

Structural, Technical and Petrographic Analysis of Bullae from the Samaria Papyri

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Twenty-two clay bullae associated with mid-4th century BCE Samaria Papyri from the cave of Wadi Daliyeh were subjected to structural, technical and petrographic examination. Results suggest that the bullae were all made in the Samaria region from several types of local soils. The technology and function of the bullae differ from those of earlier (Iron Age) Judahite bullae.

KEYWORDS Persian period, Samaria papyri, Wadi Daliyeh, Bullae, Optical mineralogy, Petrography

This paper presents the results of a structural, technical and petrographic examination of 22 of the clay bullae associated with the late Persian period (375–334 BCE) Samaria Papyri from Wadi Daliyeh (Cross 1963: 110; 1969; Gropp 1986: vi–vii).

The Samaria Papyri were retrieved in the early spring of 1962 from Bedouin of the local Ta'amireh tribe, who reportedly discovered them in the Abu Shingi Cave in Wadi Daliyeh in the Samaritan Desert, about 14 km north of Jericho (Fig. 1). Together with the cache of papyri, there were human skeletons, a hoard of coins and jewellery that included seal-rings, bullae and pottery—all strewn across the floor of the cave (Cross 1988: 17–18; Leith 1997: 4; Eshel 1998: 72; Dušek 2007: 5–6, 9–10). The papyri were purchased by the American Schools of Oriental Research, and Cross (1963) published them in a preliminary document shortly thereafter. Based on their contents and style, he dated the Wadi Daliyeh papyri and their related bullae to a short time-span between 375 and 334 BCE (Cross 1963: 110; 1969; Gropp 1986: vi–vii; see also Dušek 2007: 441–445). As part of the purchase agreement, the location of the find spot was revealed. In the following years (1963–1964) two excavation seasons were carried out in the cave by Lapp and Lapp (1974). The excavations yielded a few additional papyri fragments, two more bullae and other small finds that had escaped the eyes of the Bedouin (Cross 1969: 45–46; Leith 1990; Gropp 2001; Dušek 2007: 6–7, 10–18). All the bullae found in the cave had most likely originally been affixed to the papyri.

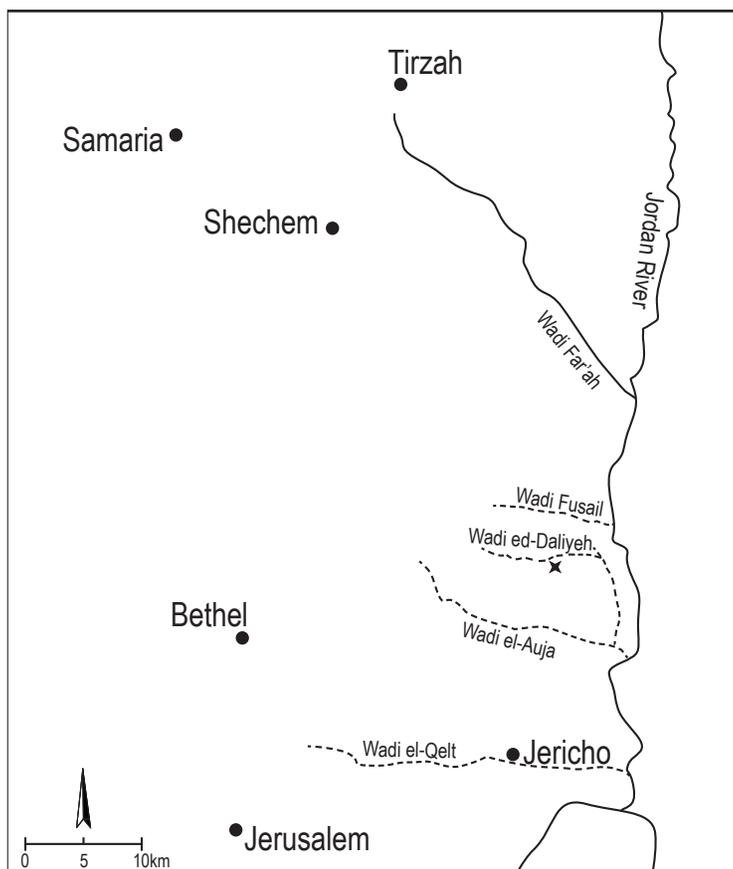


FIGURE 1 Location of Wadi Daliyeh and Samaria.

