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Petrographic Variability of the Fabrics of Wine Jars from Sha'ar-Ha 'Amakim as a Reflection of Differences in Their Provenance and Chronology

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Abstract: The aim of the present study is to investigate the relationship between the shape of the Levantine wine jars discovered at Sha'ar-Ha 'Amakim and the petrography of their respective fabrics. The majority of sampled ceramic material originates in well-defined chronological phases of the settlement at the site, spanning the Persian through to the Middle Roman periods. The obtained results clearly demonstrate a connection between the historical period and the raw materials used in jar production. Specifically, the jars of the Phoenician type used in the Persian and Hellenistic periods were made from a fairly homogeneous raw material, the features of which such as the content of the fragments of the coralline alga *Amphiroa* confirm the previous results of the investigations of jars whose fabric has been considered as Phoenician. On the other hand the bag-shaped jars, especially those of the Hellenistic period, are characterized by the more diversified petrography of their fabrics, suggesting that they were produced by a number of local workshops to supply the needs of local wineries. Finally, the Roman period brings an abrupt change in the production of wine containers, with the introduction of the common use of the fine ferruginous soil rich in quartz silt.

Keywords: Sha'ar-Ha 'Amakim, wine jars, Persian period, Hellenistic period, Roman period, jars petrography

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As is known from written sources and archaeological finds, Galilee was a region abounding not only in olive groves, but also in vineyards.[1] The wine that came from them was probably an object of regional trade, especially intense in the borderland between western Galilee and southern Phoenicia. Differences in the shape of wine containers found in this region reflect not only chronological divisions, but are also indicative of the origin of their

[1] Safrai 1994: 132–133.

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individual models, that is, of 'coastal' Phoenician and 'inland' non-Phoenician tradition respectively. Those types and their derivatives kept developing over centuries, giving rise to several typo-chronological variants (see below).

It is obvious that the centres producing each type of wine jar[2] were associated with specific areas of grapevine cultivation. However, any closer identification of places producing amphorae is impossible without an in-depth analysis of the mineral composition of the raw material used, often termed 'fingerprints' of individual workshops. Such a study requires both optical microscope observations and an analysis of the chemical composition of the ceramic mass of the containers.

In the framework of the research project entitled 'Provenance of the Palestinian-type amphorae from the Graeco-Roman period at the Sha'ar-Ha 'Amakim and Tell Keisan sites (Galilee, Israel) in the light of petro-archeological studies', samples of jars found at three different localities in western Lower Galilee (Sha'ar-Ha 'Amakim) and southern Phoenicia (Tell Keisan and Tel Akko) were selected for the above-mentioned analyses. However, the subject of the present paper are the samples only from Sha'ar-Ha 'Amakim, firstly because they constitute the most numerous group, and then because of the specific geographical situation of the site. Its location on a stretch of *Via Maris,* between the plain of Akko (the Zevulun valley) which was a part of southern Phoenicia, and the plain of Esdrelon (Yezreel valley) made it an ideal place for interregional trade exchange.

The excavations at Sha'ar-Ha 'Amakim (1984–1998) were carried out by Arthur Segal from Haifa University and Yehuda Naor, one of the founders of the kibbutz on the grounds of which the ancient site had been discovered, with Jolanta Młynarczyk in charge of the stratigraphy and ceramics from 1994. Within the excavated area, seven strata have been distinguished, the lowermost of which (stratum VII) has been dated to the fourth century BC, and the uppermost one (stratum I) to the Roman period. In correlation with these strata, the ceramic material has been divided into Phases A through F. While the eldest Phase A was connected with some scanty architectural remains of the Persian and Early Hellenistic periods,[3] Phase B was represented, among others, by a rich assemblage of the third to earlier second century BC pottery sealed in an abandoned wine cellar of a mansion.[4] The final phase of the settlement, Phase F, was best represented by the domestic pottery assemblage from Cistern D, dated to the third and into the fourth century AD.

The ceramics and other objects found at Sha'ar-Ha 'Amakim are eloquent in illustrating the changes in the ethnicity of its inhabitants. In the Persian to the Late Hellenistic periods it was a gentile site, which after 200 BC passed from Ptolemaic into Seleucid hands. However, at the very turn of the second century BC this area was conquered by either Aristoboulos I or Alexander Jannaeus and became a part of the Jewish Hasmonean kingdom. This may have been also the place of *Gaba Hippeon*, where Herod the Great settled the veterans of

[2] See: Finkielsztejn 2006: 254 n. 3, for the explanation of the term 'jar', commonly used to describe the Levantine amphorae.

[3] For the stratigraphy of the site and the phasing of the ceramics, see: Młynarczyk 2009a.

[4] So-called Cistern G/R, see: Młynarczyk 2000.

his cavalry. In the Herodian period, on the eve of the First Revolt, at least some part of the population must have been Jewish, to judge by the finds of fragmentary Jewish ritual vessels of chalk stone (*kallalim*).[5] After a possible episode of a Roman outpost established there during the Revolt, Sha'ar-Ha 'Amakim became a modest settlement, once again Jewish, in the second–third centuries AD, probably connected with the nearby Beth Shearim.

All those historical periods and stratigraphical phases attested at Sha'ar-Ha 'Amakim abounded in storage jars, destined mostly for the wine, but some perhaps also for olive oil. Moreover, one should note the presence of a number of rims pertaining to the jars of a period earlier than any architectural remains discovered at the site, that is to the last phase of the Iron Age II (late seventh and sixth centuries BC).[6]

The research questions we posed at the start of our project were the following:

– How many 'ceramic workshops', understood as distinct 'petrographic groups', could take part in providing Sha'ar-Ha 'Amakim with wine amphorae (or possibly interchangeably with the olive ones)? How far do the kinds of material distinguished on the basis of macroscopic observation coincide with divisions obtained as a result of physico-chemical examinations?
– Does the material used to produce amphorae of the Persian and Hellenistic periods (fifth to second century BC) differ from that used to produce vessels performing the same function in the Roman period (first century BC to third century AD)? Can we speak of a technological evolution over the ages?
– Is it possible to indicate the source (sources?) of the material used to produce the amphorae found in Sha'ar-Ha 'Amakim?
– Does the physico-chemical examination of amphorae identical in shape and similarly dated, but differing in colour confirm their different workshop origin?

A total of 152 samples were examined: 134 fragments of jars (Levantine amphorae, among them a few may have pertained to other large closed forms such as *pithoi* or jugs), plus 10 samples of jugs and eight samples of other ceramic objects.

In order to facilitate the comparisons between the jar samples representing vessels of different (Phoenician *versus* non-Phoenician) origin, as well as their predecessors and later developments, each typo-group in our study received a numeric symbol: 1 for jar shape of Phoenician origin (with chronological subdivisions), 2 for jar shape of non-Phoenician origin (with chronological subdivisions), 3 for water jugs whose fabrics are visually comparable to those of jars, and 4 for objects other than jars and jugs. The relevant groups can be characterized as follows:

[5] For chalk vessels from Sha'ar-Ha 'Amakim as 'reliable indicator of Jewish presence', see: Burdajewicz 2009: 203–206 and Fig. 1. In Yodefat, with its definitely Jewish population, *c*. 110 fragments of stone vessels were found (Aviam 2015: 122–123).

[6] Burdajewicz 2015; that a settlement existed at Sha'ar-Ha 'Amakim during the Persian period has been recognized by Lehmann 2001: 98, Fig. 3.9 (site no. 110).

GROUP 1A (**Fig. 1**)

The Phoenician type jar, hole-mouthed, known among other things as a 'shouldered', 'waisted', 'torpedo' or 'carinated-shoulder' jar, its capacity amounting to 10–13 liters.[7] In Sha'ar-Ha Ămakim it occurs in the Persian and Early Hellenistic periods,[8] with a number of residual rim fragments from the late Iron Age II – Iron Age III.[9] A detailed typology of the Phoenician jars according to their shape has recently been presented by Elisabeth Bettles on the basis of the finds from Sarepta.[10] It is unfortunately useless for our material in which usually only rim fragments are preserved, while the body shape can rarely be reconstructed.

Macroscopically, the prevailing fabric of the jars in our group 1a is the so-called Phoenician semi-fine ware, first described by Andrea Berlin at Tel Anafa in the Hula valley,[11] and said to have come from the Tyre area. Actually, the same fabric characterizes the jars from Sarepta.[12] Another recognizable fabric, less represented at Sha'ar-Ha Ămakim, but very common at Tell Keisan in the Persian and Hellenistic periods, is the so-called Light White ware.[13]

GROUP 1B (**Fig. 2:1–3)**

A late Phoenician type jar, hole-mouthed with a thick out-rolled rim; the body is bag--shaped and mildly wheel-ridged (except for the shoulder); it has twisted handles and a knob base. As with most jars of our group 1a it represents the so-called Phoenician semi-fine ware.[14] Gerald Finkielsztejn, who describes the form in question as the 'ribbed pear-shaped amphora', believes that this type appeared in the second century BC.[15] Indeed, in Tel Anafa the type was present by 125 BC,[16] and in Tel Dor it made its appearance in the contexts of the second half of the second century BC.[17] At Sha'ar-Ha Ămakim, however, its examples, represented by just rims, handles and body sherds, have occurred in context with Late Hellenistic and Early Roman pottery. They are also known in Yodefat.[18] In the Late Hellenistic stratum at

[7] According to Zemer 1978: 24–25, nos 18–22, Pls 6–7 (date range of the seventh/sixth to fourth century BC).

[8] For the Hellenistic-period examples of our group 1a present at other sites, see e.g. Tell Keisan: Briend, Humbert 1980: Pl. 7 (*niveau* 2); Akko: Regev 2010: 123–124, Figs 1–2 and Smithline 2013: 94, Fig. 11:6–8; Horbat Uza: Smithline 2009: 147, Fig. 4.8:7–8.

[9] Burdajewicz 2015: 14, Fig. 5.

[10] Bettles 2003a; 2003b; see also: Reynolds 2005: Pl. 12, Figs 84–88 ('Persian – Hellenistic Tyrian and Sidonian amphorae').

[11] Berlin 1997: 9–10; Młynarczyk 2001: 247.

[12] Bettles 2003a; 2003b.

[13] For the macroscopic description of the ware, see: Młynarczyk 2001: 240–241.

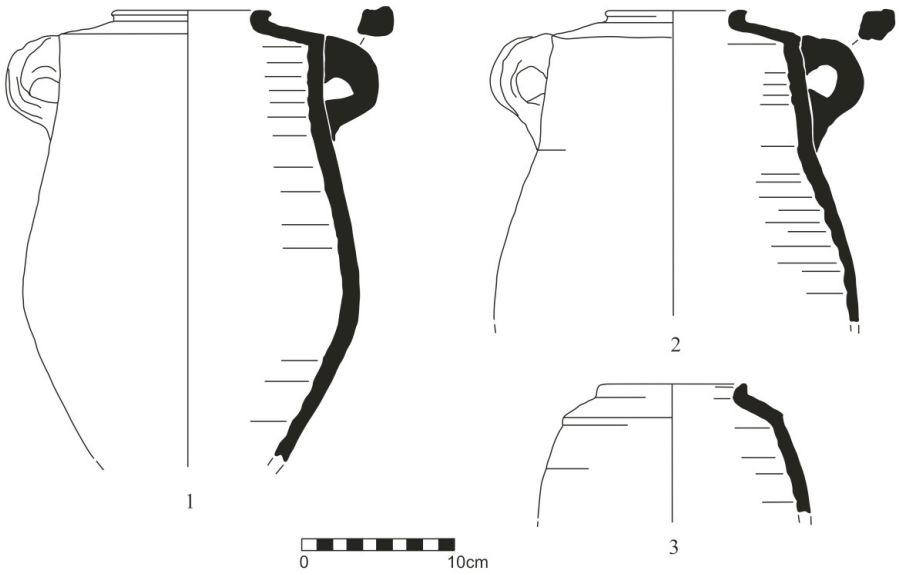
[14] It seems, however, that a parallel form was known in other wares as well, see: Młynarczyk 2009b: Fig. 5:12 (from Sha'ar-Ha Ămakim) and nn. 45–46 (from Ramat Hanadiv and Machaerus).

[15] Finkielsztejn 2006: 255, Fig. 3.

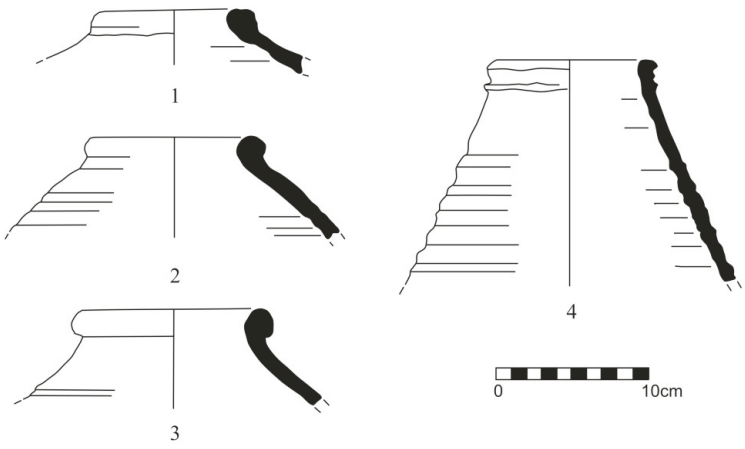
[16] Berlin 1997: 155, PW 480–483.

[17] Guz-Zilberstein 1995: 312, Type JR 3, Fig. 6.38:6–9.

[18] Avshalom-Gorni, Getzov 2002: 79, Fig. 5.2:1–2.



1. Examples of ‘carinated-shoulder’ Phoenician type jars from Sha‘ar-Ha Ămakim (group 1a): 1. inv. no. 192.2; 2. inv. no. 864.1; 3. inv. no. 192.5 (Drawing: M. Burdajewicz).



2. Examples of late Phoenician type jars (1–3, group 1b) and post-Phoenician type jar (4, group 1c) from Sha‘ar-Ha Ămakim: 1. inv. no. 818.4; 2. inv. no. 940.1; 3. inv. no. 200.19; 4. inv. no. 169.1 (Drawing: M. Burdajewicz).

Shiqmona (a destruction layer dated to between 130 and 125 BC),[19] the capacity of such jars amounted to 26 liters,[20] while Avshalom Zemer illustrates a similar jar with a capacity of *c*. 19 liters.[21] Occasionally, the handles of the jars in question bore stamp impressions. The stamps with inscriptions in Phoenician have firmly been identified as belonging to Tyrian producers, yet Sha'ar-Ha Ȧmakim has yielded three stamp impressions in Greek which remain neither deciphered nor connected to any manufacturing center.[22]

GROUP 1C (**Fig. 2:4**)

Post-Phoenician type jars, hole-mouthed elongated, of the Early Roman to Roman period. They occur at Sha'ar-Ha Ȧmakim in just few fragments which represent more than one fabric, all of them untypical for our site, to judge by visual examination.[23] They are not stratified, but the accompanying pottery would place them in the first and second centuries AD. One rim fragment (sample SF-109, not illustrated) pertains to a Roman-period 'cigar-shaped' jar with parallels in Yoqne'am,[24] Ramat Hanadiv[25] and Shiqmona,[26] while another jar fragment (sample SFx-113: **Fig. 2:4**) resembles by its form the Tyrian hole-mouth amphora of the late second century AD.[27]

GROUP 2A (**Fig. 3**)

A bag-shaped jar, in the shape variant characteristic of the Persian and Hellenistic periods.[28] It is virtually neckless, with everted rim and oval-sectioned, usually ridged, handles set below the shoulder.

