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Petrographic Analysis of Selected Vessels from the Southern Beach of Ashdod

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Samples of nine vessels from the site on the southern beach of Ashdod were examined petrographically by means of a polarized microscope.[1] The purpose of the examination was to identify the origins of the vessels. This would help to evaluate the role played by the site within the commercial network of the Late Bronze Age. In analyzing the results of the petrographic examination it is important to assess the geologic setting of the excavated site, which is situated on recent sand dunes, recent quaternary alluvium, and *kurkar* ridges from the Plio-Pleistocene (Sneh, Bartov and Rosensaft 1998; Sneh and Rosensaft 2004).

Results of the Petrographic Examination[2]

Amphoriskos (B1100/1, L164; see Nahshoni, this volume: Fig. 28:11).— The clay is micaceous, silty and rich in biotite grains. It contains discrete silty carbonate and some foraminifera. The non-plastic components (f:c ratio$_{\{0.062mm\}}$ = ~95:5)[3] include some quartz, fine carbonate and feldspar grains. The mineralogical assemblage suggests the Aegean zone as a possible source for this Mycenean amphoriskos.

Decorated Krater (B2249, L389; see Nahshoni, this volume: Fig. 22:1).— The clay is calcareous, silty and contains some foraminifera. Quartz is the predominant component in the silt fraction that contains a few other minerals, such as oxihornblende and feldspar. The non-plastic compnents are rounded quartz grains. The raw material is identified as loess soil with coastal sand.

Bowl (B1084/5, L156; see Nahshoni, this volume: Fig. 15:10).— The clay is ferruginous and silty. The non-plastic components are coarse, grain-sized, rounded quartz and feldspar grains. The raw material is identified as aeolian soil (loess?) with coastal sand.

Jar (B2402/1, L382; see Nahshoni, this volume: Fig. 20:6).— The clay is ferruginous, rich in silty quartz grains and silty carbonate. The non-plastic components (f:c ratio$_{\{0.062mm\}}$ = ~80/85:20/15) include mainly rounded, coarse quartz grains, often with andoluze extinction and some *nari* (caliche) and chalk fragments. The clay is identified as *terra rossa* soil and the vessel was most probably produced in the Shephelah region.

Jar (B1003/1, L103; see Nahshoni this volume: Fig. 30:10).— The raw material is characterized by b-fabric with silt-sized carbonate particles and shale fragments. Silicified foraminifera appear in the clay. The non-plastic components (f:c ratio$_{\{0.062mm\}}$ = ~80/70:20/30) include well-sorted quartz, limestone, chert and *Amphiroa sp*. algae fragments. On the Levantine coast, coralline algae of the genus *Amphiroa* occur in Quaternary bioclastic sediments of the Pleshet, Kurdane and Ḥefer formations of Israel (Buchbinder 1975; Almagor and Hall 1980; Sivan 1996). To the north, similar features are recorded in the contemporary beachrocks and sands on the Lebanese coast (Sanlaville 1977:161–177; Almagor and Hall 1980; Walley 1997). In the eastern Mediterranean, this alga appears only from the Pleistocene onward

(Buchbinder 1975). In the coastal sand south of the ʻAkko area, quartz is dominant and algae are very rare, but from ʻAkko northward, the algae form nearly 70% of the sand component (Buchbinder 1975:46; Nir 1989; Sivan 1996).

While the beach sand along the northern coast of Israel (from ʻAkko northward) is composed almost exclusively of carbonates (Nir 1989:12–15), on the Lebanese coast the dominance of calcareous components decreases and they constitute about 30% of the beach sands (Emery and George 1963:7). Thus, the quartz grains suggest a provenance in coastal Lebanon rather than the northern coast of Israel. The abundance of *Amphiroa sp.* Alga fragments and quartz grains as non-plastic components in the raw material is typical of the pottery that was manufactured in the large-scale pottery production center in Sarepta (Bettles 2003).[4]

This raw material was also used to manufacture the Iron Age "Wavy Band" pithoi from the Galilee (Cohen-Weinberger and Goren 1996:79; Cohen-Weinberger and Wolff 2001:644, 645 [Family C]) and the New Kingdom amphorae that were found in Egypt, whose provenance was related to the Bronze Age Tell Abu Hawam port (Bourriau, Smith and Serpico 2001:140). These New Kingdom amphorae were linked to the trade in *pistachia* resin, following Serpico's suggestion regarding a link between specific fabrics and contents (Serpico 1996).

Jar (B2302/1, L301; see Nahshoni, this volume: Fig. 34:1).— The clay and the non-plastic components assemblage are identical to those in Jar 1003/1 (see above).

Decorated Amphoriskos (B2410, L389; see Nahshoni, this volume: Fig. 22:2).— The matrix is clayey, rich in tiny rounded carbonate and rhombohedral dolomite crystals, with some large weathered foraminifera and iron oxides. The non-plastic components consist of quartz, biogenic limestone and chert. The matrix is identified as the clay member of the Moẓa Formation exposed along the Judea and Samaria anticlines.