The Samaria Papyri consist of almost 100 documents from several private and communal files and were primarily contracts and letters. They represent a group of legal documents written in Aramaic, the common language of Persian period bureaucracy. Nine of the documents record contracts of slave sales; two certify deposits or loans granted in the process of trade; one confirms the release of a slave; and three others record the sale of real estate. There was also a receipt for a refund, and a small fragment of a legal deposition given under oath (Eshel 1998: 72). None of the documents seems to relate to the official bureaucracy of the Persian province or to communications between the local Samarian rulers and their Persian superiors (Leith 1997: 5; Gropp 1986: viii–x).

Cross (1985: 7*) labelled these documents the ‘Samaria Papyri’, since the name ‘Samaria’ (*šmryn*) appears 15 times in a formula indicating the place of execution of the documents: “Samaria, the city/capital (*qryt/byrt*), which is in Samaria the province (*mdynt*)”. All the documents had originally been drafted and sealed in Samaria (Gropp 2001: 3–8), and they are the earliest legal papyri found in Palestine (Cross 1985: 7*).

Since the Samaria Papyri are so formulaic, the information they offer regarding everyday life in 4th century BCE Samaria is limited, but they do provide a few details about

administration and history of law. Two types of officials were identified: ‘the governor’ (*ph̄t šmryn*) and ‘the prefect’ (*sgn*) (Dušek 2007: 508–516, with further literature).

The owners of the papyri met their deaths at the Abu Shingi Cave; they were men of means, aristocrats, leaders and patricians of Samaria who had fled the city when Alexander the Great marched in. Whole families had found temporary refuge in the Wadi Daliyeh caves; they had been fairly well supplied with food and other necessities until they were apparently discovered and slaughtered by the Macedonians. The documents and bullae found in the cave, as well as the exquisite seal rings, jewellery and remnants of fine linen confirm the origins of the men and their status (Cross 1969: 48, 52).

While the papyri drew immediate attention, resulting in instant publication, it was not until the late 1990s that full publication of the complete assemblage of the bullae related to them came to light.¹ Because few of the papyri still bore their bullae when found, these bullae were published immediately prior to the opening of the documents (Cross 1963, 1985, 1988; Gropp 1986). Special attention has been drawn to the implications of one of these bullae (WD22), bearing the name and title of ‘Sanballat’ peḥa (governor) of Samaria (Fig. 2) (Cross 1963, 1969, 1978, 1985, 1988). The comprehensive publication of the entire lot of bullae was based on a doctoral dissertation (Leith 1990) and was published as the first of three volumes presenting the written material and artefacts from Wadi Daliyeh (Leith 1997).

The bullae assemblage consists of 128 items, most of which were bought either directly or indirectly from the Ta’amireh Bedouin during the early 1960s. A few of the bullae were retrieved from the excavations that followed (Lapp and Lapp 1974). At present, some of the bullae are deposited at the storage facilities of the Israel Antiquities Authority (IAA) and others are exhibited at the Israel Museum in Jerusalem. A collection of a further 44 Persian period bullae, privately purchased in the Jerusalem antiquities market by the late Reuven Hecht, were published by Stern (1992) and were included in the final publication of seal impressions from Wadi Daliyeh. However, none of these bullae was included in the present study as their attribution to the Wadi Daliyeh assemblage is circumstantial and relies only on their stylistic affinities (Dušek 2007: 43–44, with further literature).

Clay bullae were dried but not fired for the obvious reason that fire would destroy the document, the cord or any organic materials attached to the bullae. This phenomenon greatly affects the preservation of bullae in the archaeological record, because it is very unlikely that small, unfired lumps of clay would survive over millennia in the ground of a humid or sub-humid climatic zone. Thus, finding bullae in excavations is rare. Indeed, recent analyses of Iron Age Judahite bullae from Jerusalem and several other sites, as well as unprovenanced bullae from private collections, have shown that most of them were probably preserved due to their exposure to fire, which brought about their sintering to ceramic phase (Ariel and Naveh 2003: 61; Gurwin 2010; Arie *et al.* 2011; Goren and Gurwin 2013). The Wadi Daliyeh assemblage of bullae is thus unique for its remarkable state of preservation, undoubtedly owing its conservation to the arid desert climate. Similar, though somewhat earlier, is the case of the archive of 5th century BCE papyri, some bearing their bullae, discovered at Elephantine in Upper Egypt (Porten and Yardeni 1986; Porten 1996).