The manufacturing of such jars at Tel Michal during the fifth century BC has been attested by kiln finds.[29] At Nahal Tut (near Yoqne'am) jars of this form were found in a context dated to the last quarter of the fourth century BC.[30] As a matter of fact, they were common in a wide area from Judea and Sharon in the south through Samaria to the Galilee in the north, including the whole coastal belt.[31] It is to be noted that during the later Persian and

[19] Elgavish 1976: 65–67.

[20] Elgavish 1976: 74–75, Fig. 6:18, Pl. 15:D.

[21] Zemer 1978: 32, no. 27, Pl. IX, vol. *c*. 19 liters (misdated to the fifth–fourth centuries BC).

[22] Finkielsztejn 2006: 258; 2009: 140–142, does not exclude that they may have come from Tyre as well.

[23] Młynarczyk 2009b: Fig. 5:13–14 (our samples SF-109 and SFx-113, respectively).

[24] Avissar 1996: 74, Fig. XII.7:7.

[25] Calderon 2000: 92–93, Pl. I:28.

[26] Elgavish 1977: Pl. XIX:155.

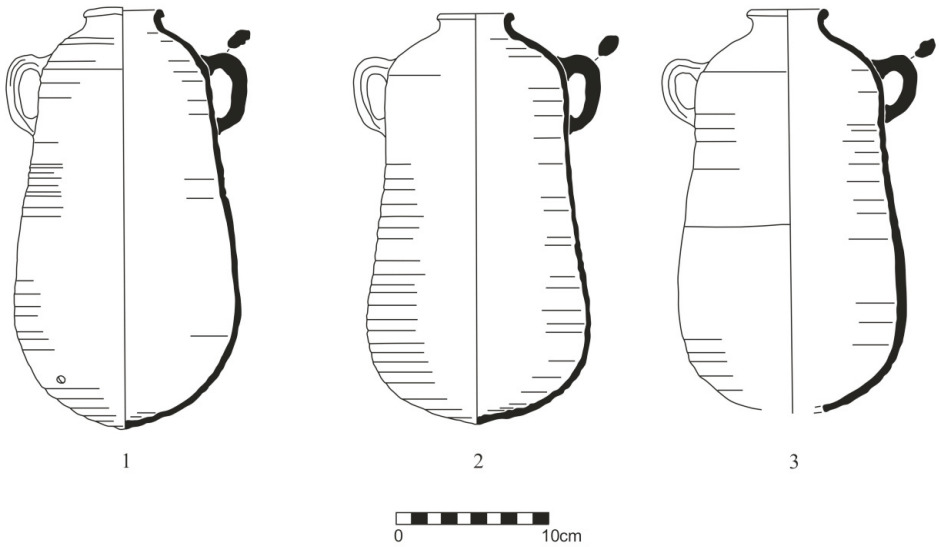
[27] Reynolds 1997–1998: 81, Fig. 200. A fragment of a comparable amphora from the nearby Jalame (Johnson 1988: Fig. 7–50, no. 747, undated) is made of 'fine red clay with pale yellow slip'. See also: Reynolds 2005: Pl. 12, Figs 89–91 ('Tyrian amphorae of the Roman period'); Avshalom-Gorni, Getzov 2002: 79, Fig. 5.2:4 (from Yodefat).

[28] Finkielsztejn 2006: 255, Fig. 4.

[29] Singer-Avitz 1989: Fig. 9.4.

[30] Alexandre 2006: 156 and Figs 50:1–10, 52:1–3, 8–12, 53:12–17, 60:2–18, 61:4 and 9–15.

[31] For references, see: Młynarczyk 2000: 226–228, nn. 7–10. An example with a Phoenician inscription was found at Bat Yam near Ashdod in southern Israel, see: Shapira 1966: 10, Pl. 4A.



3. Examples of bag-shaped Hellenistic jars from Sha'ar-Ha 'Amakim (group 2a): 1. inv. no. 897.7; 2. inv. no. 890.8; 3. inv. no. 889.7 (Drawing: M. Burdajewicz).

the Hellenistic periods at a number of northern sites the jars of our group 2a co-occurred with those of groups 1a and 1b. That was the case with Yodefat,[32] Tell Keisan,[33] Tel Michal,[34] Akko,[35] and Horbat Uza stratum 10 (Hellenistic).[36]

In Sha'ar-Ha 'Amakim, the jar of group 2a is best represented by several restorable examples found in a household wine cellar ('cistern' G/R), whose one-time fill was fairly closely dated to the end of the third century and the first half of the second century BC.[37] The restorable jars were designed to contain 25–26 litres of wine.

At the coastal Shiqmona (the modern Haifa, *c*. 15km to the west of Sha'ar-Ha 'Amakim), similar jars continued to appear in a Late Hellenistic layer; they had capacity of *c*. 25 liters, but also of just 17 liters(!), and were said to be about half as common as the co-occurring jars of our group 1b.[38] Also at Dor, the type was still used in the second half of the second century BC.[39] At Tel Anafa in Hula valley, where there was a gap in occupation

[32] Avshalom-Gorni, Getzov 2002: 77, Fig. 5.1:1–3 (our group 2a, late variant) and 80, Fig. 5.2:1 (our group 1b); Aviam 2015: 111, Fig. B.

[33] Briend, Humbert 1980: Pls 7–8 (*niveau* 2: Persian/Hellenistic).

[34] Singer-Avitz 1989: 139–142, Fig. 9.17, nos 1 (our 2a, described as 'elongated' type) and 3 (our group 1a).

[35] Regev 2010: 123–124, Figs 1–2 (our groups 1a-b: 'Phoenician amphora Forms 1–2') and Fig. 3 (our group 2a: 'Local amphora Form 3'); Smithline 2013: 94 and Fig. 11:6–8 (our group 1a) and 9 (our group 2a).

[36] Smithline 2009: 146–147, Fig. 4.8, nos 1–6 (our group 2a) and nos 7–8 (our group 1a).

[37] Młynarczyk 2000; 2009b: Fig. 1–3.

[38] Elgavish 1976: 74, Fig. 6:19 and Pl. 15:E.

[39] Guz-Silberstein 1995: 311, type JR 1, subtypes a-b, apparently of local manufacture: Fig. 6.35:5 and 8–10; Fig. 6.36:1, 4 and 6–9. Cf. also Lapp 1961: type 11.3, rim variant F, example from Shechem, dated to 150–100 BC.

between *c*. 250 and 125 BC, a related shape appeared only in the last quarter of the second century BC.

The jars of group 2a at Sha'ar-Ha Ămakim were made of more granular fabrics than those of groups 1a-b; sometimes they were fired with a core, and normally had a pale--coloured surface. Visually, the fabrics can be described as gritty orange, pale brown, pale pink, light greyish brown etc, often with a range of mineral inclusions (white, light and dark grey, brown). However, some of the examples can be identified as the Light White ware, the same as occurring in group 1a.

GROUP 2B (**Fig. 4**)

A bag-shaped jar of the Roman period,[40] present at Sha'ar-Ha Ămakim from the latter first century BC to the third–fourth centuries AD.[41]

In the second half of the first century BC (phase D1), the Roman-period type of Levantine jars made its mass appearance at Sha'ar-Ha Ămakim. These containers were thin-walled, hard-fired, usually smaller than those of our group 2a; perhaps some of them may have held olive oil rather than wine. The occurrence of the group 2b jars at our site covers the phases D, E and F. Initially they had an elongated, round-bottomed body which with time became shorter and wider ('bulbous'), typically a ridge between the shoulder and an upright neck with a variety of rim profiles.

The fabric of the jars of the latter first century BC[42] and those of the first–second centuries AD[43] is very dense and extremely 'metallic', with a full or partial ash-grey core and white mineral inclusions seen mostly as eruptions to the surface, which is beige, pale pink, light greyish brown or reddish brown. Some jars preserve the remains of a thin and flaky beige slip. Subsequently, in the second/third century AD and later, the jars present at Sha'ar-Ha Ămakim have no grey core anymore, their break assuming the hues of red with abundant white grits, the surface fired to dark pink, orange-red, reddish brown.[44]

The final period of habitation of Sha'ar-Ha Ămakim has been dated to between the second and the third/fourth centuries AD by the material found in unsealed Stratum I and in the fill of a water cistern (Cistern D). The latter, apparently in use down to the first half of the fourth century, yielded ceramics of Phase F and residual objects of Phases D-E. Thus, the assemblage from Cistern D include jar forms apparently of the first/second centuries AD,[45] as well as the later ones.[46]

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[40] The form described as 'barrel-shaped' by Avshalom-Gorni, Getzov 2002.

[41] Byzantine-period version, type 2c, absent from Sha'ar-Ha Ămakim, is represented only by a couple of samples from Tell Keisan, not discussed in the present paper.

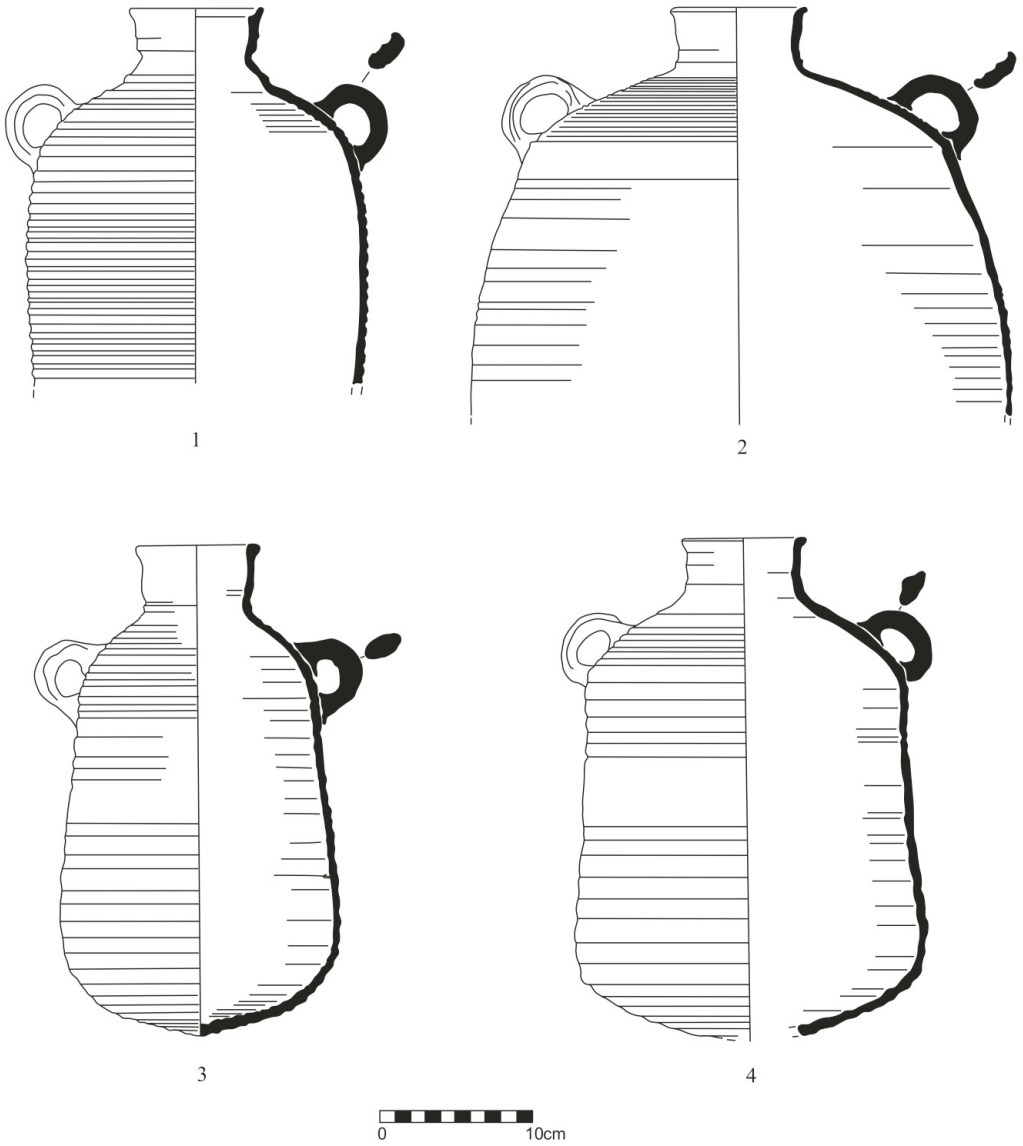
[42] Díez Fernández 1983: 181–182 and 229, T 1.3, with *floruit* between 50 BC and AD 50; see: Młynarczyk 2009b: Fig. 7:1.

[43] Díez Fernández 1983: T 1.8 and T 1.7 respectively; see: Młynarczyk 2009b: Fig. 7:2–3.

[44] Díez Fernández 1983: T 1.8 and T 1.9.

[45] Młynarczyk 2009b: Fig. 7:6, corresponding to Díez Fernández 1983: type T 1.2, dated to *c*. AD 50–150.

[46] Młynarczyk 2009b: Fig. 7:7, possibly to be identified as Díez Fernández 1983: type T 1.9 of the late second to early fourth century AD; close to Johnson 1988: Fig. 7–53, no. 809, in the same fabric.



4. Examples of bag-shaped Roman jars from Sha'ar-Ha Ămakim (group 2b): 1. inv. no. 806/809/836; 2. inv. no. 185.1; 3. inv. no. 744.1; 4. inv. no. 737.1 (Drawing: M. Burdajewicz).

For the Early Roman period, the best parallels to our jars are provided by the products of Yodefat, a Jewish settlement destroyed by the Romans in AD 67 and never rebuilt, where pottery kilns were found.[47] Allegedly, the same type of jars was being fired in two kilns discovered at Karm er-Ras site of Kafr Kanna (to the south-east of Yodefat and east of Sepphoris).[48] The parallels to the jars of our Phases E-F (Roman period) come from Shikhin,[49] while some jars comparable to those of Sha'ar-Ha Amakim Phase F were made in Ahihud.[50] Actually, the kiln site of Ahihud pertained to the cluster of sites situated less than 10km to the east of Akko, embracing also Yavor and Horbat Uza; all the three sites apparently began their activity as jar manufacturing centres in the Middle rather than the Early Roman period, that is, from the mid-second century AD on.[51]

GROUP 3A (**Fig. 5:1–3**)

Large bag- (sack-) shaped jugs, apparently intended for supplying and storing water; their body sherds or small fragments of rims may sometimes be mistaken for those of jars group 2a. Unlike those jars, however, they feature a pronounced neck. Such jugs at Sha'ar-Ha Amakim have been identified in the deposit of 'cistern' G/R.[52] Visually, they are of similar fabrics as most of the jars in group 2a. This vessel form originates in the local/regional ceramic repertoire of the Persian period, with examples attested both in the north and south.[53] In the Hellenistic period, however, the production of this form of the vessels seems to have been limited to the northern coastal area. Apart from Sha'ar-Ha Amakim, this form of jug is still common in the Hellenistic layers at Tell Keisan[54] and at Tel Dor, at the latter site occurring in a well-dated context of between 200 and 125 BC.[55]

GROUP 3B (**Fig. 5:4–5**)

Per analogiam to Hellenistic water jugs, these are the Roman-period jugs, apparently destined to carry water (dipper jugs), found in the deposit of Cistern D. Their fabric is comparable to that of the contemporaneous wine/olive-oil jars of our group 2b. Very thin-walled (almost 'egg-shell'), by their form they seem to be a distant development of storage jugs from 'cistern' G/R of pre-mid second century BC. They are not easy to be

[47] For the Yodefat type of jar, see: Avshalom-Gorni, Getzov 2002: 77, Fig. 5.1:4–7; Aviam 2014: 142, Fig. 5; 2015: 114 and 118; Avshalom-Gorni, Shapiro 2015: Fig. 10, no. 1a.

