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Daily Life, Materiality, and Complexity in Early Urban Communities of the Southern Levant

Papers in Honor of Walter E. Rast and R. Thomas Schaub

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Calcite: A Hard Habit To Break

Gloria London and Robert Shuster

Introduction

One important outcome of the Walter Rast and Thomas Schaub collaboration that affects Early Bronze Age and later studies is their technological and typological approach to ceramic analysis. In the Tell Deir ʿAlla Iron Age excavation publication, Franken and Kalsbeek (1969) presented a challenge to traditional typological studies by focusing on ceramic traditions and technology rather than idealized ceramic types. Their hope was that others would test and improve their pioneering attempt to explain how and why potters worked as they did. Among those embracing a more anthropological perspective were Schaub and Rast (1989) and the team they assembled to study the material excavated in the southeastern Dead Sea Plain region. In terms of burials and human skeletal remains (Ortner and Fröhlich 2008), as with the pottery, the object of inquiry became a quantitative analysis of the habits and behaviors of ancient people based on the material culture. The pottery is treated as more than a mere container, but as an artifact fabricated by potters to create something useful for other people to use. Chesson adopts the same approach in analyzing pottery from the Dead Sea site of Numeirah, as well as material from her excavation at Tell el-Handaquq South (Chesson 2000).

Earlier ceramic studies of pottery excavated at Bab edh-Dhraʿ documented a particular procedure that proved constant among potters for thousands of years. One aspect of the enduring stability and continuity of pottery production in Israel and Jordan was the intentional addition of crushed calcite to the clay bodies of cooking pots. Here we examine why the practice survived virtually unchanged longer than almost any other habit common among potters. We also assess the end of the calcite tradition and its impact on the organization of the entire ceramics industry.

Early Bronze Age Calcite Tempered Cooking Wares

In the petrologic study of Early Bronze Age (EB) pottery excavated at Bab edh-Dhraʿ, geologists identified calcite as the predominate inclusions in cooking pots (Beynon et al. 1986: 303). Cookware with calcite temper was the norm and predominated at Bronze and Iron Age sites in Jordan and Israel: Tell Deir ʿAlla (Franken and Kalsbeek 1969: 11, 124; Franken 1992: 109); Jericho (Franken and Kalsbeek 1974: 58); Tall al-ʿUmayri (London et al. 1991: 436); Tell Hadar (Shoval et al. 1993: 264); Tell es-Saʿidiyeh (Vilders 1991–92); and many other sites, such as in southwestern Canaan (Yekutieli 2000: 149). At Iron Age Bethsaida, cooking pots with calcite were identified, but they were not common, based on our sample (London and Shuster 1999: 198–200). Beyond the east Mediterranean corridor, north of Mosul at Hatara Saghir, Late Islamic cookware displays deliberately added calcite temper (Simpson 1997: 109). Throughout history, in diverse parts of the globe, potters recognized the unique properties of calcite, from the Far East (Rye 1976), to the United States (Stimmel et al. 1982 and Steponaitis 1984: 113).

The ability of calcite to withstand repeated reheating without decomposing led to the insistence of potters and their clientele on calcite-tempered cooking pots. Other carbonaceous minerals prove less satisfactory. Shoval (1988) measured the superior qualities of calcite over other carbonates. His experimental work demonstrates that calcite remains stabile at higher kiln temperatures than chalk or limestone. In addition, calcite retains its grain shape, which minimizes defects in the pot walls. In contrast, chalk or limestone can encounter thermal decomposition at temperatures as low as 600 degrees Centigrade (Shoval et al. 1993: 269). Sharp, angular, and large calcite crystals can measure 3.0 mm or more and, along with limestone, contribute to the present-day unglamorous appearance of cooking pots. Since pot walls cannot be thinner than the largest inclusion, the large size of the carbonates limited wall thinness.

The spatial and temporal dominance of large calcite grains in cooking ware for millennia out-lived other pottery staples, such as red slip and burnished surfaces. When the replacements for calcite finally emerged in the Iron Age, they coincided with critically important changes in the ceramics industry, including how pots were made and who made them. The inevitable, but reluctant shift, from calcite, despite its laboratory-proven advantages, was a major turning point in the production of pottery.

The break or calcite "liberation" (Franken and Kalsbeek 1974: 58) allowed any potter to make cooking ware. They no longer needed access to crystalline calcite nodules, which are far less plentiful than limestone (Shoval et al. 1993: 269). In Iron II pots excavated at Jericho, Franken and Kalsbeek (1974: 58) detected the intriguing departure from calcite. They previously observed it in Iron Age pottery excavated at Deir ʿAlla (Franken and Kalsbeek 1969: 124, 128) and later in the study of Kenyon's Jerusalem material (Franken and Steiner 1990: 106–7). It remains to define this transformation in the ceramics industry to determine if it was rapid and complete, if it was permanent, and if it coincided with a political, cultural, economic, or other social event of the first millennium B.C.E.