¹ For a detailed review of the history of the research of the bullae, see Dušek 2007: 39–48.



FIGURE 2 WD22, The ‘Sanballat’ peḥa bulla.

While two of the authors of this article recently examined several hundred Judahite bullae from Jerusalem that date from the late 9th to the early 6th centuries BCE (Gurwin 2010; Arie *et al.* 2011; Goren and Gurwin 2013), the Wadi Daliyeh bullae offered a unique opportunity to study an assemblage of later specimens that were still intact and found with their cords, some of which were still attached to the papyri. Together with the Elephantine papyri, this is the only evidence of the exact use of clay bullae during the later Persian period, thus shedding additional light on the preparation process of bullae in this era as compared with the earlier Iron Age. The technological analysis helps to determine the form of the bullae and to reconstruct their production and sealing processes. The petrographic analysis of the bullae also helps to determine the provenance of the clay, enabling the identification of the location of writing and sealing of the papyri.

Materials and methods

Twenty-two bullae were studied (see Table 1 for summary of information). Fourteen are stored by the IAA and eight by the Israel Museum.² All the bullae are intact with the sealing identified, except for three, which are unreadable. Five bullae bear typical Persian-style motifs and 11 bear Greek motifs. Two were defined as Israelite bullae, containing

² Many discrepancies were discovered between Leith’s final publication (1997) and the information at the location where the bullae are stored today. At the IAA, there is a discrepancy between two bullae; registration numbers for WD48 and WD51 seem to have been interchanged. At the Israel Museum, we discovered a discrepancy between publications and the museum’s card index. The records show that the museum is in possession of all the bullae that sealed WDSP1 and the bulla of ‘Sanballat’. However, when comparing the photographs taken at the museum to those published by Gropp (2001), only five out of seven bullae attached to the papyrus can be identified. In cross-referencing the data from the museum and the IAA numbers, it is apparent that apart from five bullae that did seal WDSP1, the museum is in possession of WD15B, which was attached to WDSP6 and another bulla, which might be WD10B, but we cannot be certain (see Table 1 for details). In this study, we decided to follow the registration numbers of the final publication.

Palaeo-Hebrew script: WD22 (Fig. 2) is entirely epigraphic, having a sealing of "...-iah, son of [San]ballat, governor of Samaria". WD23 depicts an image, possibly of a boar, with the script "of Yesh..a".

In all the legible bullae but one, the sealing was performed by a metal finger ring or a scaraboid pendant. Only one bulla (WD51) seems to have been sealed by a cylinder seal (Leith 1997). Thick cords were found attached to all analyzed bullae except for one (WD39), which may have been burnt. Originally, 12 of the bullae were found attached to six different papyri.

The examination of the bullae was carried out in the climate-controlled storeroom of the IAA and at the conservation laboratories of the Israel Museum. The tiny samples extracted from the bullae were analyzed at the Laboratory for Comparative Microarchaeology at Tel Aviv University.

This research was performed in two stages. First, the structural and technical aspects of the bullae were examined under a stereomicroscope, with magnifications ranging between $\times 10$ and $\times 100$. This was done in order to record minute details of the papyrus and the cord impressions, the fingerprints and other imprints, and of course the seal impressions themselves. These examinations were aimed at addressing some technical questions, such as the general composition of the fabric and the process of preparing the bullae around the cord. At the same time, minute samples were extracted from the bullae by a peeling technique with the aid of a scalpel. The samples were stored in small test tubes and brought to the Laboratory for Comparative Microarchaeology at Tel Aviv University for further analysis. The shallow laminae taken from the bullae, only a few millimetres in size, were peeled off from a broken facet of each of the bulla or from its reverse side under the stereomicroscope (Zeiss Stemi C). The samples were set in moulds made of small, rounded polyethylene test tube cups, and arranged with the widest surface area facing downward. The cups with the samples were put in a dissector, where they 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 petrographic examination under a polarizing microscope Zeiss Axiolab Pol using $\times 50$ – $\times 400$ magnifications.