[48] Aviam 2015: 118.

[49] For the Shikhin type of jar, see Avshalom-Gorni, Getzov 2002: 77, Fig. 5.1:8–12, allegedly dated to AD 63–135; recently also Avshalom-Gorni, Shapiro 2015: Fig. 10, nos 3–3a.

[50] Avshalom-Gorni, Shapiro 2015: Fig. 10, no. 7 (type 'Uza 1a jar').

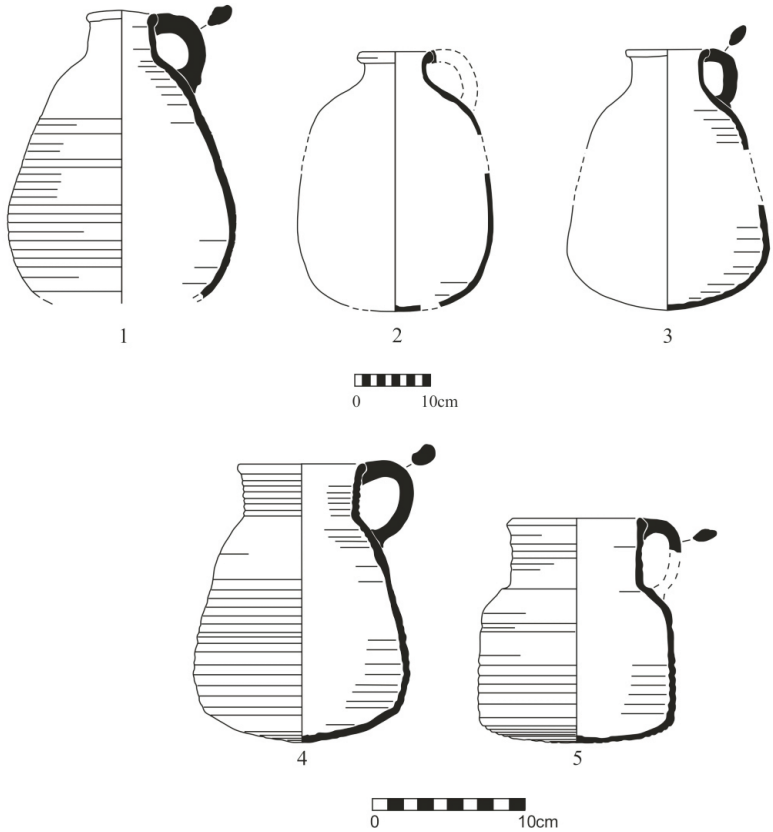
[51] See: Avshalom-Gorni, Shapiro 2015: 76–78 (the typology of the jars, see Fig. 10) and 80 (the discussion of the chronology).

[52] Młynarczyk 2000.

[53] Młynarczyk 2009b: 100.

[54] Briend, Humbert 1980, Pl. 9:3–11.

[55] Guz-Silberstein 1995: 308–309, type JG 11, Fig. 6.30:1 and 4.



5. Examples of 'baggy' water jars from Sha'ar-Ha 'Amakim of the Hellenistic (1–3, group 3a) and Roman (4–5, group 3b) periods: 1. inv. no. 889.5; 2. inv. no. 912.7; 3. inv. no. 889.4; 4. inv. no. 709.4; 5. inv. no. 735.5 (Drawing: M. Burdajewicz).

dated as only a couple of parallels are known from nearby sites such as Jalame, Sumaqa and Sepphoris.[56]

GROUP 4

Finally, also a few samples of other ceramics (marked as 'group 4') were chosen for the analyses on the assumption they might be diagnostic for a local/regional source of clay. They include fragments of ovens, raw clay pieces found close to one of the ovens, as well as a piece of a brick.

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[56] Jalame: Johnson 1988: 198–199, Fig. 7–42:619, erroneously described as a 'cooking pot with ribbed neck'; Sumaqa: Kingsley 1999: Fig. 9:23; Sepphoris: Tsuk, Rosenberger, Peilstocker 1996: Pl. IX:5.

Due to the usually small size of sampled fragments, in some cases it was not certain if a body sherd belonged, for example, to a jar (2a) or to a water jug (3a), or if a body sherd in the Phoenician semi-fine ware belonged to jar form 1a or 1b. Needless to say that with the body sherds, the shape of the vessels may have been uncertain, and when a small section of the rim is preserved, any closer identification of the jar's form is not possible either. Thus, some of the containers with a rim diameter bigger than that of average jars, may have been alternatively described as *pithoi.*

THE GEOLOGICAL SETTING OF SHA'AR-HA ʼAMAKIM

Sha'ar-Ha ʼAmakim is situated on the north-western slopes of the Lower Galilee foothills (14km south-east from Haifa, coordinates: 32°43'22.79''N, 35°6'47.88''E), on a synclinal Qiryat Tiv'on Eocene block constituting the south-western part of the Lower Galilee hills (**Fig. 6**). In the south it is bordered by the Jezreel valley, in the south-west, a narrow Qishon river pass behind which rises the Mt Carmel ridge. The western border is the Zevulun Plain.

In this area the oldest sediments can be found in the Mt Carmel, Um el-Fahm and Lebanon Mountains anticlinoria. They represent dolomites belonging to the Albian Yagur Formation, covered by the Cenomanian-Turonian carbonates of the Judean Group. During the Senonian until the end of the Eocene uniform sedimentation of deep-sea chalks prevailed, locally with phosphates and some limestones in a local erosional unconformity.

Those deposits fill the Ramot Menashe (Galilee) and Bekaa (Lebanon) synclinoria,[57] and belong to the Mount Scopus Group in Israel[58] and the Chekka Formation in Lebanon.[59] They are most exposed in the Lower Galilee foothills characterised by a gentle morphology.[60]

What attracts special attention in a search for ceramic material are green marls, green shales and argillaceous chalks with some phosphates of the Santonian – Early Campanian Kabri Member of the Menuha Formation, the white to yellow chalk and marls of the Campanian to Maastrichtian Ghareb Formation and the Paleocene to Early Eocene grey to green, partially bituminous marls of the Taqiye Formation.[61]

The Taqiye Formation is overlain by thinly-bedded Eocene chalks of the Avedat Group, Miocene-Pliocene coarse-grained, reddish, calcareous sandstone, sandy limestone, reddish clay and conglomerates of well sorted chert (Qurdani Formation), as well as poorly sorted conglomerates (Bet Nir Formation) of the Saqiye Group.

The Pliocene-Quaternary conglomerates, travertine, red sands, calcareous sandstone, dune sands, alluvia and soils belong to the Kurkar Group.[62]

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[57] Cf. Kafri 1972; Sass, Bein 1982; Lipson-Benitah *et al*. 1997; Buchbinder *et al*. 2000; Bachmann, Hirsch 2006; Bentor 1966.

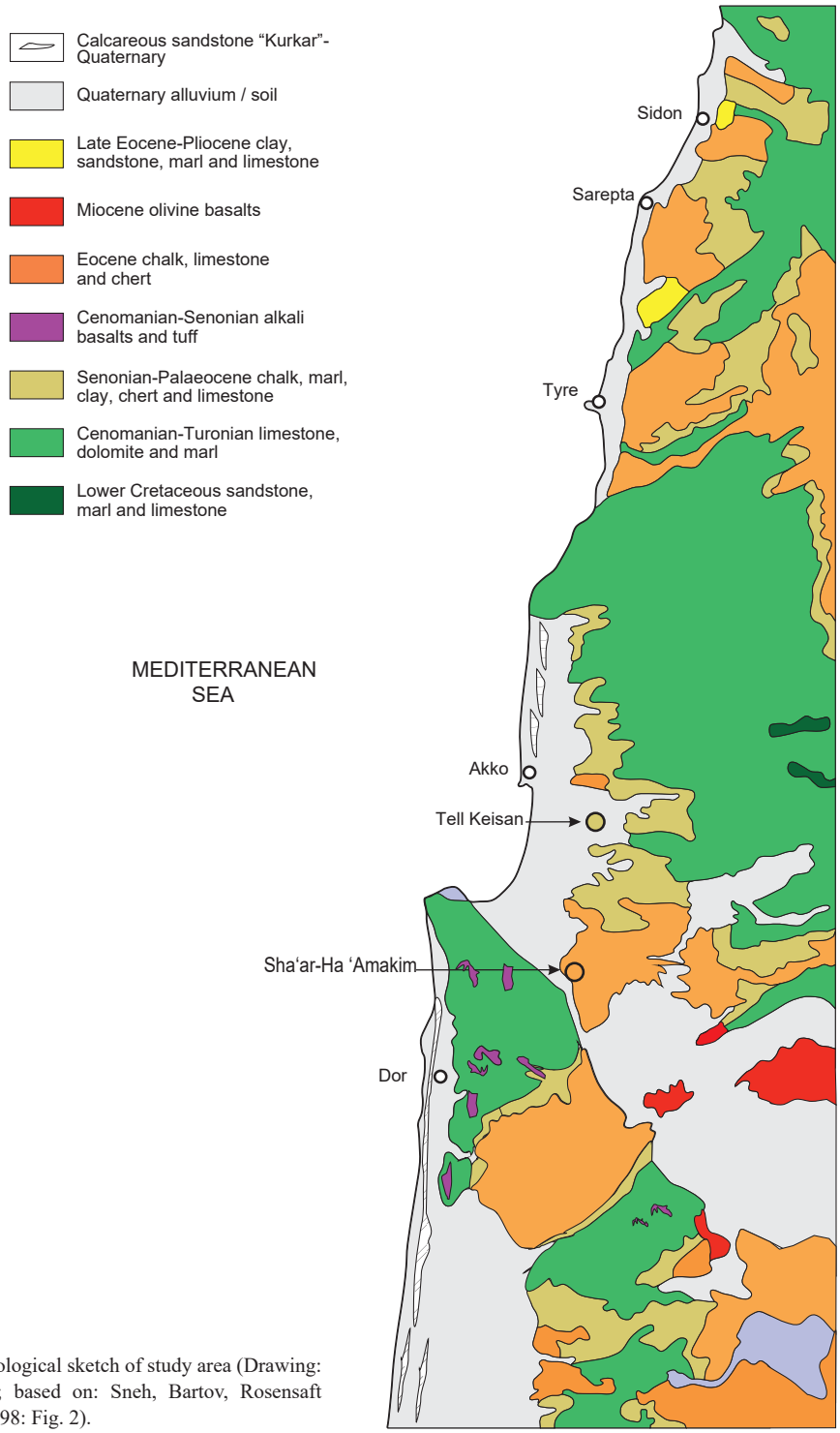
[58] Flexer 1968.

[59] Walley 1997.

[60] Levy 1983: 59.

[61] Generally used in the production of ceramics, cf. Bentor 1966: 72–73; Porat 1989; Goren 1995; Gilboa *et al*. 2006; Gorzalczany 2008: 83.

[62] Levy 1983; Sneh 2004; 2008; Segev, Sass 2009; Karcz, Sneh 2011.



6. Simplified geological sketch of study area (Drawing: J. Michniewicz; based on: Sneh, Bartov, Rosensaft 1998; Walley 1998: Fig. 2).

The coastal margin of the Zevulun Plain and the Galilean Coastal Plain is mostly covered by sand dunes composed of Nile-Delta quartz sands.[63] They form Plio-Pleistocene and younger Pleistocene eolianite ridges, locally termed *kurkar*, which run parallel to the coastline, intercalated by red sandy loam soils locally termed *hamra*[64] (there are also submerged *kurkar* horizons in the nearshore zone[65]).

What should be emphasised are differences in the mineral composition of Levantine beach sands, especially in the proportions of quartz and calcareous bioclasts. While the Nile-transported quartz is a component dominating on the beaches located south of Akko, northward of the site quartz disappears and calcareous components start to dominate.[66]

Volcanism of the area

Submarine volcanism was intensive from the Jurassic to the end of the Cretaceous period. Volcanic rocks are mainly tuffs and alkaline basalts.

In the Lower Cretaceous Hatira Formation, weathered fragments of Tayasir volcanic rocks can be observed. In the Mt Carmel and Um el-Fahm areas there are four Cretaceous magmatic/hyaloclastite outcrop horizons intercalated with carbonates:[67] Early Cenomanian Kerem Maharal tuffs, the Middle Cenomanian Tavasim pyroclastics, Upper Cenomanian Makura, Me-Ammi pyroclastics, Shefeya lava flows and Senonian Bat Shelomo dark pyroclastics. The Cenozoic magmatism manifests itself in the Galilean outcrops as small Miocene intrusions (olivine/basalts/basanite). They are observed south and east of Qiryat Tiv'on[68] in the foothills where a few Pliocene volcanic bodies of cover basalts represent the Bashan volcanic event.[69]

THE STATE OF PETRO-ARCHEOLOGICAL RESEARCH ON JAR PRODUCTION IN GALILEE

The petrographic and chemical research on the ceramics discovered in the Levant is conducted primarily in order to determine the places of their production and to identify trade routes. While the distribution of ceramic workshops in the Galilean area in the Roman period is relatively well known in archaeological terms, the Hellenistic period is one of the most poorly recognized in the coastal Levant and Galilee.[70]

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[63] Zviely *et al*. 2006; Elyashiv *et al*. 2015.

[64] Arabic word for 'red'. Sivan *et al*. 1999; Horovitz 1979: 100–108; Issar 1968; Bentor 1966: 1; Sneh 2008; Segev, Sass 2009; Ravikovitch 1969; Sneh, Bartov, Rosensaft 1998; Gvirtzman, Buchbinder 1978; Horowitz 1979: 84–88; Barzilay 2006.

[65] Cf. Zviely *et al*. 2007.

[66] Cf. Gilboa *et al*. 2006: 311; Cohen-Weinberger, Goren 2004; Landau, Goren 2004: 28–29.

[67] Bentor 1966: 105; Kaminchik *et al*. 2014: 116; Segev, Sass 2009; Segev *et al*. 2002.

[68] Miocene volcanic rocks extending mainly in south-eastern Lower Galilee and the Yizre'el Valley (Segev 2005).

[69] Segev 2005; Levy 1983 (geological map).

[70] Nitschke, Martin, Shalev 2011; Leibner 2009: 7.

