Archaeology & History in Lebanon Issue Seventeen : Spring 2003, p.17-21

Dafydd Griffiths

Petrographic Analysis of Middle Bronze age Burial Jars from Sidon

During the reconstruction of nine of the Middle Bronze Age burial jars discovered at Sidon during the 2001 excavations, it was possible to take small samples for petrographic analysis. Petrographic analysis of other Middle Bronze Age jars also from the 2001 excavations will be undertaken in the near future.

The immediate purpose of this investigation was to assess whether the raw materials used to make the various jars were all similar or whether the jars were made from a variety of raw material sources. In this role, petrographic analysis served to provide a more detailed picture of differences that seemed apparent to the naked eye. It was also hoped that some insights into the technology of manufacture might be gained. The investigation was also intended to assess whether the raw materials being used were similar to those used in making the Early Bronze Age ceramics excavated at the same site.

As more petrographic analysis is conducted in the future, it will be possible to compare the Sidon ceramic fabrics not only with those of different periods within the site but also with ceramic fabrics from other sites and with samples of raw material (clay and rocks) from known geographical locations. This will in principle allow mapping of the distribution of different ceramic fabrics at different periods and allow inferences to be drawn concerning cultural contacts and changes in those contacts over time. Petrographic evidence will provide an independent means of addressing such questions as a complement to the better-established approaches based on form and decoration of pottery. It may be possible to draw further inferences from any correlations between ceramic fabrics and particular vessel forms or decorative features.

For the present, however, this process is in its infancy and hence the deductions that can be made at this stage will be limited. It is hoped that the value of the data presented here will gradually grow as more comparative data becomes available. It is hoped that petrographic data on the ceramics will then start to show its true potential as an independent indicator of the place of Sidon in the Middle Bronze Age eastern Mediterranean.

As the fabrics analysed here come from vessels that were being reconstructed, it was only possible to take small samples. These are sufficient to give a good idea of the ceramic fabrics and their main constituents but are not sufficient to give a reliable picture of the uniformity of the paste used to make a vessel or to give a quantitative indication of the relative frequencies of different inclusions in the fabrics. The remaining chips of material will however allow elemental analysis of the fine grained clay matrix to be undertaken as a further parameter for comparing ceramics excavated at Sidon and elsewhere.

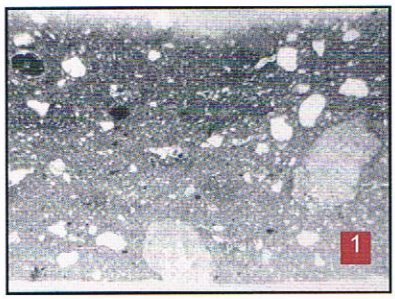
Samples taken from the nine burial jars will be referred to here by the burial number as these numbers are probably easier to remember. The corresponding find numbers are burial 2 = 1709, burial 8.2 = 1756, burial 11 = 1793, burial 14 = 1853, burial 15 = 3056-1854, burial 17 = 1872, burial 18 = 3055 and 1874.

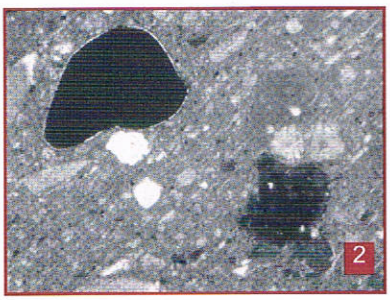
In terms of the technology of firing, it is apparent from the thin sections that the jars have all been subjected to a final stage of firing in an oxidizing atmosphere. The organic material usually present in secondary clay deposits (micro-organisms etc.) is charred to carbon during the initial stages of firing, rendering the ceramic fabric grey or black throughout. Carbon from the fuel may also be deposited on the ceramic and in the pores if the fire burns with a smoky flame. If free oxygen is available at the surface of the pottery at a temperature above about 500°C the carbon will start to be burnt away from the surface layer as the oxygen diffuses into the pottery. The oxygen reacts with the carbon to form carbon monoxide or dioxide, both of which escape as gases. In the firing of these burial jars, the duration of the oxidizing stage was not long enough in any case to remove entirely the grey core of remaining charred organic material. In some cases, such as the jar from burial 18B, the oxidized carbon-free layer is purely superficial. This suggests that the firing was conducted in a

reducing or neutral atmosphere for all but its final stage.

