Ḥadashot Arkheologiyot—
Excavations and Surveys in Israel 135

Appendix: The Fabric of the Stratum 2 Pottery from Ẓippori

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Thirty rather weathered pottery sherds—five rims, one neck and 24 body sherds (Table 1)—which can be dated to either the Early Chalcolithic period or the Early Bronze Age I were retrieved from Stratum 2 in the excavation conducted in Moshav Ẓippori. Fresh breaks of these potsherds were examined under a binocular microscope at magnifications of ×20 to ×40, using 5% diluted hydrochloric acid and a steel needle. This examination defined the rock, mineral and other sand-size non-plastic inclusions and described their granulometry, i.e., the size, shape and sorting of the grains. A rough estimation of the firing temperature is offered based on the sherds' color and hardness and on the state of the carbonate inclusions. This data served to identify the raw materials that were used to produce the vessels and their possible provenance, as well as to find lithological parallels in the contemporary pottery from 'En Ẓippori (Milevski and Getzov 2014), located 1 km to the south of the excavation.[1] This comparison was undertaken with the hope of dating Stratum 2 more precisely.

The study identified two lithological groups: Group 1 comprising 29 of the sherds, and Group 2 comprising a single sherd.

Group 1 (Table 1:1–29)

The 29 sherds comprising this group exhibit a high degree of homogeneity. The matrix of all 29 sherds is calcareous foraminiferous marl. Furthermore, all the vessels of this group were fired at low (<650° C) to very low (<600° C) temperatures, just barely enough for sintering—the transformation of clay into ceramic—which resulted in a soft and very friable material. Sand-size non-plastic inclusions make up 1–10% of the volume of each sherd and comprise the following:

Crystalline calcite (Fig. 1:1): angular grains (0.1–2.0 mm) that are either whitish or grayish in color, apparently depending on the firing conditions.

[1] The author conducted the petrographic study of selected vessels from 'En Ẓippori pottery.

Table 1. Inventory of the Examined Pottery

No.	Lithologic Group	Locus	Basket	Description	Firing Temperature (°C)	Fig.	Fig. in Tzin 2023
1	1.1	34	302/3	Body sherd. Inclusions of crystalline calcite and sporadic lumps of ferruginous soil compose c. 10% of the volume	<650	1:4	
2		33	304/1	Body sherd. Remains of red slip on both surfaces. Inclusions of crystalline calcite, gray limestone, and sporadic lumps of ferruginous soil compose c. 5% of the volume	600		
3		33	304/3	Body sherd. Remains of red slip on both surfaces. Inclusions of crystalline calcite compose c. 5% of the volume	<650		
4		33	304/6	Body sherd. Remains of red slip on both surfaces. Inclusions of crystalline calcite compose c. 10% of the volume	<600		
5		43	317/1	Body sherd. Inclusions of crystalline calcite, rare small lumps of ferruginous soil and negatives of the organic matters compose c. 7% of the volume	<650		
6		43	317/3	Body sherd. Grayish core. Inclusions of crystalline calcite and negatives of the organic matters compose c. 10% of the volume	<650		
7		43	317/5	Body sherd. Thick gray core. Inclusions of crystalline calcite and gray limestone compose c. 10% of the volume	<650		
8	1.2	30	300/2	Body sherd. Rare inclusions of crystalline calcite, same as the vessel grog, and lumps of ferruginous soil	<600		
9		33	301	Rim fragment. Rare inclusions of crystalline calcite, same as the vessel grog, and lumps of ferruginous soil. Fired in unoxidized atmosphere, resulting gray color of the sherd	<650		13:2
10		33	301/3	Body sherd. Inclusions of same as the vessel grog, rare crystalline calcite, and sporadic lumps of ferruginous soil comprise c. 10% of the volume	<650		
11		34	303	Rim fragment. Rare inclusions of chalk, same as the vessel grog and negatives of the organic matters	<650	1:2, 1:6	13:4
12		34	303/3	Body sherd. Traces of light brown slip. Sporadic inclusions of crystalline calcite and lumps of ferruginous soil	600		
13		33	304/4	Rim fragment. Traces of light reddish-brown slip. Rare inclusions of crystalline calcite, gray limestone and same as the sherd grog	<650		
14		33	304/5	Body sherd. Rare inclusions of chalk, crystalline calcite, same as the sherd grog, and sporadic small lumps of ferruginous soil	<650		
15		38	305	Rim fragment. Rare inclusions of crystalline calcite, same as the vessel grog, and lumps of ferruginous soil	<650	1:1	13:3
16	1.3	33	301/2	Body sherd. Rare inclusions of gray limestone and lumps of ferruginous soil	<650		
17		33	301/4	Body sherd. Rare inclusions of gray limestone and sporadic lumps of ferruginous soil	<650	1:3	

Table 1. (cpont.).