Persian Period

The finds of the Persian-period carinated-shoulder amphorae are abundant. Only in the southern Levant they have been found in at least 40 sites.[71] At the same time the number of kilns known from this period is small. They embrace the Persian-period kilns of Sarepta[72] and a workshop in the south (the Sharon region), at Tel Michal.[73]

Bettles examined 307 thin sections of carinated-shoulder amphorae gathered from ceramic assemblages from 21 sites.[74] The effect of this work was the distinction of two basic fabric classes (FC1 and FC2):

– fabric class 1 (four subclasses: 1A, 1B, 1C, 1D), characterised by a very fine, dense and highly calcareous matrix incorporating various quantities and genera of foraminifers of orange-red, red and brown colour, and
– fabric class 2 (four subclasses: 2A, 2B, 2C, 2D), characterised by a ferruginous silty matrix, with varying levels of carbonate matter.[75]

Predominant among those amphorae is FC1A, which the author describes as follows: *macroscopically this fabric is characterized by moderate to sparse amounts of transparent and translucent well-sorted fine sand-size inclusions, moderate multi-chambered micro-fauna, and sparse blobs or streaks of red iron oxide of medium to coarse sand-size, cloudy pale yellow limestone of very coarse sand. Under microscope the matrix consists of a fine, dense, foraminiferous and ferruginous marl of clear orange colour with streaks of ferric oxide,* Globigerinidae *of Paleogene age, including* Acarinina *sp*.[76] Moreover, Bettles notes the presence of rare white mica flakes.[77] Aplastic inclusions make up 2–5% of the volume. They consists predominantly of quartz and carbonate grains, with accessory minerals of hornblende, epidote, feldspar, chert and schist, as well as fragments of coralline algae, *Amphiroa* sp.[78] She considers FC1A to be local to Sarepta on the basis of a comparison of the petrography of the amphorae discovered at the site with the local source – foraminiferous chalky Middle Eocene marls, the presence of local pottery workshops dated to the Late Bronze Age and the entire first millennium BC,[79] and a comparison of the chemical composition of those amphorae to eleven pottery sherds from Sarepta previously analysed by Jan Gunneweg and others.[80]

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[71] Cf. Bettles 2003b: 53.
[72] Bettles 2003a: 63; 2003b: 96–97.
[73] Nitschke, Martin, Shalev 2011: 138.
[74] Bettles 2003b.
[75] Bettles 2003b: 138.
[76] Bettles 2003a: 67.
[77] A feature not found in the Sha‘ar-Ha ʼAmakim amphorae.
[78] Bettles 2003a: 67.
[79] Bettles 2003b: 151.
[80] Gunneweg *et al*. 1986.

The next in terms of frequency is FC2A, characterised by a matrix reddish-brown in colour, ferruginous, silty and moderately calcareous, with sand-sized quartz accounting for up to 25% of the volume, which in Bettles' opinion is consistent with the *hamra* paleosol cropping out along the coastal region of Israel.[81]

The material of most of those fabric classes is of Paleocene-Eocene age, as indicated by the foraminifers it contains. Foraminiferous marls of Paleocene-Middle Eocene age are exposed along the Lebanese and north Galilean coast, between Sidon and Akko.[82] That is why Bettles' FC1A, described by other scholars as 'Phoenician clay', need not come from the Sarepta region, because it was used at various times to produce all kinds of pottery since at least the Iron Age.[83] However, worth emphasising is the distinctness of those marls from the older horizons of lithologically similar rocks, especially Paleocene Taqiye marls and Senonian marls, identifiable by the presence of foraminifers.[84]

Hellenistic and Roman Periods

The material of jars made in the Hellenistic period in Galilee and adjacent areas was examined by Yardenna Alexandre.[85] Hellenistic pottery kilns are known from Karem el-Ras (near today's Kefr Kanna).[86]

In an extensive study of common pottery from nineteen excavated sites in the Galilee and Golan, David Adan-Bayewitz and Moshe Wieder[87] demonstrated that in the Roman period common pottery was mainly made in three manufacturing centres of Lower Galilee: Kefar Hananya (specialising in cooking pottery), Shikhin, and Yodefat.[88] During the Early Roman period a large-scale production of jars took place in Shikhin and probably also in many smaller, so far unknown, local workshops, as shown by the discoveries of kilns in Yodefat.[89] In Yodefat (situated on an outcrop of Cenomanian dolomites) two pottery workshops were discovered containing four kilns, the waste of cooking ware and storage jars.[90] In Shikhin, which was a major supplier of storage jars, the vessels were made of one of the three soil types: colluvial-alluvial soils, brown grumusols, or pale rendzinas. At Yodefat

[81] Those conclusions are corroborated by Gorzalczany's (2006) later study of Persian-period vessels found in the kilns of Tel Mikhal and amphorae discovered at Horbat Malta which, according to Gorzalczany (2008), were made of a mixture of *terra rossa* and rendzina soils rich in nummulitic chalk.

[82] Cf. Sneh, Bartov, Rosensaft 1998; Bettles 2003a: 148–149. Bettles considers in detail other potential sources of those marls, but she points out that they lie many kilometres away from the coast.

[83] Cf. Cohen-Weinberger, Goren 2004; Stager 2011: 58, 101; Gilboa, Waiman-Barak, Jones 2015: 374.

[84] Cf. Sneh, Bartov, Rosensaft 1998; Beydoun 1977: 332.

[85] Alexandre 2013: 14–15.

[86] Cf. Aviam 2014: 140–142.

[87] Adan-Bayewitz, Wieder 1992; Wieder, Adan-Bayewitz 1999. Cf. also Adan-Bayewitz 1993.

[88] Significantly different are also the ceramics produced in the Golan region.

[89] Wieder, Adan-Bayewitz 1999; Berlin, Frankel 2012.

[90] Cf. Wieder, Adan-Bayewitz 1999: 329; Adan-Bayewitz, Aviam 1997; Aviam 2014.

the remains of a pottery kiln and waste are dated to the Early Roman period. This pottery group is composed of reddish-yellow carbonate rendzina soil mixed with much less calcareous clayey red soil.[91] In Shikhin no tempering admixture was used, and in Yodefat highly calcareous rendzina was enriched with an addition of *terra rossa*.[92]

Ceramic kilns also operated in Ahihud, a few kilometres east of Horbat Uza (Khirbet Aiyadiya),[93] 4km north-east of Tell Keisan. The ceramics discovered at that site (common pottery and jars) were made of at least four varieties of material described as: (1) *terra rossa* and ferruginous ooliths assigned to Kefar Hananya workshops;[94] (2) *terra rossa* and sand of a yellowish brown silty matrix and quartz sea sand, assigned as local to Ahihud workshops;[95] (3) *terra rossa* and carbonate material, composed of *terra rossa* and calcareous streambed sand; and finally (4) non-homogeneous clay and *terra rossa* pellets made of calcareous rendzina – soil rich in reddish oval pellets of different size and distinct silty texture. Sometimes the pellets are dark grey to black, having been fired in reduced-oxygen conditions in the kiln. The clay paste of group 3, compared with group 2, was less levigated. In the opinion of the authors, some of those vessels could be copies of Shikhin technology; storage jars made of this material are characterised by a thick grey core and relatively thin edges in the cross-section.

They match the Yodefat group of pottery described by Wieder and Adan-Bayewitz, probably produced locally in Ahihud.[96]

RESULTS OF PETROGRAPHIC STUDIES

Comparative petrographic analyses of 154 specimens were performed. Each sample was described macroscopically and documented photographically using an Olympus SZX-9 binocular. Polished petrographic preparations were made of each fragment by embedding them in epoxy resin. The study was made in transmitted light complemented with observations in reflected light using an Olympus AX70 Provis petrographic microscope. Microscopic studies were conducted to establish the mineral composition and petrographic features of aplastic components and the matrix, including the temperature of its firing. Minerals hard to identify optically were examined by X-ray diffraction (XRD), their chemical composition being determined using the Energy-dispersive X-ray method (EDX). To determine the age of the material, each polished section was examined micro-paleontologically. This study was carried out by Prof. Barbara

[91] Cf. Aviam 2014; Wieder, Adan-Bayewitz 1999: 339.

[92] Cf. Wieder, Adan-Bayewitz 1999: 329; Adan-Bayewitz, Aviam 1997; 2014.

[93] Cf. Avshalom-Gorni, Shapiro 2015.

[94] The authors claim the presence of ferruginous ooliths to be evidence of the connection of the material with the Lower Cretaceous rocks near Kefar Hananya, which is hard to accept because landforms of this type are a common effect of laterite weathering, cf. e.g. Jones 1965.

[95] According to the authors, the same material was used in Horbat Uza.

[96] Wieder, Adan-Bayewitz 1999; Avshalom-Gorni, Shapiro 2015: 82.

Olszewska from the Institute of Geological Sciences, Polish Academy of Sciences in Cracow.

The examined specimens are listed in **Tab. 1**. Eleven samples, which have not been assigned to any petrographic group, are omitted from the present discussion.

The conducted examination allows to distinguish at least eight petrographic groups (henceforth: PG) of ceramics, the most important including:

PETROGRAPHIC GROUP I.A – 'ALGAE'

SUBGROUP I.A1 (**Fig. 7:1**)

Eocene foraminiferous 'light' marl with sparse algae, chalk rich in ferruginous-globigerina ooze, 5–8% quartz sand +/- minute red soil balls.

Specimens:[97] SA-2, SA-6, SA-8, SA-11, SA-13,[98] SC-39, SC-41,[99] SD1-62, SD1-67, SD2-71, SE-86, SFx-115, SX-119, SA-126, SX-129, SX-135, SX-143, SX-146.

A group of ceramics light red in colour (5YR 7/6), mostly fired slightly silty on the surface. They were made of foraminiferous marl locally coloured by iron oxides, tempered with a 5–8% admixture of sand. On optical examination the matrix (groundmass) is light, yellow-brown or light-orange, in places of concentration of iron and manganese oxides red or opaque. In most samples the matrix is optically active, which is indicative of a low temperature of firing, 650–700°C. Only samples SA-2, SA-126, SX-129, and SX-135 were fired at a higher temperature, the result being the anisotropy of their groundmass.

A diagnostic feature of the groundmass is the presence of well-preserved, abundant Middle-Late Eocene microfauna: *Chilogumbelina* sp. and *Globigerina* ex gr. *praebulloides-officinalis*, less commonly *Tenuitella* sp. and *Uvigerina* sp., and also numerous, though of no major stratigraphic significance, *Globigerina* sp., *Brizalina* sp., and radiolarians of the genus *Spumellaria.* Their shells are either scattered throughout the matrix or form local clusters (this especially holds for *Globigerina*), which is usually accompanied by a concentration of iron and manganese oxides.[100] The clasts embedded in the groundmass, often of ferruginous chalk, vary in size and shape. They are usually more or less oval, and

[97] The particular elements of sample' symbols refers to Sha'ar-Ha 'Amakim (S), phase according to the site stratigraphy, and number of the sample.

[98] What distinguishes sample SA-13 from the other representatives of PG I.A1 is the higher, 15%, content of the sandy admixture.

[99] Samples fired in reduced-oxygen conditions.

[100] It is a debatable question whether the chalk clasts rich in iron and *Globigerina* are an integral part of the material used or are an admixture intentionally made and added by the potter.

their boundaries are fuzzy; less frequent are clasts a few millimetres in size with sharp, irregular contours and sharp boundaries.

The content of silt-sized quartz particles is low (under 5% of the volume), some of the samples are almost completely devoid of them.

The temper consists of irregularly scattered grains of fine sand-sized quartz (0.1–0.25mm) accounting for 5–8% of the volume. It is well sorted, only a few grains are larger, 0.3–0.4mm in diameter. In sample SA-126 the admixture has a different composition. The sand grains it contains are quartz-carbonates in the 50:50% proportion. Carbonate grains that are micritic in structure are coarser and partly decomposed as a result of firing.

Quartz is mostly monocrystalline, moderately rounded, less frequently unrounded (subangular-subrounded). Its crystals show uniform extinction (volcanic grains) and undulose extinction (metamorphic grains). A few grains of polycrystalline quartz are certainly of metamorphic origin. Feldspars appear sporadically; they are both, polysynthetically twinned plagioclases and potassium feldspars distinguishable optically, especially when the twinning is cross-hatched. There are also single grains of chert with a characteristic mosaic structure, and heavy minerals, mostly rutile, apatite and green pleochroic amphibole. Titanomagnetite predominates among the numerous opaque minerals.

The presence of Amphiroa *sp.*

A characteristic feature of this group is the presence of single fragments of red algae of the family *Corallinaceae*, especially *Amphiroa* sp. They can be identified on the basis of their structure: an alternate arrangement of layers composed of long and short cells. The alga fragments are of a fine- and a medium-sand fraction, often angular in shape, appear regularly though in small numbers, apart from sample SA-126.

Their presence among the remaining numerous microorganisms gives the impression that they are a natural component of the marl employed. However, as Binyamin Buchbinder[101] demonstrated, *Amphiroa* start to be common from the Pleistocene to the present. They can be found in bioclastic sediments distributed along the Coastal Plain and in the foothill areas in Neogene formations. Today their remnants are common in the beach sand north of Haifa along the Israeli and Lebanese coasts. Considering the Eocene age of the material established micro-paleontologically, the *Amphiroa* fragments it contains seem to be a component added with quartz sand.[102]

Analogies

The descriptions of ceramics from several south Levantine sites are almost analogical: Tyre, Sarepta, Akko, Ashkelon, Atlit, Gil'am, Tell el-Hesi, Yoqne'am, Tell Keisan,[103] Sidon,[104]

[101] Buchbinder 1975.

[102] Cf. Eliyahu-Behar *et al*. 2008: 2899; Gorzalczany 2006: 59; 2008: 83; Bettles 2003a; 2003b; Landau, Goren 2004: 28.

[103] Cf. Bettles 2003a; 2003b.

[104] Cf. Bettles 2003a; 2003b; Griffiths 2003: 18–19.

Horbat Malta,[105] Tel Dor,[106] Ashdod,[107] Gamla,[108] and the Iron Age Phoenician ceramics of Kommos, Crete.[109]

Subgroup I.A2 (**Fig. 7:2**)

Eocene foraminiferous 'light' marl + red soil balls + quartz sand (devoid of ferruginous globigerina ooze).

Specimens: SBc-15, SDc-51, and SA-127.

The fabric of PG I.A2 is macroscopically similar to that of the ceramics of PG I.A1, light orange (7.5YR 8/6) and light red in colour (2.5YR 7/6–8), with similar petrographic features and micro-paleontological composition. What makes it fundamentally different from the ceramics of PG I.A1 is the absence of foraminiferous iron oxides, replaced here by an admixture of ferruginous red type soil (*terra rossa*).

Analogies
Tel Michal,[110] Iron Age Phoenician ceramics from Kommos, Crete.[111]

Subgroup I.A3 (**Fig. 7:3**)

Eocene foraminiferous 'light' marl + red soil balls + quartz sand + hyaloclastite fragments.

Specimens: SBc-35, SD1-66, SD2-72, SE-101,[112] SFx-112, SF-124, SD1-125, SE-134.

A group of pottery petrographically similar to PG I.A1 and especially to PG I.A2. What makes it different is the presence of single honey-yellow hyaloclastites.

Sand-sized glassy 'yellow fragments' irregularly translucent, fragmentarily argillitised, honey-brown in colour, usually characterised by sharp boundaries, sometimes with polygonal e.g. hexagonal contours. Therefore, it cannot be excluded that some of them can represent pseudomorphs of garnet(?), pyroxene(?), amphibole, or olivine.