Jar (B2285/1, L404; see Nahshoni, this volume: Fig. 33:3).— The matrix is clayey, with a milky appearance, and contains a small amount of silty carbonate. The non-plastic components include acidic volcanic rock fragments, chlorites, metamorphic rocks (schistose quartz), some decomposed carbonate and a single microcline grain. The source of the raw material is Cyprus, the Aegean zone or Turkey.

Flask (B2008/1, L206; see Nahshoni, this volume: Fig. 21:6).— The clay is calcareous, foraminiferous, and extremely rich in glauconite pellets. The non-plastic components (f:c ratio$_{\{0.062mm\}}$ = ~95:5) include limestone, fine chert and quartz grain. The clay is most probably the Senonian "Kabri marl" that is exposed in the western Galilee (Baida 1963), and is well-attested in petrographic studies of pottery from the Galilee (e.g., Goren and Cohen-Weinberger 2002:438). A Shephelah provenance can not, however, be ruled out because glauconite concentrations appear in the Oligocene-Eocene marls of the Lakhish and Bet Guvrin formations which are exposed in the area of Lakhish (Sneh, Bartov and Rosensaft 1998). Determining the age of the microfauna in this thin section may contribute to a more accurate attribution of provenance for this vessel. Notably, Horowitz had already suggested that the marl of the Bet Guvrin Formation was used for pottery production in Lakhish (Horowitz 2004:2569). Petrographic study of a group of Hellenistic oil lamps from Maresha suggests that the soil used for their production developed from the Bet Guvrin Formation (Cohen-Weinberger, unpublished).

Disccussion and Conclusions

The petrographic results indicate that there was a variety of sources for the sampled pottery vessels. The decorated krater B2249, L389 and bowl B1084/5, L156 are made of loess

soil. Loess soil is massively exposed about 30 km south of Ashdod in the vicinity of Gaza (Ravikovitch 1970). It also occurs north of Gaza, in the region of Ashqelon (Dan, Marish and Saltzman 1975) and about 20 km southeast of Ashdod in the southern Shephelah, in the area of Qiryat Gat (Ravikovitch 1970). The source of the temper in the decorated krater and bowl above, and in jar B2402/1, L382 is in the coastal region. The source of the decorated amphoriskos B2410, L389 is in the Judean Hills. Jars B1003/1, L103 and B2302/1, L301 were imported from the northern coast of Israel or Lebanon. Amphoriskos B1100/1, L164 and jar B2285/1, L404 were imported from Cyprus or the Aegean zone, and flask B2008/1, L206 was probably imported from the western Galilee.

According to the petrographic results, it appears that none of the sampled vessels were locally made. The pottery assemblage from the site includes 16% imported vessels (see Nahshoni, this volume: Fig. 12). With the exception of two Canaanite jars from Lebanon, these were produced overseas (see Nahshoni, this volume). The amount of vessels that were produced in other regions of Israel and were distributed to the site of Ashdod was not estimated. From a typological standpoint, jars B1003/1, L103 and B2302/1, L301 belong to the so-called Canaanite-type jar, which is found in numerous contemporary sites in Israel and in neighboring countries (e.g., Egypt, Lebanon, Cyprus and aboard sunken ships along the Turkish coast). Petrographic analyses indicate that Canaanite jars that were made along the northern coast of Israel or the Lebanese coast were traded to Ashdod and to New Kingdom sites in Egypt (Bourriau, Smith and Serpico 2001), as well as to other sites in the Levant such as Bet She'an (Cohen-Weinberger 1997; Killebrew 2007:179). The same raw material was most probably used for the Ulu Burun amphorae (Serpico et al. 2003:369). Thus, the petrography identified a production center of a group of Canaanite jars that were distributed throughout the Levant and Egypt.

The variety of the vessels' raw materials bears witness to the commercial relations this site had with other sites located along the northern coast of Israel and the Lebanese coast as well as its ties overseas. The internationality of the Late Bronze Age finds is clearly expressed in the petrographic results.

NOTES

[1] The petrographic method is based on examination of thin sections (30 microns thick) under the petrographic (polarizing) microscope. For details concerning the petrographic method, see Whitbread (1995) and Vaughan (1999).

[2] This paper was submitted in 2003; only minor updates were made in 2010.

[3] The f:c ratio expresses the relative proportions of the fine (f) and coarse (c) components of a fabric. In this case, the boundary between these two components is 0.062 mm, which is the boundry between silt and sand size (Kemp 1985:22).

[4] The vessels were sampled by Ayelet Gilboa and Yuval Goren as part of a research project on Phoenician pottery, courtesy of the University of Pennsylvania Museum of Archaeology and Anthropology.

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