No.	Lithologic Group	Locus	Basket	Description	Firing Temperature (°C)	Fig.	Fig. in Tzin 2023
18	1.4	30	300	Neck fragment with rope decoration. Rare inclusions of crystalline calcite and lumps of ferruginous soil	<650		13:5
19		30	300/1	Body sherd. Rare lumps of ferruginous soil	<650		
20		33	301/1	Body sherd. Rare inclusions of crystalline calcite, lumps of ferruginous soil and negatives of the organic matters	<650		
21		34	302	Rim fragment. Traces of light orange slip. Rare inclusions of crystalline calcite and lumps of ferruginous soil	<650	1:5	13:1
22		34	302/1	Body sherd. Traces of light brown slip. Rare inclusions of chalk, crystalline calcite and lumps of ferruginous soil	<650		
23		34	302/2	Body sherd. Inclusions of crystalline calcite, chalk, and sporadic lumps of ferruginous soil compose c. 7% of the volume	<650		
24		34	303/1	Body sherd. Rare inclusions of crystalline calcite, chalk, and lumps of ferruginous soil	<650		
25		34	303/2	Body sherd. Traces of light yellowish-brown slip. Rare inclusions of chalk, crystalline calcite, grog, and organic matters	600		
26		33	304/2	Body sherd. Remains of red slip. Rare inclusions of chalk and crystalline calcite	~650		
27		43	317/2	Body sherd. Rare inclusions of crystalline calcite and lumps of ferruginous soil	<650		
28		43	317/4	Body sherd. Inclusions of crystalline calcite compose c. 5% of the volume	<650		
29		43	317/6	Body sherd. Brown slip. Rare inclusions of biogenic chalk	<650		
30	2	43	317/7	Body sherd. Dull red sherd. Ferruginous and silty clay not carefully kneaded and admixed with c. 10% of sub-angular with rounded edges to almost rectangular fragments of pure ferruginous shale, rare chalk, and quartz grains. Contains also numerous negatives after organic matters	700–750	2	

Grog (Fig. 1:2): crushed pottery sherds, whose fragments are sub-rounded (0.3–3.0 mm). Its lithology is the same as that of the vessel, and some of the grog fragments bear red slip, as seen in Fig. 1:2, indicating that red-slipped vessels of the same lithology as that of the examined pottery were crushed into crumbs and added to the clay paste.

Gray limestone (Fig. 1:3): sub-rounded to rounded grains (0.4–3.0 mm).

Chalk (Fig. 1:4): these inclusions are rounded and sub-rounded (0.2–1.5 mm) and are composed of either plain or biogenic chalk.

Ferruginous soil (Fig. 1:5): lumps (0.1–1.0 mm), most likely of terra rossa.