Thin sections of the nine samples were prepared and examined using a petrographic microscope. Figures 1-9 which appear immediately beneath each burial heading give an overview at low magnification of the textures of the nine samples. In each case the field of view is 9mm from side to side.

Burial 2

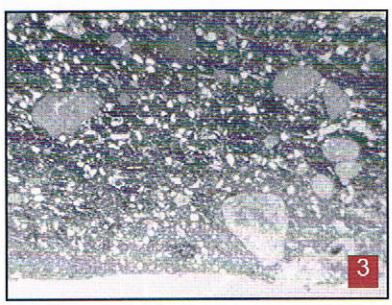


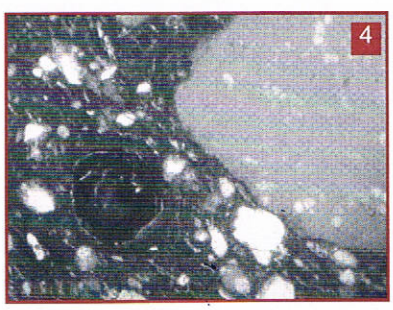


The fabric of the jar (fig. 1) from burial 2 has a mottled pale orange to buff calcareous matrix. It has some narrow elongate voids parallel to the alignment of the fabric but these are not pronounced. The matrix contains many iron-rich clay pellets in all sizes up to about 0.6mm in diameter. Some of these are totally opaque with distinct boundaries while others contain inclusions of quartz and/or have more diffuse boundaries. The matrix contains abundant calcareous fragments as well as larger limestone inclusions, up to 2.5mm in diameter, some fossiliferous, some plain and some with quartz inclusions. There are occasional larger fragments of fossil shell or coralline algae 1-2mm in diameter. The fabric also contains quartz inclusions. Some of these are small (<0.05mm to 0. 3mm) and angular: some are larger (up to 1mm) and sub-angular to sub-rounded. In both size ranges there are examples showing uniform extinction (the majority) but a significant proportion show undulose extinction.

Section of the jar from burial 2 (fig. 2) showing the calcareous matrix with a sub-rounded opaque inclusion (upper left quadrant) and an iron-rich clay pellet (bottom right quadrant), the latter containing quartz inclusions and having a more diffuse boundary. There are numerous smaller iron rich pellets in the matrix. The clear grain below the opaque grain is monocrystalline quartz and the one below that a monocrystalline calcite inclusion. The field of view is 1.2mm across.

Burial 8

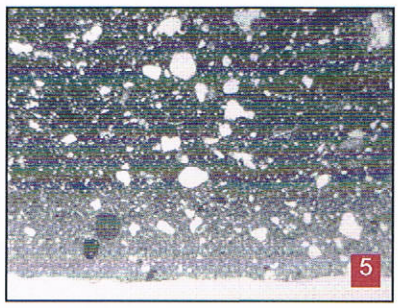




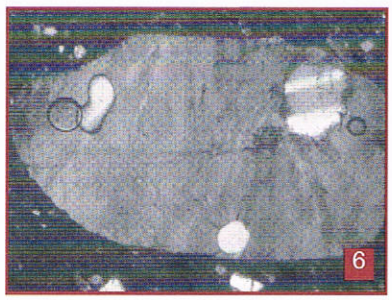
The cross-section of this sherd (fig. 3) is mostly grey due to carbon remaining in the fabric but just at the surface the carbon has been burnt away to expose the buff/pale orange colour of the fabric. The matrix is calcareous with some elongate voids. There are a few iron rich pellets showing some oncoid structure reference. There are many limestone inclusions in all sizes up to 2mm in diameter, many containing foraminifera. Most are sub-rounded but some of the smaller limestone inclusions are more angular. There are also numerous monocrystalline quartz inclusions, mostly angular to sub angular and up to about 0.2mm in diameter. Most show uniform extinction but a few have undulose extinction. The section contained a number of shell fragments. A single sub- rounded feldspar grain and a single polycrystalline quartz grain with undulose extinction and sutured grain boundaries were also noted. The most notable difference between fabrics of burial 2 and burial 8 is the absence of the larger quartz grains in the burial 8 fabric. The limestone inclusions of the fabric from burial 8 appeared richer in foraminifera than those of burial 2.

