Royal Delicacy: Material Study of Iron Age Bullae from Jerusalem

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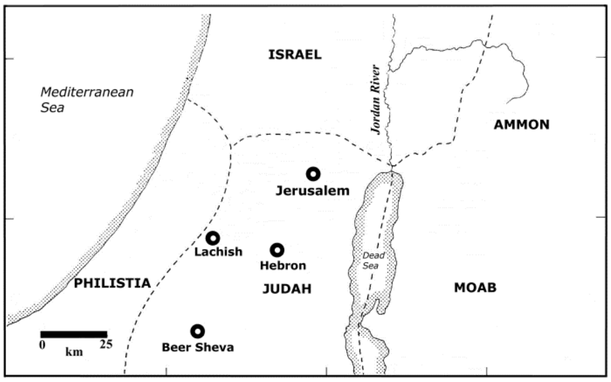

Figure 1. Jerusalem and the boundaries of the Kingdom of Judah between the 8th and the 6th century B.C.

Introduction

The application of optical mineralogy (OM, often dubbed petrography) for ceramic studies in archaeology is celebrating now almost eight decades since its introduction. Over the years, it established as one of the most common scientific methods in archaeology, due to its availability and impressive track record. Even the introduction of elemental methods for provenancing ceramics, such as Neutron Activation Analysis (NAA), has not affected the use of OM due to its ability to supply a wide range of technological as well as provenance data. However, the method has always been limited by its destructive nature, restricting the analyses of delicate artefacts.

During the last decade, one of the authors (YG) has developed a methodology for OM examination of delicate clay objects, such as cuneiform tablets and seal impressions (*bullae*). Amongst other things, it has been used for provenance studies of cuneiform tablets from el Amarna, Ugarit (Ras Shamra), Hattuša (Boğazköy), and from sites in Israel (Goren *et al.* 2004; 2011 with further references), as well as the "Knossian Replica-Rings" from Crete and Thera (Goren and Panagiotopoulos, in preparation). The present paper presents the methodology, results, and implications of the examination of Iron Age *bullae* from Iron Age Jerusalem.

Little has been preserved in the archaeological record from the rich literary material of the kingdom of Judah (Figure 1). Despite the discovery of some contemporary written sources, such as *ostraca* and seals, it may be assumed that many of the documents were apparently written on scrolls or papyri that have not survived. Consequently, most of the scholarly records from this period often referred to in the biblical sources, have been lost forever. Only some meagre remains of these texts have been preserved in the form of *bullae*, namely, the clay sealings that were once attached to them. *Bullae* are small lumps of clay, often fingernail-sized and shaped as flat disks (Figure 2). They were usually affixed to a cord binding a papyrus-document and then stamped with a seal. Other *bullae* were apparently sealing basketry or fabrics, most likely small bags containing some commodities, as evident by the impressions on their reverse sides.

Figure 2. General stereomicroscopic view of one of the inscribed bullae from the "Bullae House" in Area G, the City of David (IAA 84-123). The palaeo-Hebrew seal reads: "(of) Nachum son of Sha'ala". Late 7th–early 6th century B.C. (field width: about 2.5 cm).

Only a relatively small number of *bullae* have been found in the course of over a century of archaeological exploration of the major Iron Age sites of Judah (Avigad 1997: 167-241). The reasons for this situation seem to be related with their small size, which can easily escape the attention of inexperienced workers who do not search specifically for them. Moreover, careful sifting was not always the common practice in several of the early large-scale excavations of the major Judahite tells. Last but not least, the preservation of unfired *bullae* is often impossible in the sub-humid conditions of the southern Levant, hence most of the *bullae* found in recorded excavations were discovered as part of very few caches, which survived due to specific depositional conditions.

The *bullae* sampled in our research include several major groups, dating to two different phases of the Iron Age. The first group, comprising 51 items, was uncovered during the 1982 season of excavations in Area G at The City of David by Shiloh (1984: 19-20; 1986; Shiloh and Tarler 1986; Shoham 2000; Brandl 2000). They were found on the floor of the 'Bullae House', which was only partly excavated. It was covered by a thick charred destruction layer containing the *bullae* together with pottery vessels, arrowheads, a scale weight and four limestone altars. The finds are typical of the final stage of the Iron Age and the *bullae* found in this context clearly date to the last phase before the Babylonian destruction of Jerusalem in 586 B.C. Most of the *bullae* are in very good state of preservation, hence fully legible (Figure 2). They bear dozens of Hebrew personal names, two of which belong to figures known from the Bible. The first is Gemaryahu son of Shaphan (Shoham 2000: 33), a high official at the court of King Jehoiakim, and the second is 'Azaryahu son of Ḥilkiyahu (*ibid:* 43), a member of a priestly family appearing in the book of Chronicles (Schneider 1988).