The identification of the above phases was also made using the XRD method. In spite of the removal of carbonates, this study ruled out the presence of iddingsite and did not confirm the presence of minerals from the group of pyroxenes, amphiboles, olivines and

[105] Gorzalczany 2008.
[106] Gilboa, Cohen-Weinberger, Goren 2006: 310–311; Eliyahu-Behar *et al*. 2008: 2899.
[107] Cohen-Weinberger 2013: 123–124.
[108] Berlin 2006: 16.
[109] Gilboa, Waiman-Barak, Jones 2015: 82, Fig. 3.
[110] Gorzalczany 2006: 59.
[111] Gilboa, Waiman-Barak, Jones 2015: 80–81.
[112] Containing no quartz, fired in reduced-oxygen conditions?

garnets. At the same time there was a slight elevation of the groundmass, corroborating the presence of the glassy phase.

Thus, it is hard to decide unequivocally what the 'yellow fragments' are. What speaks for a hyaloclastic origin of those particles is the presence of submarine tuffs among rocks of Mt Carmel, and especially the nearby Sha'ar-Ha Amakim outcrops of Tayasir tuffs.

What attests to the volcanic origin of those particles is also the presence of scattered fine crystals of unaltered pyroxene, amphiboles and 'fresh' feldspars. Automorphism and no signs of any transformation of those minerals also suggest their volcanic origin.[113]

Analogies

Iron Age Phoenician ceramics from Kommos, Crete,[114] Tel Dor,[115] Yoqne'am, Amarna tablets,[116] Megiddo.[117]

PETROGRAPHIC GROUP II

Red soil, silty clay, almost devoid of a sand-sized admixture.

This fabric is iron-rich; it contains an abundant amount of fine, silt-sized quartz or carbonates and taxonomically different foraminifer groups. Their age and the macroscopic similarity of shells served to distinguish following subgroups.

Subgroup II.A (**Fig. 7:4**)

Paleogene foraminifers: silty rendzina soil.

Specimens: SBc-22, SDc-50, SDc-54, SDc-57, SOV-137'.[118]

This is the most distinct subgroup. It contains a set of five thin-walled sherds fired to a light-red colour (2.5YR 6/8–7/8) and a fragment of the wall of an oven, SOV-137'.

On optical examination the matrix of the vessels is light red or light brown, depending on the level of oxidation, inactive in samples SDc-50, SDc-57 and SDc-54. The presence of numerous dark red oval infillings is probably an effect of clay mixing (but the activity of earthworms cannot be ruled out).[119]

The raw material is extremely lean, rich in quartz silt, which accounts for 30–40% of the volume. It is made up almost exclusively of particles of Eolian quartz, there are also

[113] Cf. Cohen-Weinberger, Goren 2004: 9.
[114] Gilboa, Waiman-Barak, Jones 2015: 85, Fig. 6.
[115] Cf. Eliyahu-Behar *et al*. 2008: 2901 ('Group 5').
[116] Goren, Finkelstein, Na'aman 2004: 252–254, Fig. EA259.
[117] Arie, Buzaglo, Goren 2006: 560.
[118] Fragment of the wall of the oven, used for comparison.
[119] Cf. Koistra, Pulleman 2010.

accessory grains of feldspar, oxidised amphibole and fine pedogenic(?)/pyroclastic(?) 'red fragments'.

The sand-sized admixture consists of single oval grains of micritic limestone (especially in SDc-50), sporadically one can also find sand-sized quartz, feldspars and pyroxenes. Notable is the presence of single ferruginous (iron-manganese?) ooliths.

In spite of the sintering of the groundmass, some foraminifer associations have remained in the samples: *Acarinina* cf. *alticonica* Fleisher, *Acarinina* sp., *Chiloguembelina* sp., *Globigerina* sp., and *Paragloborotali* aff. *nana* (Bolli), dating the association to the Paleogene, most probably the Eocene. Since the rendzina soil found in the Sha'ar-Ha Ámakim region has developed on Eocene chalk, this can be a group of vessels produced locally.

The Eocene is also the age of the sample of the wall of an oven SOV-137, petrographically similar to the other samples in this subgroup (the same content of quartz silt, the presence of just a few sand-sized grains of limestone, and opaque ferruginous ooliths). Unlike the vessels of PG II.A, perhaps because of a different function, this oven fragment contains numerous grass remnants; it also shows a much lower degree of sintering.

SUBGROUP II.B (**Fig. 7:5**)

Cretaceous foraminifers: silty soil + chalk rich in *Globigerinelloides*.

An alternative name of the group: rendzina(?) soil – Cretaceous parent rock age.

Specimens: SC-36, SDc-44, SD1-64, SD1-69, SD2-76, SD2-77, SD2-79, SD2-80, SE-87, SE-92, SE-98, SE-99, SF-106, SF-107, SX-142, SX-148, SX-151, SOV-250.

Ceramics made of clay rich in calcite-quartz silt, with some clasts of chalk rich in *Globigerinelloides* and additions of *terra rossa* balls. Most vessels of this group: SC-36, SDc-44, SD1-64, SD1-69, SD2-79, SD2-80, SE-87, SE-98, SE-99, SF-107, SX-148, SX-151, and SOV-250, are light red on the surface and dark steel-grey on the fracture. Samples that differ in colour are SD2-76, SD2-77, SE-92, SF-106, and SX-142 – with a pale brown outer surface (10YR 8/3), a grey core, and a brown inside (5YR 6/4–5YR 6/3).

Especially significant is the presence of irregular clasts of light-grey chalk rich in *Globigerinelloides*. It is possible that they are fragments of the parent rock on which the examined soil has developed. A characteristic feature of the entire association is the presence of opaque ferruginous ooliths.

The composition of the foraminifer associations preserved in the ceramics: *Globigerinelloides* sp., *Hedbergella* sp. and *Heterohelix* sp., sets the age of the material at Upper Cretaceous.

Subgroup II.C (**Fig. 7:6**)

Cretaceous foraminifers: soil rich in carbonate silt (no chalk).

Specimens: SDc-46, SDc-47, SD2-73, SD2-75, SD2-81, SD2-83, SE-96, SF-110, SFx-118, SX-144, SX-147.

Those are ceramics similar to PG II.B, but with no chalk clasts. Besides, the chief aplastic component is carbonate silt (prevailing over quartz silt in terms of quantity). The microfauna found in samples SDc-46, SDc-47, SD2-73 and SD2-75: *Globigerinelloides* sp., *Globigerinelloides* aff. *bolli* Pessagno, *Hedbergella* sp., and *Heterohelix* sp., determine the age of the material at Late Cretaceous.

Subgroup II.D (**Fig. 7:7**)

Soil rich in calcareous silt (unknown age of parent rock).

Specimens: SDc-42, SDc-43, SDc-45, SDc-49, SDc-52, SDc-53, SDc-55,SDc-56, SD2-84, SD2-85, SE-89, SE-91, SE-93, SF-103, SF-104, SD1-121, SX-141, SX-145.

A set of vessels produced from material with an elevated content of calcareous silt and a small proportion, or absence, of a sand admixture with signs of pedogenic changes. The state of preservation of the microorganisms makes it impossible to determine the geological age of the material.

Analogies for subgroups II.A-D

Shikhin,[120] Horbat Uza and Ahihud,[121] Tel Michal,[122] Persian-period Horbat Malta.[123]

PETROGRAPHIC GROUP III (**Fig. 7:8**)

Cretaceous dolomitic marl.

Specimens: SE-94, SE-97, SF-102, SF-105, SF-108, SFx-113, SFx-114, SFx-117, SFx-149, SX-150.

This is a group the fabric which stands out for the very high content of fine rhombohedral crystals of dolomite. Those are amphorae with a light red sherd (2.5YR 6/8), massive, only

[120] Cf. Adan-Bayewitz, Wieder 1992: 198–199; Wieder, Adan-Bayewitz 1999: 335–338.
[121] Avshalom-Gorni, Shapiro 2015: 80–83.
[122] Gorzalczany 2006: 60–61.
[123] Gorzalczany 2008: 82–83.

sample SX-150 is light brown (5YR 6/6), as well as more lightly fired and slightly weathered. Their matrix is composed of dolomitic marl, light red and yellow in plane-polarized light (henceforth PPL), light brown in partly reduced fragments.

The argillaceous minerals of the groundmass have remained optically active in samples SE-97, SF-102, SF-105, SF-108, SFx-117, and residually active in samples SE-94, SFx-113, SFx-114, SFx-149, SX-150, thus reflecting the different temperatures of firing.

Dolomite crystals are silt-sized or fine-grained sand, 0.01–0.13mm, usually automorphic, accounting for 40–60% of the volume.

The material of samples SE-97 and SF-108 is enriched with an admixture of *terra rossa* containing some quartz silt. The red silty soil of *terra rossa* is distributed in the form of stains and fine balls. The other vessels of this group contain just a few fragments of ferruginous argillaceous shales devoid of quartz silt.

Aplastic inclusions can be observed in the form of single bits of dolomitic rock; their content is higher in samples SF-102, SF-105 and SFx-114.

Most species found in the polished sections of this group are indicative of the Late Cretaceous, i.e. younger than the Albian: *Hedbergella* sp., *Heterohelix* sp., single *Globigerinelloides*. In the case of sample SF-102, the presence of *Guembelitria* aff. *cretacea* Cushman gives the age of the material as not older than the Santonian.

Analogies

Chalcolithic ceramics,[124] Amarna tablets,[125] Late Bronze Age Ashdod,[126] Bet-She'an,[127] Persian-period Tel Michal.[128]

PETROGRAPHIC GROUP IV

'Creamy pottery': chalky marl of varied age + *terra rossa* balls or ferruginous argillaceous shale.

A group of fragments of amphorae with creamy-white sherds (10YR 8/3–5YR 8/4), slightly darker on the fracture, sometimes light beige (10YR 7/3–6/3). They are made of highly calcareous marl containing abundant foraminifers, some *terra rossa* balls, or ferruginous argillaceous shale fragments.

Predominant among the microorganisms are foraminifers, indicating the age of the material to be Cretaceous and Paleogene. Their state of preservation differs; what has been left of them is often only fine, grey-golden clusters of micrite and voids.

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[124] Cf. Goren 1995: 291.
[125] Cf. Goren, Finkelstein, Na'aman 2004: 262–263.
[126] Cohen-Weinberger 2013: 124.
[127] Cohen-Weinberger, Goren 2011: 218–219.
[128] Gorzalczany 2006: 61.

The colour of the matrix in transmitted light depends on the content of *terra rossa* and the reduction level of a sherd. Usually it is grey-olive with a hint of red pigmentation. Differences in the temperature of firing are reflected in the variously preserved optical activity of argillaceous minerals. *Terra rossa* occurs as an admixture in the form of dark red points or irregular streaks and spots.

In some samples there are grey, isotropic oval balls of high micro-porosity. Those are fragments of a red soil in which iron has undergone reduction, and minerals – partial melting. What indicates such an origin of those clasts is the locally preserved red colour, the presence of silt-sized quartz and micro-oolitic pedogenic structures (the reduction process has not been completed). It cannot be ruled out that some of those grains are fragments of tephra.

Both the percentages of the above-mentioned components and the petrographic composition of the aplastic admixture vary. In this context we observe especially great similarities among the following subgroups of vessels:

Subgroup IV.A (**Fig. 7:9**)

Late Paleocene-Eocene chalky marl, red soil admixture.

Specimens: SA-1*,[129] SA-3, SA-7, SBc-21*, SD1-59, SD1-61.

The material devoid, or almost devoid, of a sand-sized admixture (SA-3, SD1-61 – sand-sized quartz accounting for less than 3% of the volume).

Subgroup IV.B (**Fig. 7:10**)

Eocene chalky marl + large clasts of isotropic levigated red soil.

Specimens: SBc-23, SBc-25, SC-40.

The matrix contains numerous clasts of red soil (0.2–2.0mm in diameter) and clasts of grey foraminiferous chalk. Together those components make up *c*. 15% of the volume. Occasionally one can find transparent, colourless sand-sized particles of the glaze as well as single automorphic feldspars. What characterises this subgroup is the absence of quartz in the form of the silt or sand fraction.

Subgroup IV.C (**Fig. 7:11**)

Chalky marl of unknown age + amorphic red clayey shales + 5–8% of fine quartz sand.

Specimens: SA-10, SBc-16, SD1-65.

[129] (*) specimens containing few reduced *terra rossa* pellets.

Ceramics similar to PG IV.B, but with 5–10% of quartz silt and an admixture of quartz sand making up 5–7% of the volume. Its characteristic feature is also the presence of numerous argillaceous red shales, amorphic slag, and a small admixture of quartz silt (<2–5% of the volume). Sample SA-10 contains a glaze clast. The absence of preserved foraminifers makes it impossible to determine the age of the material.

SUBGROUP IV.D (**Fig. 7:12**)

Paleogene marl + 5–8% quartz sand.

Specimens: SA-5, SA-9, SBc-26, SBc-34, SC-37, SD2-74, SE-90, SA-120.

Those ceramics are similar to PG IV.A, but they contain 5–8% of fine-grained quartz sand. In most samples there are relatively few variously shaped 'black fragments' which are pellets of black tephra or red soil darkened in reduced-oxygen conditions. The presence of single specimens of foraminifers *Pseudohastigerina* sp. and *Chiloguembelina* sp., and of relatively numerous *Globigerina* sp. is indicative of the Paleogene (Eocene?).

SUBGROUP IV.E (**Fig. 7:13**)

Cretaceous marl + amorphic clayey soil or slag + 5–8% fine quartz sand.

Specimens: SBc-24, SBc-28,[130] SBc-33, SOV-139.

Macroscopically, ceramics of creamy colour (7.5YR 8/4) with numerous black pellets of black-reduced red soil, sometimes containing pedogenic ferruginous ooliths. The presence of *Hedbergella* sp., *Heterohelix* sp. and *Globigerinelloides* sp. sets the age of the material at Late Cretaceous.

The sample SOV-139 from a kiln is made of a material similar to that of PG IV.E. It is fired to a light-creamy colour. On optical examination its matrix is light yellow. It was made of calcareous marl containing an admixture of chalk. The composition of the preserved foraminifers: *Globigerinelloides* aff. *bentonensis* (Morrow), *Heterohelix* aff. *moremani* (Cushman), *Hedbergella* sp., and *Hedbergella* aff. *infracretacea* (Glaessner) as well as the presence of fairly numerous cross-sections of very small plant fragments (charophytes?) put the age of the material at Late Cretaceous (not older than the Albian because of the presence of the genus *Heterohelix*).

[130] Because of the absence of microorganisms preserved in the material, it can be from the Eocene age and belong to the technologically similar PG IV.B.

Subgroup IV.F (**Fig. 7:14**)

Eocene marl with mica particles.

Specimen: SE-100.

SE-100 stands out for the presence of numerous fine lamellae of mica, oxidised biotite, and colourless muscovite. The preserved microfauna: *Angulogerina* sp., *Globigerinoides* sp., *Tenuitella* sp, *Brizalina* sp., *Globigerina* sp., and *Lingulina* sp., indicate the Eocene period as the age of the material.