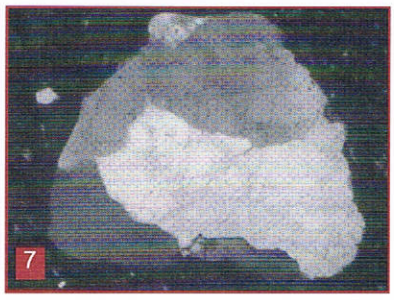
Section of the jar from burial 2 (fig. 4) showing an oncoid iron rich clay pellet and an adjacent sub-rounded limestone fragment containing foraminifera. The field of view is 1.2mm across.

Burial 11



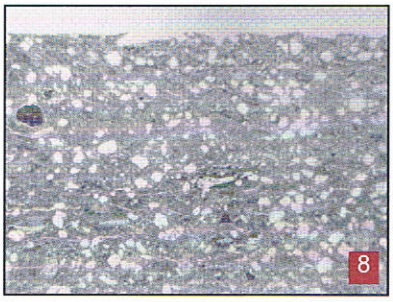
This fabric (fig. 5) had a dark orange appearance where not coloured grey by remaining carbon. The fabric appears to be composed of more than one clay or to come from an inhomogeneous source that has not been well mixed prior to forming the jar. The fabric contains numerous small iron rich pellets and a few larger ones. It contains a number of fairly large sub- rounded monocrystalline quartz grains of 0.5-1.5mm diameter. Quite a number of these show undulose extinction. One of the larger quartz grains contains inclusions, suggestive of an igneous origin. One or two of the quartz grains are polycrystalline. There are also numerous small angular quartz inclusions <0.1mm in diameter. There are quite a number of small high birefringence grains and a few feldspars are also present.





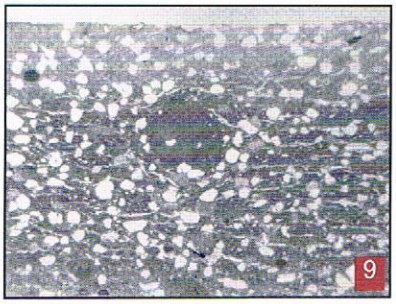
Burial 11. A quartz grain with inclusions seen under crossed polars. (The field of view is 1.2mm across) (fig. 6).
Burial 11. A polycrystalline quartz grain seen under crossed polars. (The field of view is 1.2mm across) (fig. 7).

Burial 14



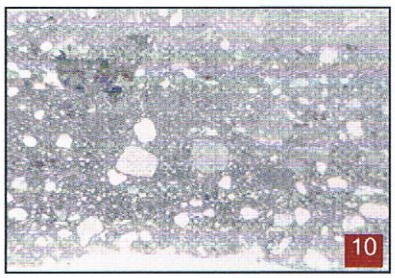
This jar has a buff to pale orange calcareous fabric containing many quartz grains in the 0.15-0.5mm diameter range. They are angular to sub-rounded. There are also a fair number of smaller quartz inclusions but these occupy far less of the field of view. Shell and other fossil fragments are quite common and there are quite a number of small iron rich pellets (<0.05mm) (fig. 8).