The second group of *bullae* includes over 120 items, dating to the 9th–late 8th centuries B.C., discovered more recently in the water system of City of David near the Gihon spring (Reich *et al.* 2007: 156-157). Being earlier to the second group, these *bullae* are not epigraphic and their seal impressions contain only decorative patterns. The third group, as yet unpublished, is of *bullae* found in the excavations at the Ophel slope above the latter excavations, under the direction of Mazar (2009).

Method

This study was aimed at providing the opportunity to analyse some as yet undetermined aspects of the Judahite *bullae*. Since it is widely believed that *bullae* were used to seal documents or small parcels sent from one authority to another, ensuring the discrete reading of a message or opening of the parcel by the addressee alone, we first attempted to disclose the geographical origin of the *bullae* through the provenance of their clays, in order to map the network of the administrative correspondence of Judah during the middle to the end of the Iron Age. By doing so, we hoped to reveal the location of several personalities and to draw the network of Judahite bureaucracy. Therefore, our first question was whether the material composition of a given assemblage of *bullae* would reflect sufficient similarity to justify their assignment to a single site, or whether the analysis would show that they were made of clay from different locations. The answer to this question was the key to the research questions that followed, since if the first option were true, then the following question had to be related with the issue of provenance of the entire lot. However, if greater diversity of raw materials were recognised, then the study would need to focus on the correlation of the clay types with the textual and stylistic characteristics of the *bullae* and the location of their discovery. As in standard provenance studies of ceramics in archaeology, it would be naive to expect that the mineralogical or chemical analyses of small size samples of clay would enable provenance determinations to the single site level. Moreover, there are obviously some fundamental differences between *bullae* and pottery, and consequently between the preferences of potters and scribes or other officials. However, as is the case of pottery, the background of the study of *bullae* is such that the interpretation of the results can be considerably narrowed by many archaeological and historical considerations. In fact, the distribution of the Judahite Iron Age sites where *bullae* could have been issued and used is such that it leaves only very few possibilities open, if the analysis were to suggest even a general area within the confines of Judah.

As a result, our research project was planned to be made in three stages. In the first stage we examined the structural and technical aspects of the *bullae* based on surface microscopic observations under a stereomicroscope, with magnifications ranging between 10 to 100 times. This was made in order to record minute details of the papyrus, fabric, or leather, and the cord impressions, the fingerprints and other imprints, and of course the seal impression themselves. These examinations attempted to address some technical questions, such as the general composition of the fabric and the formation process.

In the second stage, minute samples were extracted from the *bullae* by the peeling technique and examined in thin sections under the petrographic microscope. In this method, a thin lamina, only few mm thick, is taken from a broken facet of the *bulla* or from its reverse side under the stereomicroscope with the aid of a scalpel. The samples were set in improvised moulds made of small rounded polyethylene test tube cups, and dried in an oven at 60 °C for a few hours. Then the cups with the samples were put in a desiccator, where the samples were impregnated with Buehler Epo-Thin low viscosity epoxy resin under vacuum conditions. After curing, the resulting pellet was used for the preparation of a standard thin-section and subjected to routine petrological examination under a polarising microscope using X40–X400 magnifications.

The OM definition of each sample was then supported by microstructural and chemical examinations under the analytical Quanta 200 FEG Environmental Scanning Electron Microscope (ESEM), operated by the Wolfson Applied Materials Research Centre of the Tel Aviv University. The microscope combines high vacuum, low vacuum and wet-mode to support a variety of material characterisation applications. The specific instrument was chosen because it allows the examination of non-conducting, contaminated, hydrated and even living samples without significant sample preparation, in addition to those samples that have always been viewable under conventional scanning electron microscopes. It allows for user selection of accelerating voltage, magnification, gas type, gas pressure, and detector type. The microscope uses a Field Emission Gun electron source and allows wide range of accelerating voltages from 200 V to 30 kV. It also has a complete set of detectors providing imagining in secondary and back-scattered electrons in all the operating modes (high and low vacuum) at the resolution of 3.5 nm (for more details see Stokes 2008). The system also includes energy dispersive spectroscopy (EDS), for qualitative and quantitative analysis of ceramic materials, and light element detection down to carbon. Hence the ESEM enables the examination of the intact *bullae* at low vacuum, without any process of coating.