Study Collection: Tell Hisban Assemblage

Pottery from Tell Hisban excavated and selected by James Sauer (Lugenbeal and Sauer 1972) enables one to assess the tenacious presence of calcite in cookware from the Iron Age until the end of the Islamic Period. Use of the site spans some 2,000 years. With the support of a White-Levy Publication Grant, 229 sherds (numbered PH 1–316) were sampled for petrographic analysis, with the objective of identifying major technological developments and discontinuities in the Hisban assemblage throughout the history of the site. Additional samples include those excavated at Tall al-ʿUmayri (London et al. 1991). Identification of production locations was not the goal of the petrographic study. The aim was to recognize and describe similarities or differences in the clay bodies within and between archaeological periods. The term "clay body" refers to the combined clay, rocks, and minerals found in fired pottery. Petrographic analysis of the non-plastics in clay bodies can differentiate among coarse wares, since most minerals in thin section are identifiable when observed under the microscope. Geologists R. Shuster, J. Blair, and S. Kelly conducted the petrographic analysis at the University of Nebraska at Omaha.

We differentiate 12 petrographic ware types (Ware 1–12) for the collection as a whole, but fewer than half (Ware 1cp, 4cp, 6cp, 10cp, and 12cp) characterize the 45 cookware samples. Some petrofabrics can perhaps be collapsed, but they remain separate here. The 12 petrographic wares differ in type and quantity of the dominant non-plastic, namely quartz, grog, limestone, calcite, or a mix of rock types with none dominant. Sherds assigned to Ware 12 or 12cp contain a fraction of basalt (under 5% of the total non-plastics). Basalt was in the clay when mined or, less likely, it was purposely added. Perhaps the best explanation is that it entered the clay serendipitously as a by-product of crushing another mineral or grog with the help of basalt grinding stones, as suggested by geologist Otto Koop, who analyzed the Kerak Plateau Project pottery and generously commented on the Hisban manuscript.

Tell Hisban Cooking Pot Petrographic Wares

We briefly characterize the cooking pot wares in terms of mineralogical components for the 20 Iron Age samples. The morphological differences in the rim shapes follow.

Ware 1cp: Twenty cookers, including five of the Iron Age through Persian periods, have 80–97% quartz inclusions. In the five samples (fig. 1: PH 61, 291, 299, 300, and 301), quartz content is consistently and remarkably high at 90–97%. A determined effort was made to avoid or eliminate calcite and limestone inclusions from these clay bodies. All other sherds date to the Classical through medieval periods (PH 193–291). Quartz-rich clay bodies characterize most post-Persian Period pots of all types and account for nearly 40% of the Hisban sample.

Ware 4cp: With 70% fragments of grog, or crushed pottery, and 15% quartz, PH 124 was the sole cooking pot fashioned from a fabric normally reserved for Iron Age burnished bowls. No more than 5% of the total assemblage has grog as the predominant inclusion, but for the Iron Age pottery, grog-rich wares represent 10% of the collection.

Ware 6cp: The three pieces with over 60% limestone non-plastics include one Iron Age cooking pot (PH 91) and two Islamic Period baking trays. Wares 6 and 7 (with slightly less limestone than Ware 6) represent the products of local manufacture someplace in the Madaba Plains or Central Jordanian Plateau, given that they include 22% of the entire sample and more than one-third of the Iron Age sherds.

Ware 10cp: Seven samples (fig. 2: PH 4, 57, 58, 59, 60, 66, and 84) with predominantly calcite inclusions (92–98%) date to the Iron Age; one belongs to Ayyubid times, as does a baking tray. The paucity of other inclusions in these sherds suggests that the potters intentionally removed unwanted rocks and minerals. In all but one Iron Age example, the pulverized calcite measures 0.01–0.4 mm. In contrast, the medieval cooking pot has large calcite fragments (2 mm) reminiscent of the EB tradition. Less than 4% of the Hisban sample contains abundant calcite, but for the Iron Age through Persian Period material, the figure is close to 10%.

Although the Iron Age cookers bear the traditional temper of calcite, it differs substantially from the EB tradition in size, shape, and grading. Here the calcite was ground fine and sieved to eliminate the remaining large, angular rhombic crystals. The two laborious tasks of crushing and sieving calcite were undertaken for any of four reasons: to remain loyal to the old tradition; to accommodate higher firing temperatures in order to fire pots red; to reduce decomposition from thermal stress during use; and to adjust to a new way of shaping pottery by throwing pots on a fast heavy wheel capable of momentum. The latter development had industry-wide implications and possibly coincided with or occurred around the same time as the shift away from large calcite temper in cookware.