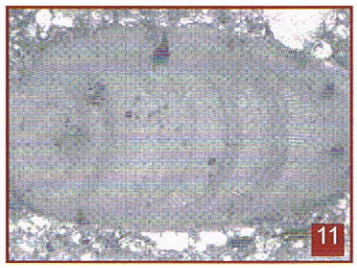
Burial 15 a



S/3056 is the upper part of the jar used in burial 15 (fig. 9) and was originally thought to be part of the same vessel as S/1854 which is the lower part of a jar. S/3056 has a fabric generally similar to the buff to pale orange calcareous fabric of burial 14 with a similar quartz population, possibly with a slightly greater proportion of the larger quartz inclusions. The fabric from S/3056 has more elongate voids than 14 and more limestone inclusions, as well as more small, iron-rich clay pellets and a few larger (0.3-0.6mm) iron rich pellets, some with inclusions of quartz and some without inclusions. The section of S/3056 has a few fragments of coralline algae and a nummulite preserved in chert. There are also a few other small fragments of chert visible in the section. The fabric of S/3056 has fewer shell fragments than the fabric of burial 14.

Burial 15 b

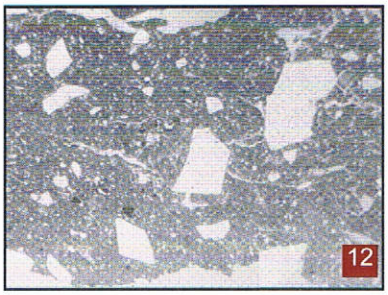




S/1854, the lower jar part enclosing burial 15 (fig. 10), has a highly calcareous fabric with calcareous inclusions of all sizes up to a diameter of about 1.5mm. There is less quartz than in 14 and in S/3056, (burial 15 a) but the quartz population is otherwise similar with small angular and larger angular to sub-rounded pieces, some of them perhaps a little larger than in 14 and 15 a (S/3056). Undulose extinction is fairly common in the quartz. There are numerous small iron rich inclusions and one larger one c. 0.6mm diameter with quartz inclusions. There are shell fragments, some coralline algae and a few fragments of chert.

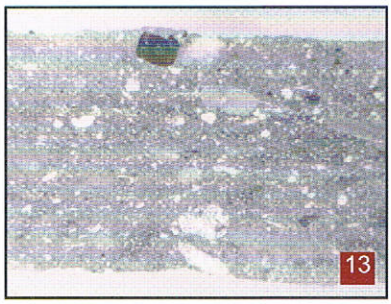
Burial 15 b. Fossil fragment. The field of view is 0.9mm across (fig. 11).

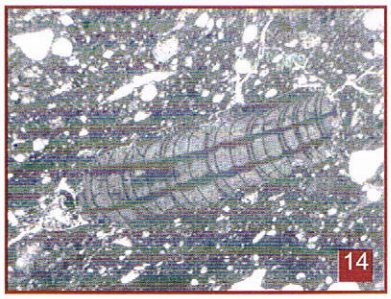
Burial 17



The jar of burial 17 has a calcareous buff to light orange fabric (fig. 12). Most of the calcareous inclusions in the fabric are less than 0.1mm diameter but some are up to 2mm diameter. There are numerous small iron rich clay pellets in the matrix, with some larger ones up to 0.3mm diameter with quartz inclusions. The monocrystalline quartz in the matrix is nearly all less than about 0.05mm diameter, but there are a few sub-angular to sub-rounded grains up to about 0.3mm diameter. The fine-grained matrix is not very dissimilar to that of 14, 15 a (S/3056) and 15 b (S/1854), but large quartz and large limestone inclusions are mostly absent. The dominant inclusions in fabric 17 are angular to sub angular inclusions of chert in all sizes up to about 2mm diameter.

Burial 18a

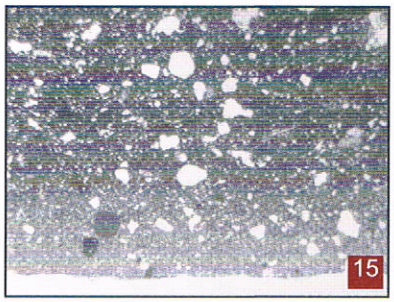


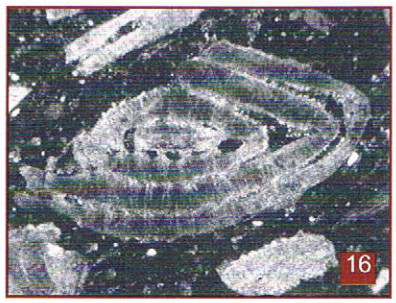


This jar again has a buff to pale orange calcareous fabric (fig. 13) with many fine-grained iron rich inclusions. There are also larger iron-rich inclusions, one of which is a millimetre in diameter and has a fairly clear concentric structure with quartz inclusions. In the rest of the matrix, quartz is a fairly common inclusion occurring in angular to sub rounded grains up to about 0.3mm diameter. The fabric is dominated by fairly large calcareous inclusions, a number of which appear to be various fossils of coralline algae or shell fragments in excess of 2mm long. There are also a few fragments of chert.