Results

Based on the OM data, combined with the ESEM results, the raw material of all the examined specimens are readily identified as derived from soil deposits which are, in fact, Quaternary alluvial beds derived from *terra rossa* soils and, in few cases, *terra rossa* from *in situ* exposures. It should be emphasised that none of the *bullae* that we have examined so far were made of clay or marl from older geological formations, such as the local Moza clay formation, even though it was extensively used for pottery production in Judah throughout the ages.

In thin section, most of the *bullae* appear as non-calcareous, ferruginous matrix (Figure 3a). This fabric is typified by reddish-tan to dark matrix in thin section, highly optically active to nearly opaque under crossed polarises, with silt ranging between 5% (rare) to nearly 20% (common). The silt is mainly quartzitic but it often contains some accessory heavy minerals of which hornblende and zircon are the most common. The inclusions are made of fine sand containing mainly quartz or limestone. Other minerals or rock fragments that rarely appear in the inclusions are chert or chalcedony.

Terra rossa soils occur on hard limestone and dolomite exposures in the semiarid to sub-humid Mediterranean climatic zones. This soil material is eroded downslope, forming colluvial-alluvial soils. All the soil materials in Israel include, to varying extents, aeolian dust of desert origin. Carbonate rocks do not contain silt-size quartz grains, but large amounts of such grains occur in the soils that developed on these rocks. The external source of the silt-size quartz grains is considered to be an aeolian contribution to the soil. The largest amount of aeolian dust occurs in soils that developed on hard limestone and dolomitic limestone, in which the residual material released from the dissolution of the rocks is only about 2% (Adan-Bayewitz and Wieder 1992). Only in a few cases nearly non-silty *terra rossa* was used (Figure 3b), indicating the employment of soil from an *in situ* exposure.

The inclusions are sparsely spread and occasional, reflecting opportunistic use of different soil mixtures where often fine sand naturally occurs. This sand is essentially quartzitic, often with the addition of calcareous rock fragments (Figure 3c). In many cases, very fine splinters of vegetal material were added, as indicated by the void structure, often infilled by secondary re-crystallisation of calcite (Figure 3d). This vegetal material can be, in fact, the result of the inclusion of cords in the *bullae*. In one case, delicate fibers of unidentified type were densely packed within the matrix of a *bulla* (Figure 3 e, f).

The OM examinations were enhanced by the ESEM-EDS analyses. The latter were made on the entire