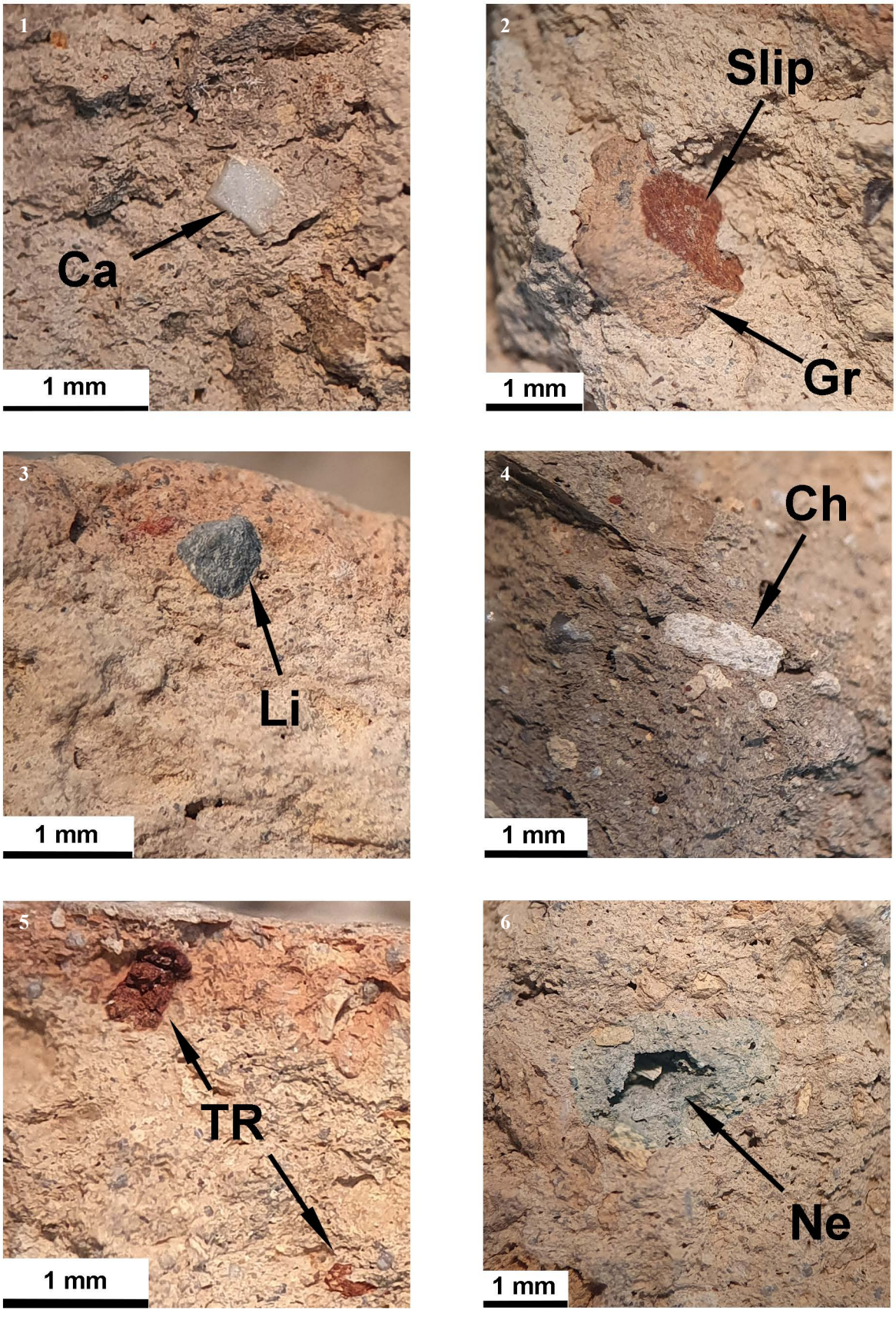

Fig. 1. Microphotographs of fresh breaks of Group 1.

◂ **Fig. 1.**

No.	Locus	Basket	Description
1	38	305	Ca = calcite
2	34	303	Gr = grog fragment with red slip
3	33	301/4	Li = gray limestone
4	34	302/3	Ch = white biogenic chalk
5	34	302	TR = terra rossa
6	34	303	Ne = negative after vegetal inclusion

Vegetal inclusions (Fig. 1:6): fragments of chopped straw or chaff that largely vanished during the firing and are indicated by negatives with or without gray aureoles.

Group 1 was divided into four sub-groups (1.1–1.4) according to the quantity and quality of the dominant sand-sized non-plastic inclusions (for rare and sporadic inclusions consult Table 1).

Sub-group 1.1.— This sub-group comprises seven sherds (Table 1:1–7) that contain 5–10% of grains of crystalline calcite.

Sub-group 1.2.— This sub-group comprises eight sherds (Table 1:8–15) containing mostly sub-rounded grog fragments (Fig. 1:2). The grog inclusions range in quantity from c. 10% of the sherd's volume (e.g., Table 1:10) to only rare fragments. Apart from grog, the vessels of this sub-group contain a remarkable quantity of negatives of vegetal inclusions.

Sub-group 1.3.— This sub-group includes two sherds (Table 1:16, 17) containing sub-rounded to rounded inclusions of gray and dark gray limestone.

Sub-group 1.4.— This sub-group comprises the 12 remaining samples in Group 1 (Table 1:18–29). They are characterized by small quantities (1–2%) of non-plastic inclusions of all the above-mentioned types.

Group 2 (Table 1:30)

One sherd was defined as a clear lithological outlier; this was obvious already when examined by the naked eye due to its dull red color. Its matrix is ferruginous clay, which was carelessly mixed with c. 10% of non-plastic inclusions. The inclusions are 0.4–1.0 mm in size, and the dominant ones are fragments of pure ferruginous shale (Fig. 2), semi-rectangular with rounded edges. Apart from the shale, there are rare grains of chalk and quartz, and numerous negatives of vegetal matter. The sherd is hard, and all the calcareous inclusions are chalky; therefore, the firing temperature is estimated at 700–750° C.

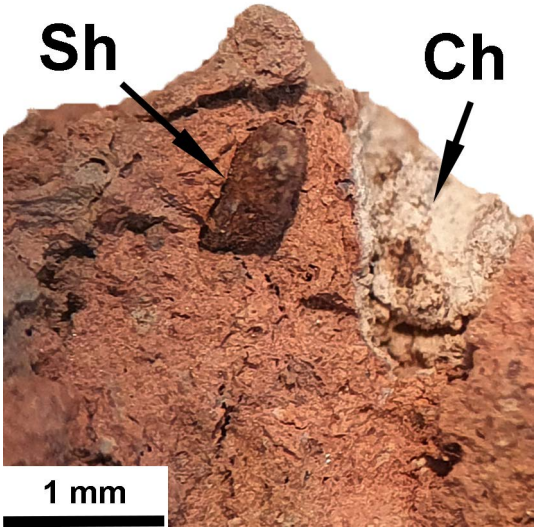

Fig. 2. Microphotographs of the fresh break of Group 2.