Subgroup PG IV.G, distinguished for the jars from Tell Keisan, will be published separately.[131]

Subgroup IV.H (**Fig. 7:15**)

Grey-fired ceramics with features of PG I.A1.

Specimen: SA-7.

Macroscopically buff, pale yellow (2.5Y 8/2), on optical examination its matrix is mostly amorphic, grey with a touch of green, locally coloured with iron compounds to brown-red, usually black. This pigmentation goes with accumulations of microfauna, especially *Globigerina* sp. There are also streaky chalk clasts of fuzzy contours, slightly de-pigmented when compared with the matrix, containing single shells of *Acarina* sp., the presence of which sets the age of the material at Late Paleocene/Eocene.

There are very few sand-sized grains, less than 5% of the volume. Those are grains of micritic limestone, perhaps bioclasts and monocrystalline medium-sand quartz. Also present are single cherts.

The above characteristics, especially the pigmentation with iron compounds clustered around *Globigerina*, make this material similar to PG I.A1 ceramics, but fired in reduced-oxygen conditions.

Analogies for subgroups IV.A-F, H

Yodefat(?),[132] Mamluk-period Khirbat Din'Ila,[133] Yoqne'am, Tell Keisan, Akko, Tell Abu Hawam.

[131] Michniewicz, Młynarczyk in preparation.
[132] Cf. Wieder, Adan-Bayewitz 1999: 338–339; Avshalom-Gorni, Shapiro 2015: 83–84.
[133] Shapiro 2014: 110, Fig. 5.

PETROGRAPHIC GROUP V (**Fig 7:16**)

Amorphic granular/dense calcareous marl + *terra rossa* balls + volcanic component + 15/20% quartz/Ca sand – high temperature of firing.

In terms of the colour of sherds, the samples can be divided into two subgroups:
– cream-beige in colour: SA-12, SBc-14, SBc-17, SBc-18, SC-38, SD1-58, SD1-60, SOV-249, and
– bright orange in colour: SA-4, SBc-27, SBc-29, SBc-30, SBc-31, SBc-32, SD1-133.

The whole group has a micro-granular structure disappearing with an increase in the sintering of the groundmass.

The cream-beige vessels are creamy on the surface (2.5Y 8/3) and beige on the fracture (10YR 7/3). The bright orange group is light red (5YR 6/4), which is due to an elevated content of dispersed red soil or a lower degree of reduction of the iron compounds that it contains. The remaining set of petrographic features is similar to those of the cream-beige subgroup.

The matrix is composed of highly calcareous marl, in PPL dark grey, greenish grey in convergent light, optically inactive apart from carbonates. Its micro-porosity is high and takes the form of tiny vermiform fractures.

The characteristic features include fragments of light grey marly shales varying in size and shape, clasts of chalk rich in fine microfossils (*Globigerina*?), and pellets or streaks of dispersed clayey ferruginous soil.

Fine golden carbonates scattered in the groundmass give it a pseudo-granular structure; they are remnants of decomposed microfauna. At a high temperature they disappear, entering into a reaction with argillaceous minerals.

Iron compounds included in marl and the admixture of red soil underwent reduction and sintering. As a result, its pellets turned black. The small oval voids present in those pellets make them similar to pyroclastic.

The group stands out for its substantial sand admixture (15–25% of the volume). Quartz predominates (over 80%), mostly in its monocrystalline form in the 0.08–0.55mm fraction. It is variably rounded – usually subangular-subrounded, its grains showing both undulose and uniform extinction. The proportion of polycrystalline quartz is small – those are fragments of metamorphic shales and quartzitic limestones.

Sand-sized carbonates have undergone decomposition; today they form irregular clusters of secondary micrite. The remains of calcareous skeletons are numerous very fine oval voids.

Secondary components of the temper include feldspars, usually fresh and polysynthetically twinned, one can also find specimens with a laminar structure (plagioclases) and twinned in a cross-hatched pattern.

Also characteristic is the presence of glassy ‘yellow fragments’ which, like *terra rossa*, mostly turned black. The yellow-honey colour of those clasts is then visible only on their margins. On examination, their chemical composition shows the presence of silica, aluminium, magnesium and a few percent of calcium, which is close to the

composition of pyroxenes. Other particles are much more complicated in structure and composition.

Accessory components are colourless sand-sized pyroxenes, fine, yellow, orange-oxidised and green amphiboles, particles of colourless glaze, and crystals of dark-orange rutile.

The age of the material is hard to determine because of the high temperature of firing. The identifiable foraminifers have only been preserved in samples SBc-18, SBc-30 and SD1-133. Those are mostly *Globigerina* sp., *Chiloguembelina* sp. and *Angulogerina* sp., making the Eocene the probable age of the material. In turn, sample SA-4 contains single *Heterohelicidae*, which can put its age at Cretaceous.

Analogies

Not known.

PETROGRAPHIC GROUP VI (**Fig. 7:17**)

Red sandy soil (*hamra*).

Specimens: SDc-48, SA-123.

Two vessels of dark-red colour (2.5YR 5/6) with dull-red, ferruginous matrix, inactive in PPL, of varied amounts of quartz silt, rich in the sand fraction (0.1–0.3mm) accounting for 30–40% of the volume. Sand grains are mostly (95%) monocrystalline quartz, showing both uniform and undulose extinction; the remaining 5% includes K-feldspars and plagioclases, some heavy minerals, chiefly amphiboles, and sparse cherts. The samples are identical to *hamra* soil occurring in the Haifa region.

Analogies

Tel Dor (petro–group 4),[134] Kommos, Crete,[135] Ashdod Fort, Ashkelon, Atlit, Tel Megadim.[136]

PETROGRAPHIC GROUP VII (**Fig. 7:18**)

Dolomitic silt, rich in 'red fragments'.

Specimens: SD1-63 and SD1-68.

The two specimens are made of dense ferruginous marl rich in dolomitic silt. Macroscopically, they are identical, heavily sintered, with sharp margins of the fracture. Both on the

[134] Eliyahu-Behar *et al*. 2008: 2901; Bettles 2003b.
[135] Gilboa, Waiman-Barak, Jones 2015: 82, Fig. 5.
[136] Bettles 2003b; Fabric Class 2A.

surface and inside they are of a characteristic red colour and with numerous fine white spots of carbonates.

The matrix in PPL is dark-red, with numerous fine rhombohedral dolomite particles accompanied by irregular medium-sand grains of dolomitic rocks and oval grains of carbonates of a micrite structure up to 1.3mm in size. Variously preserved foraminifer associations set the age of the material at Late Cretaceous.

What distinguishes the two samples is the presence of densely scattered glaukonite or pedo-features – presently fragments of ferruginous aluminium silicates of an intensive red colour. Some of them are amorphic, the rest are transparent with a laminar structure, showing undulose extinction.

Analogies

Not known.

PETROGRAPHIC GROUP VIII (**Fig. 7:19**)

Dolomitic sand.

Specimens: SBc-19, SD1-70, SD2-78.

This is a macroscopically non-uniform group and its common feature is the presence of sand-sized rhomb-shaped dolomites. Due to the non-uniform character of the group each specimen was described separately.

Specimen SBc-19

It is a fragment of a thin-walled vessel, light-red on the surface (5YR 7/6), dark grey inside. Under microscope, the calcareous matrix is devoid of quartz silt, reddish brown, optically active, with scattered rhombohedral crystals of dolomitic silt and single dark *terra rossa* balls. Sand-sized grains are oval grains of micritic limestone (15% of the volume) and sparse angular polycrystalline dolomite crystals. The presence of foraminifers: *Marssonella* sp. (?*lodoensis*) *Angulogerina* sp., *Tenuitella* sp. is indicative for Paleogene.

Specimen SD1-70

It is a thin-walled piece of pottery fired to a light red colour (2.5YR 6/8), inside the cross--section light brown. In transmitted light the groundmass is dark brown, residually optically active, rich in carbonate silt, which accounts for about 15% of the volume. Because of the high temperature of firing its carbonate content is hard to determine. The content of quartz-silt is much lower, at about 5% of the volume. The material is enriched with an admixture of *terra rossa* in the form of oval pellets.

In spite of the relatively high temperature of firing, numerous foraminifers of the genus *Globigerinelloides* cf. *bentonensis* (Morrow), *Heterohelix* cf. *reussi* (Cushman) have been preserved, setting the age of the material at Late Cretaceous. The sand-sized admixture consists of angular crystals of dolomite, micritic on margins or replaced completely by micrite; their proportion is *c*. 10% of the volume.

Specimen SD2-78

The sherd fired in reduced-oxygen conditions, steel-grey, made of marl with an admixture of dolomitic sand. The matrix of the sherd is dark brown in transmitted light, partly optically active, devoid of microfosils, with a few-millimetre elliptic clasts of dolomitic marl (with numerous fine rhombohedral dolomite particles embedded in its light brown argillaceous groundmass), smaller, irregular clasts of micritic chalk (light grey of very high porosity), and oval grains of non-transparent pure slag or sintered *terra rossa*. Quartz silt appears sporadically.

An aplastic admixture is represented by rhombohedral dolomites of the 0.2–0.5mm fraction.

Analogies

Amarna tablets.[137]

INTERPRETATION AND CONCLUSIONS

A list of the results of petrographic analyses is presented in **Tab. 1** together with archaeological typo-chrono identifications and their interpretation.

Jars of the Phoenician type, hole-mouthed with carinated shoulder (group 1a), dated to the Persian and the earlier Hellenistic periods, have a relatively uniform fabric belonging to the PG I.A1. They are light red-fired vessels composed of light marl enriched with iron-bearing *Globigerina* chalk containing single clasts of *Amphiroa* sp. and tempered with quartz sand. This type of pottery is universally known from areas of Phoenician influence. According to earlier studies,[138] it was produced in the coastal belt from Haifa northward towards Akko and beyond, especially in the region between Akko and Sidon.

Three (two?) jars of this shape (group 1a) have a different fabric assigned to PG IV; one jar was made of *hamra* soil (PG VI).

Jars of the hole-mouth Phoenician type with a thick rolled lip (group 1b), were produced in the Late Hellenistic to Early Roman periods. In the set examined, they have PG I.A1 fabric (five jars), which means that they also are products of the Phoenician coast.

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[137] Goren 1995; Goren, Finkelstein, Na'aman 2004: 262–269.

[138] Cf. Bettles 2003a: 73–74.

Jars of the hole-mouth post-Phoenician type of an elongated, tubular shape (group 1c, Early Roman period to second-third centuries AD), were made of a variety of materials assigned to:
– PG I.A1 – one jar (see above),
– PG I.A3 – one jar, local to Mt Carmel or the adjacent area,
– PG III – two jars, dolomitic Moza Formation fabric: Mt Carmel?, Samaria?
– PG II – one jar, silty soil.

Predominant among the non-Phoenician bag-shaped jars of group 2a (mostly Hellenistic, some of the Persian period?) are two variants of fabric called PG IV and PG V.

The fabric of PG IV (15 jars), fired in reduced-oxygen conditions to a creamy-white colour, is petrographically non-uniform. Generally, it is composed of highly calcareous marl of Late Cretaceous and Paleogene age, containing abundant foraminifers, some *terra rossa* balls, and even ferruginous argillaceous shale fragments. This group, internal differences notwithstanding, is distinct in chemical terms because of its highest content of phosphorus and high levels of Ni, Cr and U. Its petrographic subgroups, differing slightly in the composition of the paste used, can derive from many various local workshops operating at that time.

The fabric of PG V (11 jars) is also creamy beige or bright orange in colour, composed of highly calcareous marl, with fragments of marly shales, chalk clasts, and an admixture of ferruginous soil fired in reduced-oxygen conditions. This group also shows a high content of sand-sized quartz and glassy yellow hyaloclastites which, as in the case of PG I.A3, makes probable its link with the Mt Carmel region or adjacent areas.

Some of the bag-shaped vessels (group 2a) belong to PGs I.A2 and I.A3. Fired to a light red colour, they are composed of light calcareous marl rich in foraminifers and with some *Amphiroa* sp., but with no foraminiferous ferric oxides in favour of an admixture of *terra rossa*. And the fragments of pyroclastic hyaloclastite, 'yellow fragments', in the opinion of Israeli scholars, are proof of the material coming from the Mt Carmel/Um el-Fahm area, especially from the Carmel coast. Three jars of the 2a group are made of silty soil, one has a fabric rich in an admixture of dolomitic sand (PG VIII).

The Roman-period bag-shaped jars (group 2b, late first century BC – third century AD) were produced using a technology differing from that of the other amphorae, and mostly also of another raw material. The fabric predominating here, highly silty, makes up PG II (55 jars); it is composed of rendzina rich in quartz silt or silty *terra rossa* soil. Although this material is relatively uniform, because of its wide availability it cannot be associated with any specific ceramic workshop.

Amphorae especially distinct in petrographic terms are bag-shaped jars of group 2b, made of dolomitic marl and forming PG III (eight jars). This type of the material crops out along the Judean and Samarian hills (Upper Cretaceous Moza Formation), the equivalent of which is the Sakhnin Formation in the Mt Carmel region as well as in the central and western Galilee.[139] It is also possible that the material comes

[139] Cf. Kafri 1972: 16; Delage 2007: 45.

from the weathered rock of the Karkara Member, which is the lower part of the Deir Hanna Formation.[140]

The examined samples of Hellenistic storage jars and dipper jugs (group 3a) have the fabric of PGs IV (3 specimens) and V (2 specimens); one has been made of silty soil (PG II). The Roman-period storage jars and jugs represent a Roman fabric, i.e. silty soil, or dolomitic marl.

From the archaeological perspective, a dramatic change in the fabrics of the amphorae at Sha'ar-Ha 'Amakim from the Early Roman period on doubtlessly deserves attention, as probably reflecting a new regional network of the sources of supply in jars. While from the late Iron Age (seventh/sixth century BC)[141] through the Late Hellenistic period many northern sites of the present-day Israel were supplied in jars both by the inland workshops and by those situated in the coastal zone, in the Roman period the products of the latter became very rare in the area of Sha'ar-Ha 'Amakim. This may be the result of a change in the ethnic/religious pattern of the settlement in the Lower Galilee, from gentile to Jewish, with the *kashrut* laws recommending the avoidance of vessels made in gentile workshops.

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[140] Cf. Kafri 1972: 6; Sneh 2004.
[141] Oshri, Gal 2010: 23.

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Tab. 1. List of examined pottery samples from Sha'ar-Ha 'Amakim. Archaeological context: Phase A – late Iron Age II and Persian periods (seventh century BC – fourth century BC); Phase B – Hellenistic, to *c.* 150 BC; Phase C – Late Hellenistic/Hasmonean *c.* 150 till *c.* 40/25 BC; Phase D1 – Herodian: late first century BC; Phase D2 – first half of first century AD. Phase E – second half of first century AD; Phase F – second till third/fourth century AD. Abbreviations applied in the table: EH – Early Hellenistic; H – Hellenistic; IA – Iron Age; LH – Late Hellenistic; P – Persian; R – Roman; LWW – Light White ware.