Results

Organic remains on and within the clay were identified under the stereomicroscope. On the reverse side of all the bullae, papyri imprints and sometimes minute pieces of papyri were seen clinging to the clay or caught in a delicate coil (Fig. 3). On some of the bullae, a single set of cords was identified passing through the centre of the bullae and around the papyrus (Fig. 4), while on other bullae two sets of cords were visible—one running through the bullae centre and around the papyrus, and the other around the back of the bullae (Fig. 5).

As most of the bullae are complete, only the point of penetration and exit of the cords on either side of the bullae could be identified. The visible cords coming out of the canal have cut ends. In some cases, uncut cords were identified, still connected and forming a loop around the now disintegrated papyrus (Fig. 3). The internal cord always seems to pass close to the back of the bullae. Fingerprints could also be seen on some of the bullae,

TABLE 1
The analyzed assemblage*

Bulla No.	R No.	IM No.	IAA No.	Impression	Style	Seal type	Petrography	String	Papyri	Papyri context	Notes
WD3B	779		461370	Hero vs. flanking animals?	Persian?	Scaraboid?	<i>Terra rossa</i>	Y	14	Deed of consignment of public rooms	
WD11C	769	5107.05		Heraclès	Greek	Metal finger ring	<i>Rendzina</i>	Y	1	Deed of slave sale	Listed as 5107.07
WD11D	768	5107.09		Illegible			<i>Rendzina</i>	Y	1	Deed of slave sale	Listed as 5107.06
WD11E	772	5107.10		Mature man in himation	Greek	Metal finger ring or scaraboid	<i>Terra rossa</i>	Y	1	Deed of slave sale	Listed as 5107.10
WD11F	770	5107.07		Illegible			<i>Rendzina</i>	Y	1	Deed of slave sale	Listed as 5107.08
WD11G	774	5107.06		Illegible			<i>Rendzina</i>	Y	1	Deed of slave sale	Listed as 5107.11
WD13	966		580874	Flanking winged sphinxes, Egyptian crowns	Persian	Circular stamp (conical?)	<i>Terra rossa</i>	Y	Detached		
WD15B	766	5107.11		Seated youth	Greek	Metal finger ring	<i>Terra rossa</i>	Y	6	Deed of slave sale	Listed as 5107.05
WD16A	760		461361	Frontal nude warrior with spear	Greek	Metal finger ring?	<i>Terra rossa</i>	Y	3	Deed of slave sale	
WD16B	777		461367	Satyr (Dionysian subjects)	Greek	Metal finger ring	<i>Terra rossa</i>	Y	3	Deed of slave sale	
WD21B	767		461365	Dancing satyr	Greek	Metal finger ring	<i>Terra rossa</i>	Y	2	Deed of slave sale	
WD21D	780		461369	Standing nude youth	Greek	Scaraboid? Ring?	<i>Terra rossa</i>	Y	2	Deed of slave sale	

Bulla No.	R No.	IM No.	IAA No.	Impression	Style	Seal type	Petrography	String	Papyri	Papyri context	Notes
WD22	972	5107.12		“...-iah, son of (San)ballat, governor of Samaria”	Israelite	Scaraboid	<i>Terra rossa</i>	Y	16	Deed of pledge of vineyard?	
WD23	973		461360	“Of Yesh.aç”/ Boar?	Israelite	Metal finger ring	<i>Terra rossa</i>	Y	Detached		
WD39	936		461195	Heracles	Greek	Metal finger ring	<i>Terra rossa</i>	N	Detached		
WD40	937		461196	Kneeling Eros	Greek	Metal finger ring	<i>Terra rossa</i>	Y	Detached		
WD41	938		580881	Flanking winged sphinxes, Egyptian crowns	Persian	Circular stamp (conical?)	<i>Terra rossa</i>	Y	Detached		
WD42	939		461197	Heracles and lion	Greek	Metal finger ring	<i>Terra rossa</i>	Y	Detached		
WD48	945		580879	Flanking winged sphinxes	Persian	Metal finger ring?	<i>Terra rossa/ Rendzina</i>	Y	Detached		Listed as 580877
WD51	948		580877	Hero fights flanking inverted lions	Persian	Cylinder	<i>Terra rossa</i>	Y	Detached		Listed as 580879
WD54	951		461205	Perseus with sack / inscription?	Greek	Metal finger ring	<i>Terra rossa</i>	Y	Detached		
WD10B	771	5107.08					<i>Terra rossa</i>	Y			Listed as 5107.09

* R–Rockefeller Museum; IM–Israel Museum; IAA–Israel Antiquities Authority



FIGURE 3 WD41, reverse side. Remains of papyrus under the curvature; cords forming a loop.



