CHAPTER 4

Petrographic Analysis

Nissim Golding-Meir

Nineteen ceramic vessels from the Middle and Late Bronze (henceforth MB and LB) levels of the excavation at Yesodot were sampled and analysed (Table 4.1). Ten samples were of MB vessels and nine of LB vessels. The samples were selected with a view towards discerning possible patterns of exchange, or at least vessel or commodity movement. Two kinds of samples were chosen: (a) items judged to be morphologically unusual, or those whose matrix appeared out the ordinary, and (b) storage jars, the vessel type most likely to have been transported in commodity commerce.

The method chosen for the analysis of these vessels was thin-section petrography. This method is used by geologists to identify minerals and to describe and categorize rocks, soils and sands. Here it was used to identify and describe the minerals and rock fragments found in the sampled vessels, both as part of the temper in sand size and in the clay as silt size. The mineralogical content of the thin-sections was then compared to the various possible mineral compositions using geological maps of the suggested regions of origin. Nine additional samples were taken from sherds deemed to be of local ware, to be used as comparative data for the local groups (Table 4.2).

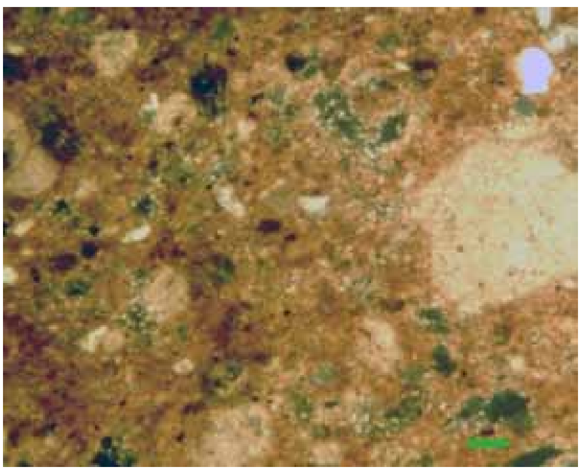

Fig. 4.1. Group A (Sample 3333/17).

The sherds analysed were divided into petrographic groups, classified by the chemical and physical properties of their fabric without reference to period, typology or juxtaposition. This method results in an independent geological analysis that may indicate geographical origin (Cohen-Weinberger and Goren 2004: 3; Goren *et al*. 2004: 4-22).

The Petrographic Groups

Group A – Hamra *soil* (Fig. 4.1)

This group is represented in both the MB and LB assemblages and also in the samples taken for the comparative data. In the MB assemblage this was the main group—eight of the ten samples belong to this group and include jugs, bowls and jars. In the LB assemblage only two of the nine samples belong to this group—two Canaanite jars. This group's fabric is characterized by ferruginous fine clay, slightly silty (2–5%), rich in small opaque bodies of iron minerals and it originates in *hamra* soil. It is unclear how these soils were formed but their proximity to the kurkar rocks—a local term for aeolianite, namely calcite-cemented sandstone incorporating quartzitic coastal sand—probably indicates a connection between them (Singer 2007: 210). *Hamra* soil is found along the coastal plain of Israel from the Ashdod area northwards (Dan *et al*. 1975). This group's temper consists mainly of chalk and limestone fragments and also contains a few opaque and quartz grains. The area around Yesodot is characterized by *hamra* soil (Dan *et al*. 1975). Grains of chalk and limestone outcropping in the nearby vicinity include the Adulam and the Ziqlag Formations (Sneh *et al*. 1998; Sneh 2004).

Table 4.1. The sampled vessels. All figures were taken under XPL to a magnification of x40. The scale on the photographs is 0.15mm.