Sample symbol	Excavation inv. no.	Fragment description	Archaeological context	Dating	Vessel group	Petrographic group	Geologic source / provenance proposals
SA-1	924.1	body sherd with handle root, LWW	Phase A, construction of an oven	EH	2a	IV.A	marl of unknown age; 'workshop A', Akko?
SA-2	864.7	rim of jar, Phoenician semi-fine ware	Phase A	P?	1a	I.A1	Middle-Late Eocene; Phoenician coast, Sidon--Sarepta?
SA-3	636	rim of storage jug	Phase A	EH	3a	IV.A	Paleogene, Taqiye Fm.?; 'workshop A', Akko?
SA-4	864.a	handle of jar	Phase A	late IA II?	?	V	Cretaceous, Ghareb Fm.?; vicinity of Mt Carmel, Tel Yoqne'am?
SA-5	897.4	rim of jar	Phase A, residual in 'cistern' G/R	P	1a	IV.D	Paleogene, Taqiye Fm.?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SA-6	192.2	body sherd of jar	Phase A	late IA II to EH	1a	I.A1	Middle-Late Eocene; Phoenician coast, Sidon--Sarepta?
SA-7	943.2	'collared' type rim of jar	Phase A	late IA II	pre-1a	IV.A	Paleocene-Eocene; 'workshop A', Akko?
SA-8	910.13	rim of jar, Phoenician semi-fine ware	Phase A, residual in 'cistern' G/R	P or EH	1a	I.A1	Middle-Late Eocene; Phoenician coast, Sidon--Sarepta?
SA-9	905.2a	rim of jar	Phase A, residual in 'cistern' G/R	P or EH	1a	IV.D	Paleogene, Taqiye Fm.?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SA-10	943.4	rim and neck of jar	Phase A	P	2a	IV.C	marl of unknown age + red shales; Lebanon mountains?, Samaria?

SA-11	908	fragment of jar handle, Phoenician semi-fine ware	Phase A, residual in 'cistern' G/R	P or EH	1a	I.A1	Eocene; Phoenician coast, Sidon-Sarepta?
SA-12	617.a	rim fragment of jar	Phase A	P or EH?	2a	V	unknown age, Ghareb or Taqiye Fm.?; vicinity of Mt Carmel, Yoqne'am?
SA-13	908.17	rim of jar	Phase A, residual in 'cistern' G/R	P or EH	1a	I.A1	Middle-Late Eocene; Phoenician coast, Sidon--Sarepta?
SBc-14	887	handle fragment of jar, LWW?	Phase B	H	2a	V	unknown age, Ghareb or Taqiye Fm.?; vicinity of Mt Carmel, Yoqne'am?
SBc-15	887.13	body sherd of jar	Phase B	H	2a	I.A2	Middle-Late Eocene; Northern coastal plain of Israel?, Lower Galilee?, Lebanon?
SBc-16	891.a	body sherd of jar, misfired	Phase B	H	2a	IV.C	marl of unknown age + red shales; Lebanon mountains?, Samaria?
SBc-17	905.14	rim of jar	Phase B	H	2a	V	unknown age, Ghareb or Taqiye Fm.?; vicinity of Mt Carmel, Yoqne'am?
SBc-18	883.32	rim of jar or storage jug, LWW	Phase B	H	2a or 3a	V	unknown age, Ghareb or Taqiye Fm.?; vicinity of Mt Carmel, Yoqne'am?
SBc-19	912.7	body sherd of jar or storage jug	Phase B	H	2a or 3a	VIII	Late Cretaceous; Mt Carmel region?, Sharon Plain?
SBc-20	886.4	rim of jar	Phase B	H	2a	IV.D	Middle Eocene; Lower Galilee?, Zevulun Plain?, Akko?
SBc-21	906.12	rim of jar	Phase B	H	2a	IV.A	unknown age, Taqiye Fm.?; 'workshop A', Akko?
SBc-22	898.18	jar rim in 'cook ware'	intrusive in Phase B	ER	2b	II.A	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?, local to Sha'ar-Ha 'Amakim?
SBc-23	889.5	body sherd of storage jug	Phase B	H	3a	IV.B	Eocene; 'workshop B', Lower Galilee?, Sharon Plain?, Northern coastal plain of Israel?
SBc-24	910.a	body sherd of jar	Phase B	H	2a	IV.E	Late Cretaceous, Ghareb Fm.; 'workshop E', Lower Galilee?, Zevulun Plain?, Ahihud?
SBc-25	889.4	body sherd of storage jug	Phase B	H	3a	IV.B	Eocene; 'workshop B', Lower Galilee?, Sharon Plain?, Northern coastal plain of Israel?

Sample symbol	Excavation inv. no.	Fragment description	Archaeological context	Dating	Vessel group	Petrographic group	Geologic source / provenance proposals
SBc-26	907	fragment of handle, LWW	Phase B	H?	1a or 2a	IV.D	unknown age, Taqiye Fm.?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SBc-27	892.19	rim fragment of jar	Phase B	H	2a	V	Cretaceous/Paleogene, Ghareb or Taqiye Fm.; vicinity of Mt Carmel, Yoqne'am?
SBc-28	906.13	fragment of jar rim?	Phase B	P? (residual)	2a	IV.E	unknown age, Ghareb Fm.?; 'workshop E', Lower Galilee?, Zevulun Plain?, Ahihud?
SBc-29	901.16	rim fragment of jar	Phase B	H	2a	V	unknown age, Ghareb or Taqiye Fm.; vicinity of Mt Carmel, Yoqne'am?
SBc-30	891	shoulder of storage jug, vitrified inner surface	Phase B	H	3a	V	Middle Eocene; vicinity of Mt Carmel, Yoqne'am?
SBc-31	892.20	rim of jar	Phase B	H	2a	V	Paleogene; vicinity of Mt Carmel, Yoqne'am?
SBc-32	887.14	rim of jar	Phase B	H	2a	V	unknown age; vicinity of Mt Carmel, Yoqne'am?
SBc-33	893.22	rim of jar	Phase B	H	2a	IV.E	Late Cretaceous, Ghareb Fm.; 'workshop E', Lower Galilee?, Zevulun Plain?, Ahihud?
SBc-34	908.40	rim of jar	Phase B	H	2a	IV.D	Paleogene?, Taqiye Fm.?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SBc-35	891.14	rim of jar	Phase B	H	2a	I.A3	Eocene; vicinity of Mt Carmel
SC-36	860.e	rim of jar	Phase C	ER (Herodian?)	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SC-37	860.b	handle of jar, LWW	Phase C	H	2a	IV.D	Paleogene, Taqiye Fm.; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SC-38	860.c	rim of jar, LWW	Phase C	H	2a?	V	unknown age, Ghareb or Taqiye Fm.; vicinity of Mt Carmel, Yoqne'am?

SC-39	860.d	rim of jar, Phoenician semi-fine ware	Phase C	late P (residual)	1a	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SC-40	860.a	handle of jar	Phase C	H	1a or 1b	IV.B	Eocene; 'workshop B', Lower Galilee?, Sharon Plain?, Northern coastal plain of Israel?
SC-41	850.a	handle of jar, Phoenician semi-fine ware	Phase C	LH	1b	I.A1	Middle-Late Eocene; Phoenician coast, Sidon--Sarepta?
SDc-42	737.b	handle of jar	Cistern D	R	2b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SDc-43	737.c	handle of jar	Cistern D	R	2b	II.D	as above
SDc-44	748.b	body sherd of jar	Cistern D	R	2b	II.B	as above?
SDc-45	728.6	rim of jar	Cistern D	R	2b	II.D	as above
SDc-46	737.a	handle of jar	Cistern D	R	2b	II.C	as above
SDc-47	748.a	body sherd of jar	Cistern D	R	2b	II.3	as above
SDc-48	742.4	rim of jar	Cistern D	R	2b	VI	*hamra* soil; coastal plain of Israel
SDc-49	745	body sherd of thin-walled dipper jug	Cistern D	R	3b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SDc-50	748.c	body sherd of jar	Cistern D	R	2b	II.A	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?, local to Sha'ar-Ha Ámakim?
SDc-51	744.29	rim of jar	Cistern D	R	2b	I.A2	Middle Eocene; Carmel Coast, surroundings of Zevulun Plain?
SDc-52	737.40	body sherd of dipper jug	Cistern D	R	3b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SDc-53	744.36	rim of jar	Cistern D	R	2b	II.D	as above
SDc-54	747.3	rim of jar	Cistern D	R	2b	II.A	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?, local to Sha'ar-Ha Ámakim?

Sample symbol	Excavation inv. no.	Fragment description	Archaeological context	Dating	Vessel group	Petrographic group	Geologic source / provenance proposals
SDc-55	735.d	body sherd of dipper jug (thin-walled)	Cistern D	R	3b	II.D	as above
SDc-56	744.37	rim of jar	Cistern D	R	2b	II.D	as above
SDc-57	742.3	rim of jar	Cistern D	R	2b	II.A	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?, local to Sha'ar-Ha Ămakim?
SD1-58	262.e	handle of jar	Phase D1	LH?	2a	V	unknown age, Ghareb or Taqiye Fm.?; vicinity of Mt Carmel, Yoqne'am?
SD1-59	262.d	rim of jar, LWW?	Phase D1	H (residual)	2a	IV.A	unknown age, Taqiye Fm.?; 'workshop A', Akko?
SD1-60	264.b	rim of jar	Phase D1	LH	2a	V	Ghareb or Taqiye Fm.; vicinity of Mt Carmel, Yoqne'am?
SD1-61	262.b	rim of jar, LWW	Phase D1	H (residual)	2a	IV.A	Taqiye Fm.; 'workshop A', Akko?
SD1-62	965.1	body sherd of jar, Phoenician semi-fine ware	Phase D1	LH	1b	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SD1-63	953	handle of jar	Phase D1	ER	2b	VII	Late Cretaceous, Kabri marl?; Lower Galilee?
SD1-64	920.a	body sherd of jar	Phase D1	H (residual)	2a	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SD1-65	939.10	rim of jar	Phase D1	H (residual)	2a	IV.C	unknown age marl + red shales; Lebanon mountains?, Samaria?
SD1-66	262.c	rim of jar	Phase D1	H (residual)	2a	I.A3	Eocene; vicinity of Mt Carmel
SD1-67	264.a	rim of jar	Phase D1	LH? (residual)	1b?	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SD1-68	939	handle root of jar	Phase D1	ER	2b	VII	Late Cretaceous, Kabri marl?; Lower Galilee?

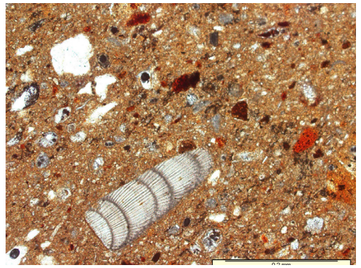
SD1-69	822	rim of jar	Phase D1	ER	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SD1-70	954	body sherd of jar	Phase D1	ER	2b	VIII?	Late Cretaceous; Mt Carmel region?, Sharon Plain?
SD2-71	959.3	rim of jar, Phoenician semi-fine ware	Phase D2	LH (residual) or ER	1b	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SD2-72	957.1	rim of jar	Phase D2	ER	2b	I.A3	Eocene; vicinity of Mt Carmel
SD2-73	936.9	rim of jar	Phase D2	ER	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SD2-74	936.10	rim of jar	Phase D2	ER	2b	IV.D	unknown age, Taqiye Fm.?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SD2-75	858.b	rim of jar	Phase D2	ER	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SD2-76	937.7a	rim of jar	Phase D2	ER	2b	II.B	as above
SD2-77	955.a	rim of jar	Phase D2	ER	2b	II.B	as above
SD2-78	921.1	rim of jar	Phase D2	H (residual)	2a	VIII	unknown age; Mt Carmel region?, Sharon Plain?
SD2-79	937.a	body sherd of jar, misfired	Phase D2	ER	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SD2-80	955.b	rim of jar	Phase D2	ER	2b	II.B	as above
SD2-81	947	rim of jar	Phase D2	ER	2b	II.C	as above
SD2-82	937.b	body sherd of pithos?	Phase D2	ER?	4	?	Ophiolite; Cyprus?, north-western Syria?, Aegean?
SD2-83	921	rim of jar	Phase D2	ER	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SD2-84	858.a	rim of jar	Phase D2	ER	2b	II.D	as above
SD2-85	937.8	rim of jar	Phase D2	ER	2b	II.D	as above
SE-86	930.a.2	rim of jar, Phoenician semi-fine ware	Phase E	LH or ER (residual)	1b	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?

Sample symbol	Excavation inv. no.	Fragment description	Archaeological context	Dating	Vessel group	Petrographic group	Geologic source / provenance proposals
SE-87	926	handle of jar	Phase E	R	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SE-88	816.b	shoulder of jar	Phase E	R	2b	II?	rendzina; Mt Carmel and adjacent area?
SE-89	808.a	rim of jar	Phase E	R	2b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SE-90	856.1	handle of jar	Phase E	R	2b	IV.D	Paleogene, Taqiye Fm?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SE-91	930.b	body sherd of jar	Phase E	R	2b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SE-92	854	neck/shoulder of jar	Phase E	R	2b	II.B	as above
SE-93	934	body sherd of jar, misfired	Phase E	ER	2b	II.D	as above
SE-94	931	handle of jar	Phase E	ER	2b	III	Late Cretaceous, Moza Fm?; Samaria hills?
SE-95	808.b	rim of jar	Phase E	ER	2b	?	unknown
SE-96	816.a	body sherd of jar	Phase E	R	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SE-97	940.7	rim of jar	Phase E	R	2b	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SE-98	825/2.5	rim of jar	Phase E	R	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SE-99	801.4	rim of jar	Phase E	ER?	2b	II.B	as above
SE-100	856.10	'cupped' rim of jar/large jug, LWW?	Phase E	R	3b? (2b?)	IV.F	Eocene; Sarepta?

SE-101	934.4	rim of jar	Phase E	ER (residual)	2b	I.A3	Eocene; vicinity of Mt Carmel
SF-102	919	body sherd of dipper jug?	Phase F	R	3b? (2b?)	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SF-103	950.a	rim of jar	Phase F	R	2b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SF-104	919.4	rim of jar	Phase F	R	2b	II.D	as above
SF-105	919.5	rim of jar	Phase F	R	2b	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SF-106	950.b	rim of jar	Phase F	R	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SF-107	950.2	rim of jar	Phase F	R	2b	II.B	as above
SF-108	919.7	rim of jar	Phase F	R	2b	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SF-109	919.a.1	rim of jar	Phase F	R	1c	?	rendzina + terra rossa; Coastal plain of Israel, Sharon Plain?
SF-110	800.3	rim of jar	Phase F	R	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SFx-111	932	*tabun*	not stratified (apparently pertaining to Phase F)	R?	4	?	unknown age; local to Sha'ar-Ha 'Amakim
SFx-112	923	body sherd of jar	not stratified (Phase F?)	R	1c	I.A3	Eocene; vicinity of Mt Carmel
SFx-113	169.1	body sherd of jar	not stratified (Phase F?)	R	1c	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SFx-114	466.2	rim of jar	not stratified (Phase F?)	R	1c	III	as above
SFx-115	211.4	rim of jar	not stratified (Phase F?)	R	1c	I.A1	Middle-Late Eocene marl; Phoenician coast, Akko-Sarepta?
SFx-116	466.3	rim of jar	not stratified (Phase F?)	R	1c	?	rendzina soil + terra rossa, undetermined provenance
SFx-117	932.11	rim of jar	not stratified (Phase F?)	R	2b	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SFx-118	932.10	rim of jar	not stratified (Phase F?)	R	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?