Burial 18 a. Coralline algae. The field of view is 2mm wide (fig. 14).

BURIAL 18b


15


16

The fabric of this jar (fig. 15) again has a buff calcareous fabric with many fine iron-rich clay pellets, as well as some larger ones with quartz inclusions up to about 1.5mm in diameter. Quartz is present as fine angular inclusions and other larger angular to sub angular inclusions up to about 0.5mm in diameter, some of which have undulose extinction. This fabric is dominated by inclusions of fossil fragments, nummulites being the most dominant but accompanied by numerous, shell fragments, coralline algae fragments and the like.

Burial 18 b. Nummulite inclusion. The field of view is 2mm across (fig. 16).

CONCLUSIONS BASED ON OPTICAL PETROGRAPHY

As stated above, the petrographic study of the ceramic fabrics from Sidon and surrounding sites is still at an early stage. The conclusions that can be drawn at this stage are necessarily limited.

One direct insight arising from this petrographic study reflects on the burial rite used in burial 15. S/3056 and S/1854 were initially thought to be the top and bottom (respectively) of the same jar. Petrographic examination shows, however, that the top and the bottom were made of different materials and that the top comes from one jar and the bottom from another. This suggests that, in this case at least, a vessel was not broken specifically in order to provide a burial container for an individual.

In terms of the fabrics of the nine jars analysed, the jar from burial 11 stands out as being less calcareous than the rest and having inclusions suggestive of an igneous, and perhaps partly metamorphic, origin.

As regards the fine-grained matrices of the rest of the jars, there appears on present evidence to be some similarity in the buff/pale orange calcareous fabric with its numerous fine iron-rich pellets and its fine angular quartz component. It is conceivable that the coarser quartz and calcareous components were added by the potters but it is also quite plausible that different sub-deposits of otherwise broadly similar clays might have different inclusions naturally present. Prospection among natural clay sources may help to resolve this question in future.

The other fabric that stands out is that from burial 17. Although the fine-grained matrix seems not dissimilar to that seen in other calcareous sections, it lacks the coarser quartz and calcareous inclusions present in the other fabrics. What it has instead are angular and sub angular pieces of chert. These seem unlikely to occur as natural inclusions in clay in such numbers, size range and angularity. The likelihood would appear to be that these were added deliberately by the potter.

In terms of comparing the fabrics of these MBA jars to fabrics in use in Sidon in the preceding early bronze age (EBA) period, there appears to be no use of the common EBA fabric characterised by elongate argillaceous rock fragments (probably low grade shale). The calcareous fabrics of the MBA jars described here do however fit reasonably comfortably between two of the previously noted EBA fabrics labelled group 2 and 5 (Griffiths 1999, "The Role of Ceramic Fabric Analysis in the 1998 Sidon Excavations" *National Museum News*, 10, 49-55; "Petrographic Analysis of the Early Bronze Age Ceramics" forthcoming in C. Doumet-Serhal, *Excavation at Sidon 1998-2000-2001, The Early Bronze Age,* Institut Français d'archéologie du Proche-Orient, Bibliothèque Archéologique et Historique). EBA vessels with fabrics between two of the main EBA groups and similar to the MBA fabrics discussed in this paper (excluding burial 11) have been noted. At least in a broad sense, it would thus appear that there might have been commonality in the use of some clay deposits between the EBA and MBA period. Until more fieldwork is undertaken, however, we remain ignorant of how widespread these clay deposits may have been. On the basis of the limited evidence presented here, however, it may be that one of the main EBA clay sources did not continue in use at Sidon in the MBA.