Field no.	Object	Locus	Period	Group	Provenance
3346/5	Pithos	410	MB	Group D	Central coast
3328/2	Jug	412	MB	Group A	Local
3333/17	Jug	415	MB	Group A	Local
3301/2	Bowl	404	MB	Group A	Local
3224/27	Jar	375	MB	Group D	Central coast
3338/10	Jar	410	MB	Group A	Local
3308/1	Carinated bowl	405	MB	Group A	Local
3284/3	Bowl with knob handle	395	MB	Group A	Local
3363/15	Jar	415	MB	Group A	Local
3229	Bowl with knob handle	375	MB	Group A	Local
3275/4	Egyptianized bowl	389	LB	Group D	Central coast
1050/1	Cypriot pithos	111	LB	Group C	Local
3251/1	Cypriote pithos	383	LB	Group D	Central coast
3361/8	Canaanite jar	310	LB	Group D	Central coast
3362	Carinated bowl/chalice	Surface	LB	Group D	Central coast
3249/6	Trumpet base	330	LB	Group C	Local
3275/5	Canaanite jar	389	LB	Group D	Central coast
3364/31	Canaanite jar	410	LB	Group A	Local
3363/14	Canaanite jar	415	LB	Group A	Local

Table 4.2. The samples taken for a database.

Field no.	Object	Locus	Period	Group	Provenance
3336/4	Carinated bowl	410	MB	Group A	Local
3094/1	Bowl	331	MB	Group A	Local
3224/6	Bowl	375	MB	Group D	Central coast
3011/8	Pithos	306	MB	Group A	Local
3275/3	Bowl	384	MB	Group A	Local
3240/3	Bowl	375	MB	Group A	Local
3232/17	Krater	375	MB	Group B	Local
3341/2	Bowl	415	MB	Group B	Local
3241/9	Krater	375	MB	Group A	Local

Most of the local sherds taken as a control data set belong to this group. Therefore this group is most likely local to the site or the near vicinity.

Group B – Hamra *with basalt grains* (Fig. 4.2)
This group is represented by only two samples (a krater and a bowl) from the local control data set. This group's fabric and temper is very similar to that of Group A but it contains several grains of basalt. Small outcrops (200–300m^2) of Neogene basalt of the Saqiya group are exposed very close to the site (Sneh 2004). Therefore this group is most likely local to the site.

Group C– Taqiye marl (Fig. 4.3)
This group was represented only in the LB samples and included one pithos sherd and one trumpet base fragment. This group's fabric is characterized by calcareous marl containing foraminifers and iron oxides. Fine carbonate crystals are abundant in the matrix, sometimes exhibiting weak optical orientation. The temper of this group is comprised mainly of carbonatic rock fragments, such as chalk, nari and limestone. Based on a large number of publications (Goren 1991: 101; Goren 1996a: 48; Goren 1996b: 150; Cohen-Weinberger 2004: 18; Goren 2004: 51; Goren *et al*. 2004:256-258) this group is identified as originating from marl belonging to the Taqiye formation of the Paleocene age. The Taqiye formation is extremely widespread along the entire southern and eastern shore of the Mediterranean, as far west as Morocco (Bentor 1966:73). Although the local samples—all from MB sherds—taken for comparative data did not include this group, exposures of Taqiye marl are found only 2.0km away from the site (Sneh 2004). Therefore this group is most likely local.

Group D – Hamra *and coastal sand* (Fig. 4.4)
This group is represented in both the MB and LB assemblages and also in the samples taken for the control data set. In the LB assemblage this was the main group; five of the nine samples belong to this group and include bowls, Canaanite jars and a pithos. In the MB assemblage only two of the ten

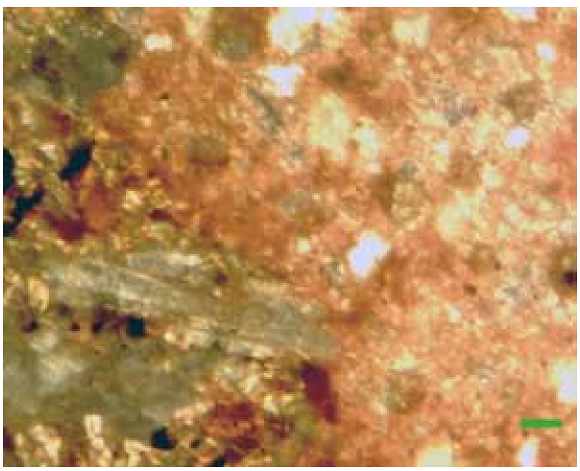

Fig. 4.2. Group B (Sample 3232/17).