Sample symbol	Excavation inv. no.	Fragment description	Archaeological context	Dating	Vessel group	Petrographic group	Geologic source / provenance proposals
SX-119	195.7b	handle of jar	not stratified	LH or ER	1b	I.A1	Middle-Late Eocene marl; Phoenician coast, Sarepta?
SA-120	864.13	rim of jar	Phase A	P?	2a	IV.D	unknown age, Taqiye Fm.?; 'workshop D', Lower Galilee?, Zevulun Plain?, Akko?
SD1-121	954.1	rim of jar or cooking pot?	Phase D1	ER	2b or 4	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SBc-122	910.b	rim of jar	Phase B	P or H	2a	II?	silty soil enriched with volcanites, undetermined provenance
SA-123	864.8	rim of jar	Phase A	late IA II?	1a	VI	*hamra* soil; coastal plain of Israel
SF-124	919.6	rim of jar	Phase F	R	2b	I.A3	Eocene; vicinity of Mt Carmel
SD1-125	264.c	rim of jar	Phase D1	H (residual)	2a	I.A3?	as above?
SA-126	943.1	collared type rim of jar	Phase A	late IA II	pre-1a	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SA-127	943.5	rim and neck of jar	Phase A	P	2a	I.A2	Middle or Late Eocene; Northern coastal plain of Israel?, Lower Galilee?, Lebanon?
SA-128	192	rim of pithos rather than jar?	Phase A	late IA II?	pre-1a? 2a?	?	Late Cretaceous; Carmel region?
SX-129	195.8	rim of jar	not stratified	P	1a	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SA-130	631	rim of jar or pithos	Phase A	late IA II?	pre-1a?	?	Late Cretaceous; Carmel region?
SDc-131	626	rim of jar	Cistern D	R	2b	?	undetermined provenance
SBc-132	905.4	rim of storage jug	Phase B	H	3a	?	Eocene; Phoenician coast?
SD1-133	262.a	rim of jar	Phase D1	LH	2a	V	Eocene; vicinity of Mt Carmel, Yoqne'am?
SE-134	854.2	rim of jar	Phase E	R	2b	I.A3	Eocene; vicinity of Mt Carmel

SX-135	195.8	rim of jar	not stratified		1a	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SOV-136	208	piece of brick	not stratified	R	4	?	*hamra* soil; coastal plain?
SOV-137	M 305	piece of brick	not stratified	?	4	II.A	silty soil; local to Sha'ar-Ha 'Amakim
SOV-137'	-	*tabun* sherd	not stratified	ER?	4	II.A	as above?
SOV-139	C	*tabun*(?) clay, from the construction of oven?	Phase B?	H?	4	IV.E?	Late Cretaceous, Ghareb Fm.?; local to Sha'ar-Ha 'Amakim
SX-141	896.6	rim of jar	not stratified	R	2b	II.D	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SX-142	460.c	rim of jar	not stratified	R	2b	II.B	as above
SX-143	180.29	rim of jar, Phoenician semi-fine ware	not stratified	LH or ER	1b	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SX-144	896.a	body sherd of jar, misfired	not stratified	ER	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SX-145	460.d	rim of jar	not stratified	R	2b	II.D	as above
SX-146	460.e	rim of jar	not stratified	LH	1b?	I.A1	Middle-Late Eocene; Phoenician coast, Sarepta?
SX-147	460.b	rim of jar	not stratified	R	2b	II.C	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SX-148	460.a	rim of jar	not stratified	R	2b	II.B	as above
SFx-149	871.11	rim and shoulder of jar	not stratified (Phase F?)	R	2b	III	Late Cretaceous, Moza Fm.?; Samaria hills?
SX-150	305	shoulder of jar	not stratified	ER?	2b	III	as above
SX-151	896.b	body sherd of jar	not stratified	R	2b	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?
SOV-249	-	*tabun* sherd	not stratified	?	4	V	unknown age, Ghareb or Taqiye Fm.?; vicinity of Mt Carmel, Yoqne'am?
SOV-250	-	*tabun* sherd	not stratified	?	4	II.B	silty soil, undetermined provenance; Shikhin?, Yodefat?, Ahihud?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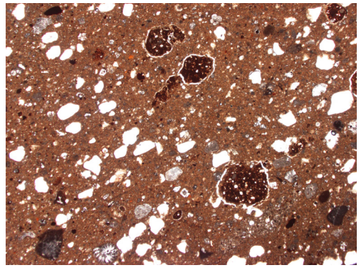
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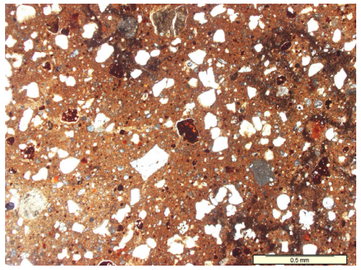
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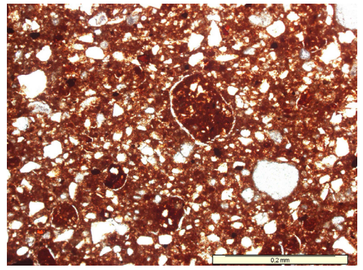
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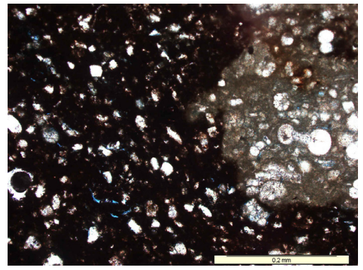
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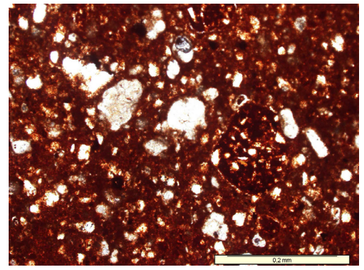
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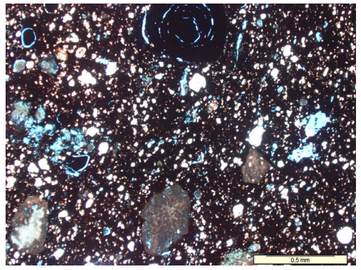
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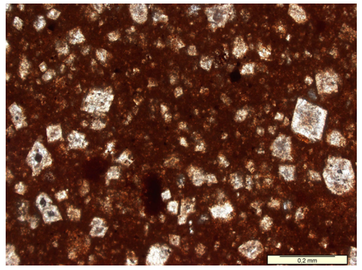
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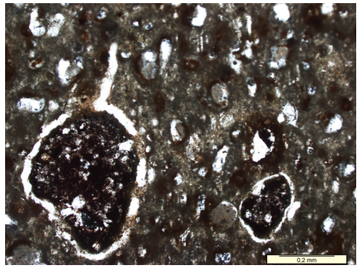
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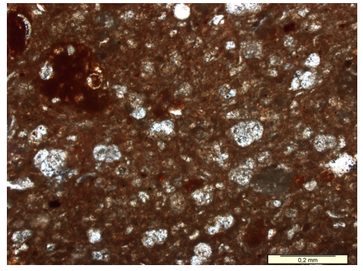
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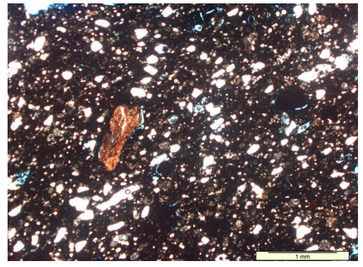
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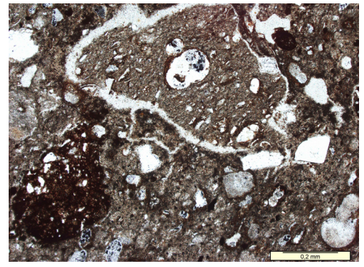
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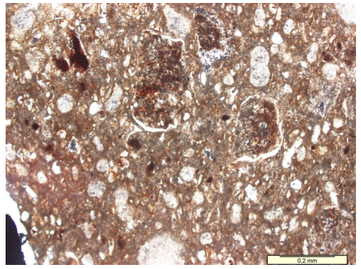
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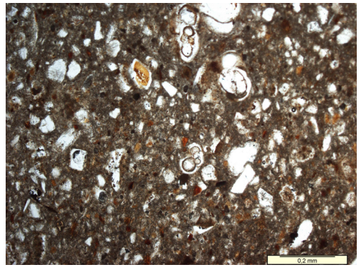
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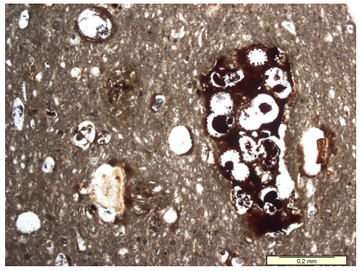
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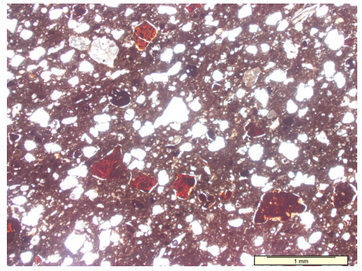
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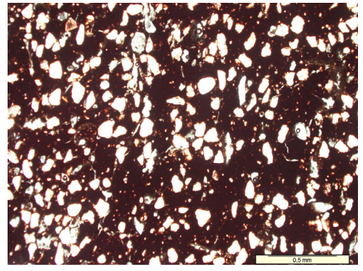
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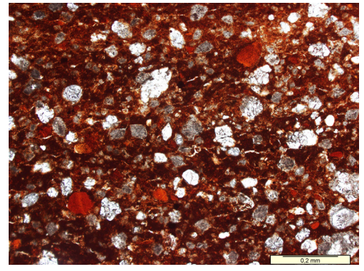
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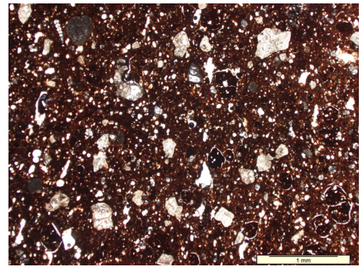
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7. Petrographic groups (PG) distinguished among pottery from Sha'ar-Ha 'Amakim: 1. PG I.A1, SX-146 (PPL); 2. PG I.A2, SBc-15 (PPL); 3. PG I.A3, SD1-125 (PPL); 4. PG II.A, SDc-54; 5. PG II.B, SE-99 (PPL); 6. PG II.C, SF-110 (PPL); 7. PG II.D, SDc-52 (PPL); 8. PG III, SX-150 (PPL); 9. PG IV.A, SA-1 (PPL); 10. PG IV.B, SC-40 (PPL); 11. PG IV.C, SA-10 (PPL); 12. PG IV.D, SBc-34 (PPL); 13. PG IV.E, SBc-33 (PPL); 14. IV.F, SE-100 (PPL); 15. PG IV.H, SA-7 (PPL); 16. PG V, SBc-27 (PPL); 17. PG VI, SA-123 (PPL); 18. PG VII, SD1-68 (PPL); 19. PG VIII, SD1-70 (PPL) (Phot. J. Michniewicz).

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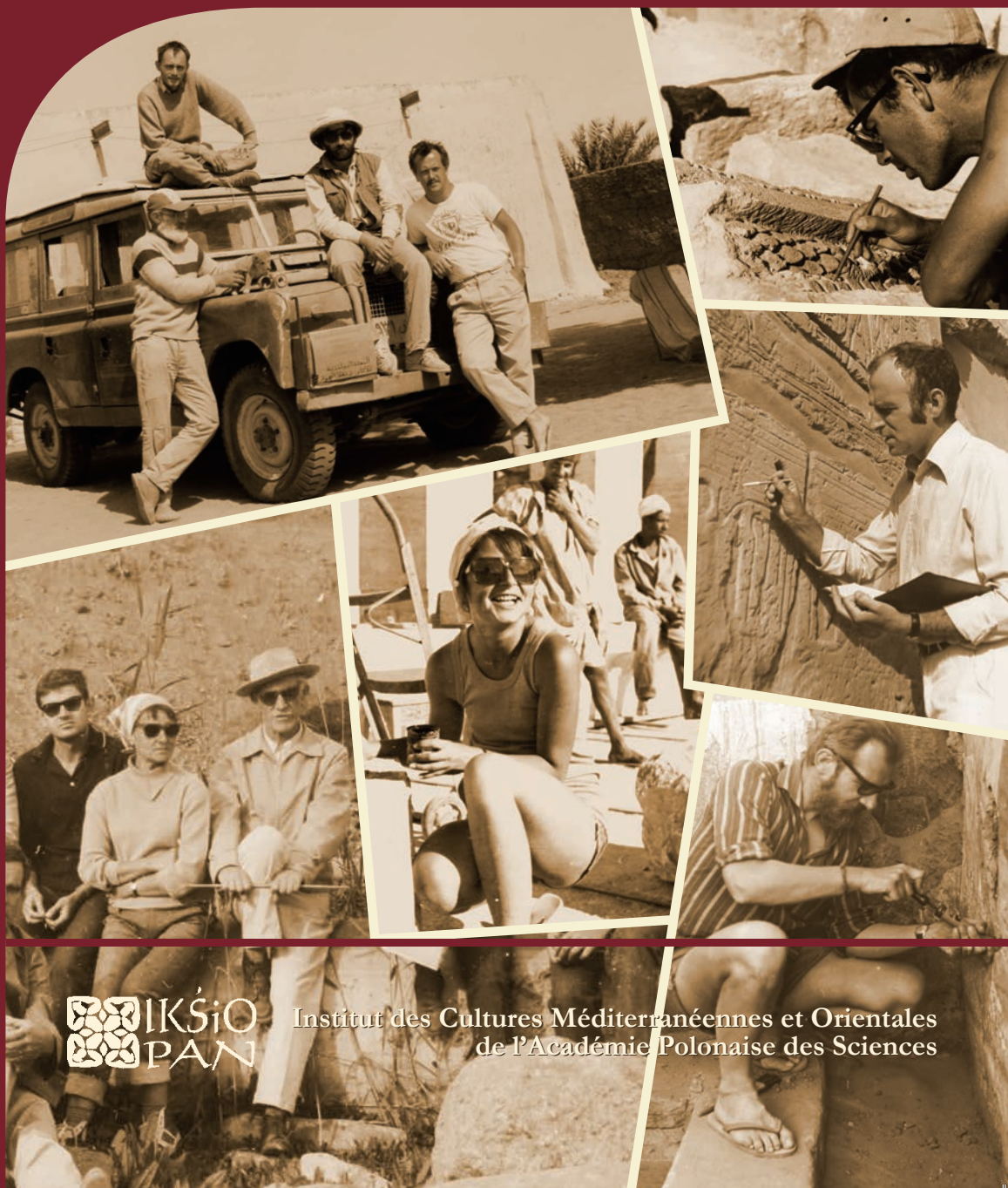

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et P. Wierzbicki (assis sur le camion) (de la collection de B. Żurawski)
En haut, à droite. Palmyre 1964, M. Marciniak au travail (phot. A. Dziewanowski)
Au centre. E. Laskowska-Kusztal au travail (de la collection de E. Laskowska-Kusztal)
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En bas, à droite. Vieille Dongola 1976, S. Jakobielski nettoyant le mur
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