FIGURE 4 WD23, single set of cords, 'partial securing technology'.



FIGURE 5 WD13, two sets of cords, 'maximal securing technology'.

usually on the sides and close to the seal impression (Fig. 2). In some cases, cracks were visible surrounding the impression, making the bullae look split and grooved.

The petrographic examination of the samples in thin sections under a polarizing microscope indicated that all bullae were made from soils local to the Samaria area. Two clear petrographic groups were identified. Sixteen bullae were made out of *terra rossa* soil. Four bullae were made out of brown *rendzina* soil and one bulla could not be definitively classified as having been made of *terra rossa* or *rendzina* soils.

The *terra rossa* group (Fig. 6: A)

Matrix: Reddish-tan in plain-polarized light (PPL), silty, non-calcareous, exhibiting strong optical orientation, hence argillaceous in nature. The silt is made mostly of quartz with accessory zircon and hornblende. In one case the matrix is dark and nearly opaque (Fig. 6: B), probably due to reducing firing atmosphere.

Inclusions: Sand of fine subangular quartz grains with the addition of calcite and a few chert particles.

Geological interpretation: *terra rossa* soils occur on hard limestone and dolomite exposures in the semi-arid to sub-humid Mediterranean climatic zones (Ravikovitch 1981: 58). This soil material is eroded downslope, forming colluvial-alluvial soils. All the soil materials in Israel include, to varying degrees, 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). 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.

The brown *rendzina* group (Fig. 6: C)

Matrix: Calcareous, greyish-yellow to orange in PPL, sometimes darker. The silt contains essentially quartz with the addition of calcite and some accessory minerals, of which plagioclase, zircon and pyroxene were identified. Small amounts of foraminifers were identified.

Inclusions: Sand in which *Nari* particles are dominant. Subangular to rounded fine quartz sand is common.

Geological interpretation: Brown *rendzina* soils cover substantial parts of slopes in the hilly areas of northern and central Israel (Ravikovitch 1981: 87). Brown *rendzina* soils occur together with pale *rendzina* in the semi-arid to sub-humid Mediterranean climate. The distribution of the two soils is related to catenary differentiation (Dan *et al.* 1972). The brown *rendzina* derives from the *Nari* crust. This soil material is eroded downslope, forming colluvial-alluvial soils and grumusols. The amount of soil material that results from

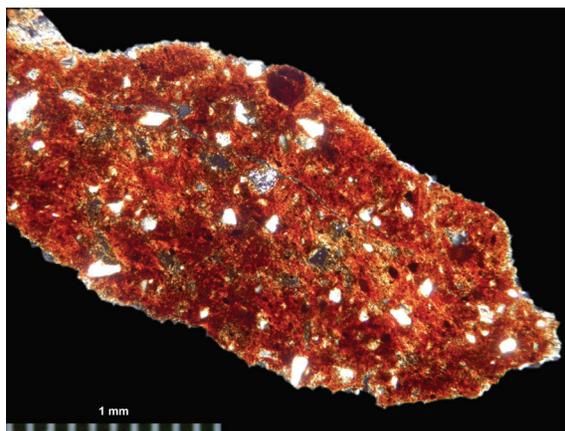


FIGURE 6A WD21B, x10, *terra rossa* soil, crossed polarizers.

