone	Fragment	
33700	Stone - sandstone	Fragment	
33734	Stone - sandstone	Fragment	
33735	Stone - sandstone	Fragment	
33736	Stone - sandstone	Fragment	
33772	Stone - sandstone	Fragment	
33784	Stone - sandstone	Fragment	
33788	Stone - sandstone	Fragment	
33795	Stone - sandstone	Unworked	
33796	Stone - sandstone	Fragment	
33805	Stone - sandstone	Fragment	
33806	Stone - sandstone	Fragment	
33816	Stone - sandstone	Fragment	
33836	Stone - sandstone	Fragment	
33837	Stone - sandstone	Fragment	
33865	Stone - sandstone	Fragment	
33888	Stone - sandstone	Fragment	
33898	Stone - sandstone	Fragment	
33936	Stone - sandstone	Fragment	
33956	Stone - sandstone	Unworked	
33957	Stone - sandstone	Fragment	
33963	Stone - sandstone	Worked	
33964	Stone - sandstone	Fragment	
33965	Stone - sandstone	Fragment	
33966	Stone - sandstone	Fragment	
33967	Stone - sandstone	Fragment	
33968	Stone - sandstone	Fragment	
33995	Stone - sandstone	Fragment	
34019	Stone - sandstone	Fragment	
34072	Stone - sandstone	Fragment	
34073	Stone - sandstone	Fragment	
34078	Stone - sandstone	Fragment	
34083	Stone - sandstone	Fragment	
34084	Stone - sandstone	Fragment	
34085	Stone - sandstone	Fragment	
34086	Stone - sandstone	Fragment	
34087	Stone - sandstone	Fragment	
34088	Stone - sandstone	Fragment	
34089	Stone - sandstone	Fragment	
34164	Stone - sandstone	Fragment	
34244	Stone - sandstone	Fragment	
34259	Stone - sandstone	Fragment	
34209	Stone - steatite	Fragment	
32155	Stone (Calcite/travertine)	Fragment	
30731	Stone (sandstone)	Fragment	
30733	Stone (sandstone)	Fragment	
32257	Stone (sandstone)	Fragment	
32324	Stone (sandstone)	Fragment	
34252	Stone (sandstone)	Fragment	
33638	Textile	Fragment	
32388	Wood	Fragment	
33684	Wood	Fragment	
33776	Wood	Fragment	

Find No	Material 1	Object type	Antiq no
33875	Wood	Fragment	
34014	Wood	Fragment	
34017	Wood	Fragment	
34053	Wood	Fragment	
34054	Wood	Fragment	
34055	Wood	Fragment	
34056	Wood	Fragment	
34057	Wood	Fragment	

List of finds by primary material.

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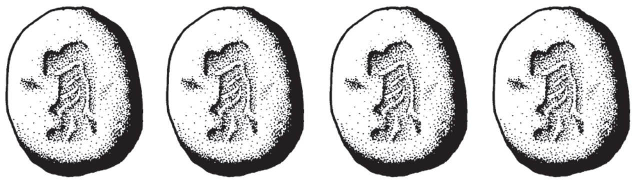

This index covers the text section of the book (Section 1). The finds are given in numerical order in Section 2.

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