Locus	Basket	Description
43	317/7	Sh = ferruginous shale; Ch = chalk

DISCUSSION AND CONCLUSIONS

The observed lithology of the vessels of Group 1 suggests that the most plausible raw material was derived from the Paleocene Ṭaqiye Formation—the dominant bedrock at Ẓippori (Sneh 2018; personal observation). The inclusions in the vessels of this Group can be divided into those that were deliberately added by the potters, such as crushed calcite and grog, and those that are naturally present in the marl or were chance inclusions, like limestone and chalk.

It is obvious that crystalline calcite, identified as a dominant inclusion in vessels of Sub-Group 1.1, was purposely added to the clay. This mineral fills cracks in calcareous rocks, forming veins of various thickness, ranging from a few millimeters to dozens of centimeters (personal observations). These veins were mined by the ancient potters, and the calcite was crushed and added to the clay. Because the expansion rates of calcite and clay are similar (Arnold 1985:24), its inclusion increased the thermal-shock resistance of the vessels and reduced their porosity. Thus, it was the preferred temper in the production of cooking wares as early as the Neolithic and Chalcolithic periods, for example at Tel Te'o (Goren and Halperin 2001:157–159) and at Ḥorbat Duvshan (Shapiro 2013), and as late as the Mamluk and Ottoman periods, as seen at sites such as Khirbat Din'ila (Shapiro 2014:108–109) and Ramla (Stern, Toueg and Shapiro 2019).

The grog, defined as a dominant inclusion for Sub-Group 1.2, is a material composed by crushed pottery, and therefore should also be interpreted as a material that was deliberately added to the clay. Because the grog fragments and the sherds themselves have the same lithology, we can suggest

that it was to re-use production waste. The vegetal material observed in samples of Sub-Group 1.2 could have been either intentionally added or chance inclusions brought by the wind. The higher the quantity of such inclusions, the higher the probability that they were added purposely.

The dominance of the rounded gray limestone inclusions observed in the two vessels of Sub-Group 1.3 may have been derived from wadi sand, and thus should probably be regarded as an occasional intrusion and not as an intentionally added temper. The chalk inclusions derived from the Ṭaqiye Formation, however, were intentionally used as plastic raw material.

Lumps of terra rossa appear in all four petrologic sub-groups, but they are slightly more prominent in Sub-Group 1.4. In general, the appearance of rare or sporadic minute lumps of terra rossa in the clay is not unusual at sites built on hard limestone bedrocks covered with soil, where the soil dust cannot be avoided. While this scenario does not provide a good explanation in our case, as the nearest location of this type of soil is found in the hills, 1–2 km to the northeast and northwest of Ẓippori. Therefore, it is suggested that the potters at Ẓippori collected terra rossa from the hills and brought it to the site in order to produce red and brown slip. Such slip was found on the surfaces of several of the examined potsherds (Table 1:2–4, 12, 13, 21, 22, 24, 25, 29). This slip was produced by sifting and washing this ferruginous soil to extract the ochre—a natural earth pigment, a mixture of iron oxides, clay and silt. Thus, the terra rossa lumps observed in the sherds seem to represent an occasional intrusion into the clay from leftover material or waist resulting from the preparation of slip.

The lithology of the sherd identified as Group 2 indicates that it was produced from materials derived either from plastic formations of the Lower Cretaceous Kurnub Group or from the soil developed on top of these formations. The nearest outcrops of Lower Cretaceous formations to the site are found at the northeastern edge of the Neṭofa Valley. These, however, are devoid of shale facies and thus cannot be the source material for this group. Exposures of such formations that include shale are found along the northeastern flank of the Ḥula Valley and at the southern foothill of Mount Ḥermon and are known to have been exploited by early pottery manufactures (Greenberg and Porat 1996; Greenberg et.al. 1998), but they are located at a distance of about 60 and 75 km from Ẓippori. Therefore, the possible provenance for this vessel cannot be determined with any precision.

Parallels can be found for the lithology of both the Group 1 vessels and the Group 2 sherd in several Chalcolithic-period and Early Bronze Age vessels of the previously examined ceramic assemblage from nearby ‘En Ẓippori (Milevski and Getzov 2014; Nimrod Getzov, personal comm). The similarities suggest that the salvage excavation at Moshav Ẓippori unearthed a small satellite community of the larger Chalcolithic settlement and the later, Early Bronze Age city at ‘En Ẓippori.

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