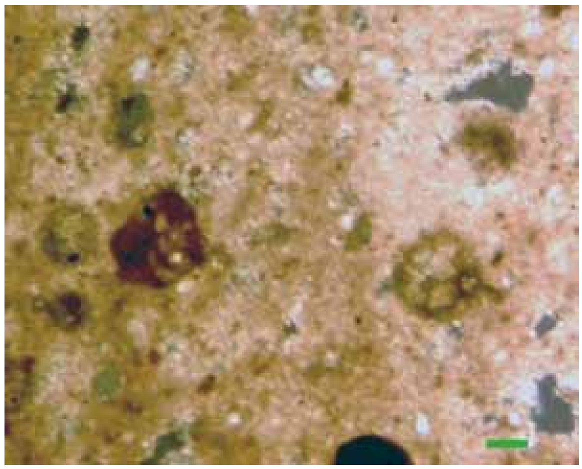

Fig. 4.3. Group C (Sample 3249/6).

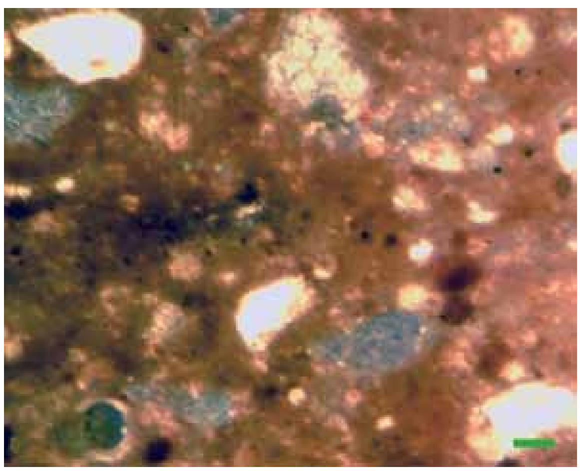

Fig. 4.4. Group D (Sample 3361/8).

samples belong to this group, comprising one pithos and one jar. This group's fabric is characterized by ferruginous fine clay, slightly silty (2–5%), rich in small opaque bodies of iron minerals and originates from *hamra* soil. This group's temper consists mainly of well-sorted, rounded-to-sub-angular quartz grains (10–20%). In a few cases accessory minerals appear, including mainly minerals of the feldspar, amphibole and pyroxene groups. Zircon is also found occasionally. *Hamra* soil is spread along the coastal plain of Israel from the Ashdod area northwards (Dan *et al*. 1975, Singer 2007: 210). The quartz grains found in the temper come from coastal sands transported by the Nile River into the Mediterranean. The proportion of quartz to other sediments diminishes as one goes north and from Akko northwards quartz virtually disappears and the sediment becomes increasingly calcareous (Nir 1989: 12). The *hamra* soil in the southern parts of Israel is rich in silty quartz of Aeolian origin and therefore the southern coast should be excluded from being a candidate for this group. In a study of modern coastal sands it is seen that from the coast of Shefayim northward the sands are already very rich in Mediterranean bioclasts and inland erosion (Golding-Meir 2010: 31-40). There are problems with the comparison of modern and ancient coastal sands (*ibid*. 34-35) but even when compared with pottery originating from the Carmel Coast it is clear that these are already extremely rich in Mediterranean bioclasts. Therefore this group is assigned to the central coast of Israel north of Ashdod and south of Shefayim.

Summary

Most of the vessels sampled from this site were local or from relatively nearby areas such as the coastal plain. Groups A and B consisted of local *hamra* soil while Group C contained local Taqiye marl. Group D contained *hamra* soil with coastal quartz grains and is assigned to the central coast of Israel.

The implications of provenance are examined in Chapter 10.

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