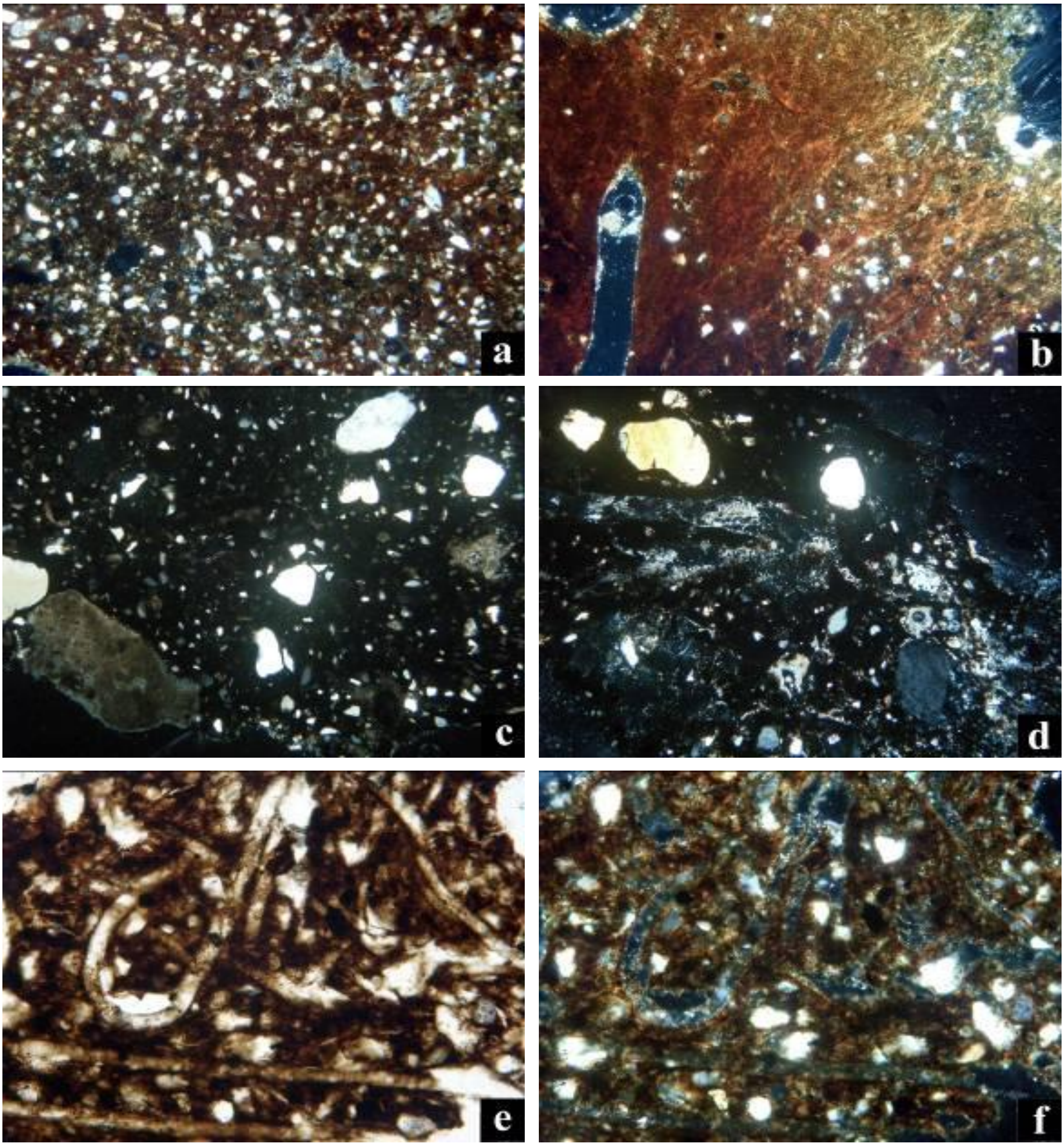

Figure 3. Bullae fabrics in thin section: (a) bulla 20867, Alluviated terra rossa with high silt content (field width: 2.5 mm, cross polarised light [XPL]); (b): bulla 18692, terra rossa with low silt contents, note the typical high optical activity with striated b-fabric. The elongated voids indicate vanished vegetal material (field width: 2.5 mm, XPL); (c): bulla 16771, terra rossa with nearly isotropic silty matrix and sand inclusions containing spherical quartz and some limestone, (field width: 2.5 mm, XPL); (d) bulla 19314, as 3c but with secondary (post-depositional) crystallisation of calcite in the voids (field width: 2.5 mm, XPL); (e): bulla 22112, , the terra rossa matrix is mixed with fine fibres (see also Figure 5). Field width: 0.8 mm, plane polarised light (PPL); (f): bulla 22112 as in Figure 3e but under XPL. Field width: 0.8 mm.