Wares 12cp: Minor quantities of basalt in cooking pots characterize 10% of the overall assemblage, but 12% of the Iron–Persian Period material (fig. 2 lower).

Ware 12cpa: Of eight cookers with a quartz-rich clay body in addition to some basalt, only one dates to the Iron Age. In PH 298, calcite is absent although there is some limestone in a clay body consisting of 92% quartz measuring 0.1–2.0 mm in size.

Ware 12cpb: PH 55 is the sole sample with limestone abundant (48%), 25% calcite (0.01–1.0 mm), and 20% quartz (0.1–0.5 mm). A trace of pyroxene (< 0.001 mm) could have been in the original clay mass or it was an unintentional addition to the clay as a result of grinding another non-plastic. The only other limestone-tempered cooker in our sample, PH 91, lacked basalt (Ware 6cp).

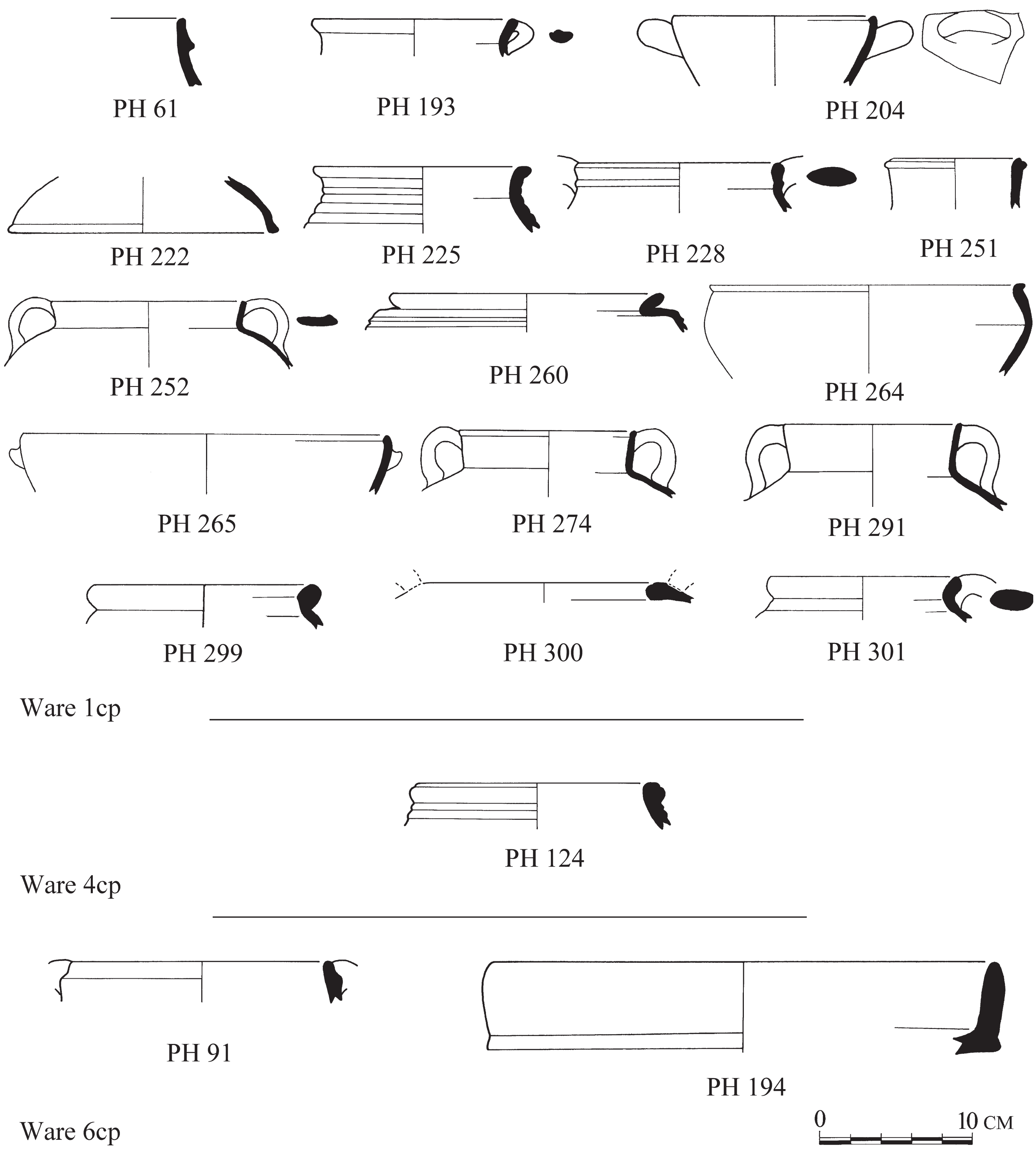

Figure 1. Cooking pots and baking trays according to predominant inclusion: Ware 1cp with quartz (PH 61-301); Ware 4cp with grog (PH 124); and Ware 6cp with limestone (PH 91 and 194).