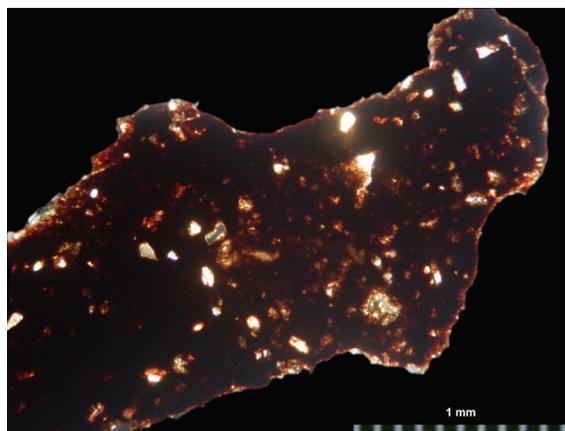


FIGURE 6B WD39, x10, *terra rossa* soil, perhaps fired, crossed polarizers.

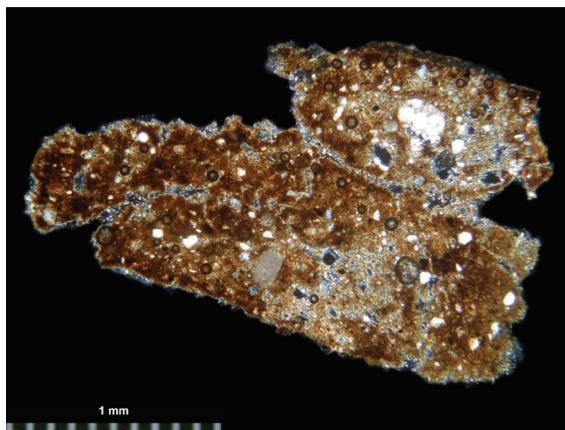


FIGURE 6C WD11D, x5, *rendzina* soil, crossed polarizers.

the weathering of the *Nari* is low, and relatively large amounts of aeolian dust contribute to the formation of the brown *rendzina* soil.

The Eocene chalks of Israel are comprised of more than 60% foraminifer biorelicts. In the upper *Nari* the foraminifera are destroyed by dissolution and recrystallization processes, while in the lower *Nari* about 30% foraminifer biorelicts occur. The appearance of the foraminifera is one of the important components in the description and classification of these soils and of the pottery that is made from them.

Discussion

Although the majority of bullae analyzed had cut cords, in a few cases, the looped cord stayed uncut (Fig. 3), as if the papyrus roll decayed and split under the cords that originally secured it (Leith 1997: 19). For the most part, the papyri were found in very poor condition, worm-eaten and with badly frayed fibres (Cross 1963: 111). The remaining loop served to indicate the document's diameter, and it is surprising to discover that it was very small.

Two main groups representing different technologies of designing and forming the bullae were recognized. The first and largest group displays a 'partial securing technology', and includes bullae that have one set of cords passing through the ball of clay (Fig. 4). This group of bullae depicts only the negative impressions of the material to which they were affixed. This technique of sealing involved pressing one lump of clay against the sealed object, securing both of them with the cord; after which another piece of clay was placed over the cord and pressed onto the first lump. Only then was the object sealed with a sealing ring. This technology assures the affixing of the bulla to the sealed object.

The second group, of which there were three examples, displays a 'maximal securing technology' and includes bullae that have two separate sets of cords: an internal set, similar to the first group, and an external set that ran along the back of the bullae (Fig. 5). These bullae depict both the negative impressions of the material to which they were affixed and the impression of the external cords. This technique of sealing involved wrapping the object with the cord and pressing the first lump of clay against the cord; the cord was then wrapped around both the sealed object and the lump of clay; another piece of clay was then placed over the cord and the first lump of clay and pressed onto them. Only then was the document sealed with a sealing ring. This technology of double wrapping the cord was the most secure way of affixing the bullae to the sealed objects.

Both these technologies are seen on bullae from the City of David and are typical of the Iron Age. These assemblages, however, depict technological variation based on the material being sealed (a document or a bundle) and on periodic changes. One assemblage excavated by Reich and Shukron (Reich *et al.* 2007) is characterized by a number of securing technologies, mainly the 'partial securing technology'. This assemblage is dated to the end of the 9th–beginning of the 8th century BCE and displays a variety of materials that the bullae sealed, among them papyri, wood, fabrics, basketry and leather. The cords in use were mainly thick. It is reasonable to assume that the nature

of the sealing process was based on the nature of the sealed object. Therefore, papyri were secured differently than wooden boxes.

The assemblage excavated by Shiloh (1984) is characterized mainly by the ‘maximal securing technology’. The bullae dated to the end of the 7th–beginning of the 6th century BCE and sealed only papyri. The technique used was homogeneous and consistent, employing very thin cords.