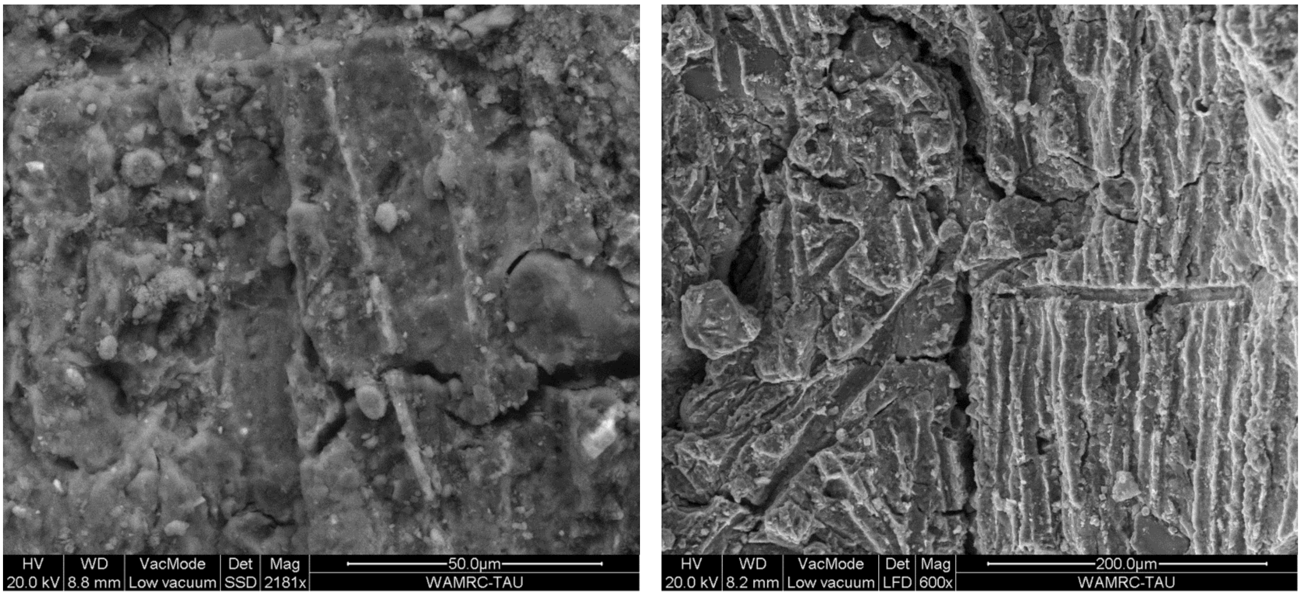

Figure 4a and b. ESEM images of bulla 29708, showing the fibre imprints in the matrix visible also in Figure 3e.

surfaces of the *bullae* rather than on samples which were extracted from them. This necessitated the opening of the vacuum chamber of the ESEM whenever the *bulla* needed to be tilted, hence in many cases we preferred to define *a priori* the desired surface for scanning. In many cases, this was the surface where the sample for OM was extracted by the peeling method. This enabled a comparison between the OM sample and the surface scanned by the ESEM.

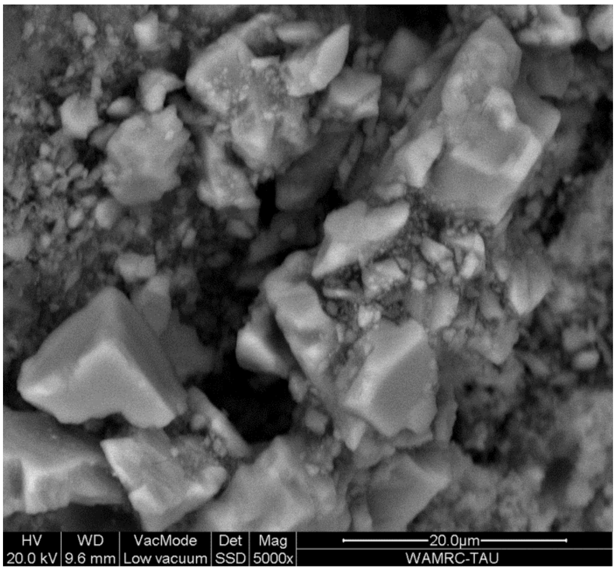

Figure 5. ESEM view of secondary re-crystallisation of calcite in a void (as seen in thin section in Figure 3d).

A few examples can be seen in Figures 4 and 5: the non-plastic inclusions (silt and fine sand) could also be observed by the ESEM and identified by EDS spot analyses. Structural features, such as the cord impressions, fibres within the clay (Figure 4a, b), secondary crystallisation of calcite (Figure 5), could be observed by the ESEM using the secondary electron (SE) and backscattered electron (BSE) detectors.

To sum up, both the OM and the ESEM analyses revealed that the entire groups of *bullae* from the City of David in Jerusalem were made of *terra rossa* soil, having the same mineralogical composition of silt and inclusions. Although *terra rossa* soils are quite widespread in the Mediterranean sub-humid parts of Israel, where they develop on hard limestone and dolomite of the Mediterranean climatic zones, the uniform composition of the silt with its accessory minerals, and the coarse fraction found in the *bullae*, suggests that the assemblage is the product of a single location. Moreover, the distribution of *terra rossa* in the confines of Judah is limited to the Judean Anticline, where Jerusalem is the only major site of this period. In addition, this mineralogical composition is identical to the fabric of the numerous local pillar figurines from the City of David (Goren *et al.* 1996). Therefore, the entire two sets of *bullae* from the City of David may be regarded as the local production of this site.