The assemblage excavated by E. Mazar (2009) depicts both of the securing technologies, with an obvious distinction in the nature of the sealed object. Bullae from the end of the Iron Age bearing negative sealings of papyri and thin cords were sealed using the ‘maximal securing technology’, while bullae sealing a variety of materials used mostly thick cords and were sealed with the ‘partial securing technology’.

It is clear that the sealing technology changed over the centuries. During the Iron Age, the ‘maximal securing technology’ was most common, where first the papyrus was tied and then sealed. In the Persian period, the ‘partial securing technology’ dominated, where the ball of clay was placed directly on the papyrus, without tying it first.

Analysis of earlier bullae indicates that only one type of soil was used for sealing complete assemblages. In the City of David, three different groups of bullae were analyzed from different excavations (Shiloh 1984; Reich *et al.* 2007; Mazar 2009). All of these bullae are made from one type of local *terra rossa* soil that develops in the hilly areas of Israel and is widespread in north and central Israel (Goren *et al.* 2004: 284). Seventeen bullae found at Lachish (Aharoni 1975: 19–22) in the early 1960s were all made out of loess soil, which occurs in Israel mainly in the northern Negev and the southern Shephelah (Goren *et al.* 2004: 112; Arie *et al.* 2011). The fact that all the bullae were found to be made of clay from the sites where they were deposited supports the idea that they sealed locally circulated documents or local legal and administrative documents (*ibid.*).

The analyzed bullae from Wadi Daliyeh were all made of local soils from the Samaria area. *Terra rossa* is the predominant clay in the sampled group, with a majority of 16 bullae vs. four bullae made of *rendzina* soil. All four of the *rendzina* bullae were found attached to WDSP1; together with them was one bulla of *terra rossa* clay. The *terra rossa* and brown mountainous *rendzina*, together with alluvial and colluvial-alluvial soils, define the region surrounding the city of Samaria.

While all the Iron Age bullae assemblages from Judah examined were homogeneous and each one was made from local soil, in Wadi Daliyeh two types of local soils were found. Five bullae were attached to WDSP1 combining two types of soil: four of *rendzina* (WD11C, WD11D, WD11F, WD11G) and one *terra rossa* (WD11E). Since both these local soils are combined, and the document was probably sealed at שמרין קריתא זי בשמרין מדינתא, it seems to indicate that there was no attempt at differentiation and no preference for one soil over another. The people of Samaria, as well as those from the Iron Age City of David and Lachish, probably took whatever local material was available at the time, without any preference or selection of the clay.

Conclusion

The extreme weather that dominates the eastern slopes of the Samaria Hills created perfect conditions for the preservation of organic materials. The Wadi Daliyeh bullae are a unique entity not only because the bullae were preserved, but also because of the papyri themselves and the cords that enclose them. This find made it possible for us to examine the organic material attached to the bullae and hence reconstruct the formation of sealing. The common method of sealing identified in the Wadi Daliyeh assemblage was two lumps of clay embracing a cord that secured the document.

The fact that the Wadi Daliyeh documents are local to Samaria can indicate a group of private letters or an archive that could be either private or public. The interpretation of the papyri as private contracts and legal records makes it possible to conclude that the assemblage was a private archive taken to the cave by a family or a group fleeing danger, grasping only what was necessary and most important to them at a time of desperation.

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References

- Adan-Bayewitz, D. and Wieder, M. 1992. Ceramics from Roman Galilee: A Comparison of Several Techniques for Fabric Characterization. *Journal of Field Archaeology* 19: 189–205.
- Aharoni, Y. 1975. *Investigations at Lachish: The Sanctuary and Residency (Lachish V)* (Publications of the Institute of Archaeology of Tel Aviv University 4). Tel Aviv.
- Arie, E., Goren, Y. and Samet, I. 2011. Indelible Impression: Petrographic Analysis of Judahite Bullae. In: Finkelstein, I. and Na'aman, N., eds. *The Fire Signals of Lachish: Studies in the Archaeology and History of Israel in the Late Bronze Age, Iron Age and the Persian Period*. Tel Aviv: 1–16.
- Ariel, D.T. and Naveh, J. 2003. Selected Inscribed Sealings from Kedesh in the Upper Galilee. *BASOR* 329: 61–80.
- Cross, F.M. 1963. The Discovery of the Samaria Papyri. *BA* 26: 110–121.
- Cross, F.M. 1969. Papyri of the Fourth Century B.C. from Daliyeh. In: Freedman, D.N. and Greenfield, J.C., eds. *New Directions in Biblical Archaeology*. New York City: 41–62.
- Cross, F.M. 1978. The Historical Importance of the Samaria Papyri. *BAR* 4: 25–27.
- Cross, F.M. 1985. Samaria Papyrus 1. *EI* 18: 7*–17*.
- Cross, F.M. 1988. A Report on the Samaria Papyri. In: Emerton, J.A., ed. *Congress Volume: Jerusalem 1986 (VT.S 40)*. Leiden: 17–26.
- Dan, J., Yaalon, D.H., Koyumdjisky, H. and Raz, Z. 1972. The Soil Association Map of Israel. 1: 1,000,000. *Israel Journal of Earth-Sciences* 21: 29–49.
- Dušek, J. 2007. *Les manuscrits araméens du Wadi Daliyeh et la Samarie vers. 450–332 av. J.-C.* Leiden and Boston.

- Eshel, H. 1998. The Finds from the Cave of Araq En-Na'saneh in Wadi ed-Daliyeh. In: Eshel, H. and Amit, D., eds. *Refuge Caves of the Bar Kokhba Revolt*. Tel Aviv: 71–76 (Hebrew).
- Goren, Y., Finkelstein, I. and Na'aman, N. 2004. *Inscribed in Clay: Provenance Study of the Amarna Tablets and other Ancient Near Eastern Texts* (Monograph Series of the Institute of Archaeology of Tel Aviv University 23). Tel Aviv.
- Goren, Y. and Gurwin, S. 2013. Royal Delicacy: Material Study of Iron Age Bullae from Jerusalem. *The Old Potter's Almanac* 18: 2–9.
- Gropp, D.M. 1986. *The Samaria Papyri from Wadi ed-Daliyeh: The Slave Sales* (Ph.D. dissertation, Harvard University). Cambridge, MA.
- Gropp, D.M. 2001. *Wadi Daliyeh II: The Samaria Papyri from Wadi Daliyeh* (Discoveries in the Judaean Desert XXVIII) Oxford.
- Gurwin, S. 2010. *Technology and Function of Judahite Bullae from the Time of the First Temple* (M.A. thesis, Tel Aviv University). Tel Aviv (Hebrew).
- Lapp, P.W. and Lapp, N.L., eds. 1974. *Discoveries in the Wadi ed-Daliyeh* (The Annual of the American Schools of Oriental Research 41). Cambridge, MA.
- Leith, M.J.W. 1990. *Greek and Persian Imagery in Pre-Alexandrine Samaria* (Ph.D. dissertation, Harvard University). Cambridge, MA.
- Leith, M.J.W. 1997. *Wadi Daliyeh I: The Wadi Daliyeh Seal Impressions* (Discoveries in the Judaean Desert XXIV). Oxford.
- Mazar, E. 2009. *The Palace of King David: Excavations at the Summit of the City of David, Preliminary Report of Seasons 2005–2007*. Jerusalem.
- Porten, B. 1996. *The Elephantine Papyri in English: Three Millennia of Cross-Cultural Continuity and Change* (Studies in Near Eastern Archaeology and Civilisation 22). Leiden.
- Porten, B. and Yardeni, A. 1986. *Textbook of Aramaic Documents from Ancient Egypt*. Jerusalem.
- Ravikovitch, S. 1981. *The Soils of Israel: Formation, Nature and Properties*. Tel Aviv (Hebrew).
- Reich, R., Shukron, E. and Lernau, O. 2007. Recent Discoveries in the City of David, Jerusalem. *IEJ* 57: 153–169.
- Shiloh, Y. 1984. *Excavations at the City of David I, 1978–1982. Interim Report of the First Five Seasons* (Qedem 19). Jerusalem.
- Stern, E. 1992. A Hoard of Persian Period Bullae from the Vicinity of Samaria. *Michmanim* 6: 7–30 (Hebrew).