Discussion

The results of this study indicate that the entire assemblage of *bullae* from the City of David was most likely made locally around Jerusalem. It enables us now to define more precisely the nature of bureaucratic networks of Judah according to the evidence at hand. The fact that all the *bullae* were found to be made of clay from the major city where they were deposited negates the assumption that the *bullae* sealed letters that arrived from far away. Instead, it appears that either the *bullae* sealed locally circulated documents, restricted to the immediate surroundings of the city in which they were found, or that they were used to seal local legal and administrative documents.

The contents of the Lachish *ostraca* (Torczyner 1938), dating to the same period as the later lot of *bullae* sampled in our research, indicate that letters written on papyrus were sent together with *ostraca*. Na'aman's analysis of the archive of Ya'ush points out that the *ostraca* uncovered in the gate of Lachish were part of a much wider correspondence, most of which was written on papyri (Na'aman 2003: 175, 179). The assumption that letters were written on papyri is reinforced by the Wadi Murabba'at document, the only provenanced Iron Age papyrus found so far in the southern Levant (Milik 1961: 93-100). Although it is a palimpsest and its text is fragmented, it is clear that it was a personal letter. Hence it seems that while *ostraca* are more frequent than papyri in the archaeological record, they substituted for papyri only for economic reasons, while the latter constituted the common writing material.

The papyri from Elephantine, dated to the 5th century B.C. (Porten 1992; 1996), and from Wadi Daliyeh, dated to the 4th century B.C (Cross 1974; Lapp 1974; Leith 1997; Gropp 2001), illustrate the sealing practices used in the Persian period, hence somewhat later than our case. After the text was written and witnessed, it was rolled from bottom to top, flattened and folded. Strings and pieces of papyrus-fibre were looped around separately to tie the documents, which in turn were sealed by the *bullae*.

A comparison between the letters and the contracts found in Elephantine made by Porten (1992: 447-448) raises some significant technical differences, which are relevant to our case: letters were shorter than contracts and unlike contracts, they were usually written on both sides of the papyrus. While contracts were rolled up and folded in thirds, letters were rolled up and folded in half. Since contracts were meant to be stored for an extended period of time, a blank space at the top of the contract was an insurance against any external damage obliterating any part of the opening lines. These differences illustrate the special treatment of legal documents, most likely due to their long-term importance, as opposed to letters.

The archives from Elephantine and Wadi Daliyeh demonstrate that most of the sealed documents were formal legal records, which were concerned with the most personal forms of social interaction. The impression of personal seals upon these papyri was thus a highly complex act of signification. The seal must have had a complex power and its imprint was the insurance of the owner for the authority. A seal impression therefore established a set of moral obligations, which bound those who encountered it.

Therefore we join the opinion first presented by Avigad (1997: 33-39) and Shiloh (1986: 36-37) and we assume that Judahite *bullae* were used as sealings of legal documents. In order to support this hypothesis, a brief cross-cultural account of sealing practices of legal documents is required. The most informative description of the preparation of a deed of sale in the days of the monarchy is found in the book of Jeremiah (32, 1-15). It concerns the purchase of a field by Jeremiah just a few days before the Babylonian conquest. The story reveals the technical features of the legal bureaucracy during the same days of the later group of *bullae* examined in our research. Although Jeremiah's purchase was of symbolic nature, this is most likely an accurate description of the legal process by which deeds were carried out at that time. Two texts, an original and a duplicate copy, were written on two separate sheets of papyrus. The first was termed the "sealed deed" because it was rolled up and sealed with a *bulla* or *bullae*; it would be opened before judicial authorities only when absolutely necessary. The second, "open deed" was a copy of the sealed one and was intended for daily use.

Conclusion

The use of the newly developed delicate sampling technique for OM thin section analyses, combined with complementary ESEM-EDS examination under low vacuum conditions, enables the examination of extremely delicate items and provides a rewarding multidisciplinary approach. It enables now the study of unique, delicate artefacts which could not be hitherto examined by the highly efficient and informative method of OM, due to the invasive sampling technique required for standard thin sectioning.

The results of the present study, in which the entire assemblage of *bullae* from the City of David was found to be most likely made locally around Jerusalem, were not predicted by the visual examination of the artefacts. Furthermore, the results provide significant information about the nature of the Judahite bureaucracy and the historical significance of the few clusters of Iron Age *bullae* which were discovered in recorded excavations. Since hundreds of contemporary, unprovenanced *bullae* originating from the antiquities market are found now in several museums and private collections, this methodology can be applied also on them. Besides serving as a tool for authenticity determinations, it may disclose the possible existence of some other Judahite administrative centres where legal administration may have been practiced.

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