Ware 12cpc: For the three calcite-rich Iron Age samples with some basalt, the finely ground calcite measures no more than 0.3 mm. We identify two distinct clay bodies: PH 7 and 28 have 90% finely ground (up to 0.3 mm) calcite; PH 68 has only 55% angular to sub-rounded calcite as large as 1.0 mm. It contains 30% quartz ground to 0.01–0.5 mm. Both recipes depart from the EB tradition of large, angular calcite grains. In PH 68, there is 55% calcite, but crushed quartz accounts for 30% of the inclusions. Although calcite was present and predominant, the older tradition is in the process of being replaced by smaller and finer calcite or quartz powder.

Ware 12cpe: PH 135 has a mix of 55% quartz (0.1–1.0 mm), 35% angular calcite (up to 1.0 mm) and 5% angular limestone (up to 1.5 mm). The angularity of the calcite and limestone attests to deliberate crushing shortly before they were added to the clay, probably with basalt equipment. There was no lag time between preparation and use of the inclusions to allow them to become rounded through rolling. Considered as a whole, the clay body combines the older reliance on moderate to large calcite (1.0 mm) inclusions in a fabric with predominantly quartz temper. For the 45 Hisban cooking pots analyzed, quartz unequivocally characterizes post-Iron Age fabrics (fig. 3).

In comparison to the non-cooking pot petrofabrics, it is clear that the cookware stands apart in terms of clay manipulation, treatment, and choice of non-plastics. Cooking pot clay bodies exhibit:

1. Limited number of clay bodies: cookware was made of fewer wares than used for the regular repertoire of jugs, jars, etc. For millennia, potters relied on a small number of clay bodies for cooking pots.
2. Exclusivity of inclusions: for the Iron Age through Persian Period sherds, cooking pots alone tend toward the exclusivity of a single non-plastic. Homogeneity of the non-plastic signals considerable control and care potters exercised in preparing clay for cooking pots, unlike most other clay containers.
3. Rarity of mixed inclusions: one-quarter of the non-cooking pots were composed of a mix of non-plastics such as quartz, limestone, grog, etc., in varying quantities (Wares 8 and 9), yet only one cooker belongs to Ware 12cpe, a mix of inclusions plus medium to large (1.0 mm) calcite.
4. Decreasing dependency on calcite: in lieu of calcite, crushed grog, limestone, and quartz were added to the clay as evidenced by their sharp angular shapes, small grain size, and upper size limit.
5. Manipulation of the raw material: potters carefully selected and prepared the raw material by removing extraneous minerals and organics from the clay and by grinding and sorting inclusions for cooking pots.
6. Within the Iron through Persian Period samples, the cookers lead the shift to quartz temper. Virtually all of the listed features serve to separate cooking-pot makers from the potters who made the non-cookware ceramics.

Morphological features of the Iron Age cooking pots: The petrographic suite of samples includes the maximum number of clay bodies and rim shapes discernible macroscopically. Morphological features vary considerably between and within the ware categories.

Ware 1cp: Quartz-rich Iron Age cookers display widely varying rims: holemouth, rounded, triangular, pointed, bulbous, thickened, or ridged. Some show a ridge above a handle. Most are red-fired and have diameters measuring 14–16 cm. Comparable forms from stratified deposits include ʿUmayri (Herr 1989: fig. 19.10.20–23; fig. 19.11.1–9) and others from the Transjordanian plateau (1989: 306). In terms of rim shapes, comparable examples come from LB and Iron I deposits, but when considering the non-plastics, quartz has replaced calcite as the prime non-plastic in line with the post-Persian Period tradition (fig. 4).

Ware 4cp: Holemouth PH 124 has a groove on the rim and several on the wall below. It measures 14.5 cm in diameter and bears a resemblance to an ʿUmayri example (Herr 1989: fig. 19.11.2 and p. 306) with parallels from the Transjordanian plateau and Dibon. Both the narrow rim opening and the inward stance of the rim are harbingers of the newer cooking-pot forms.

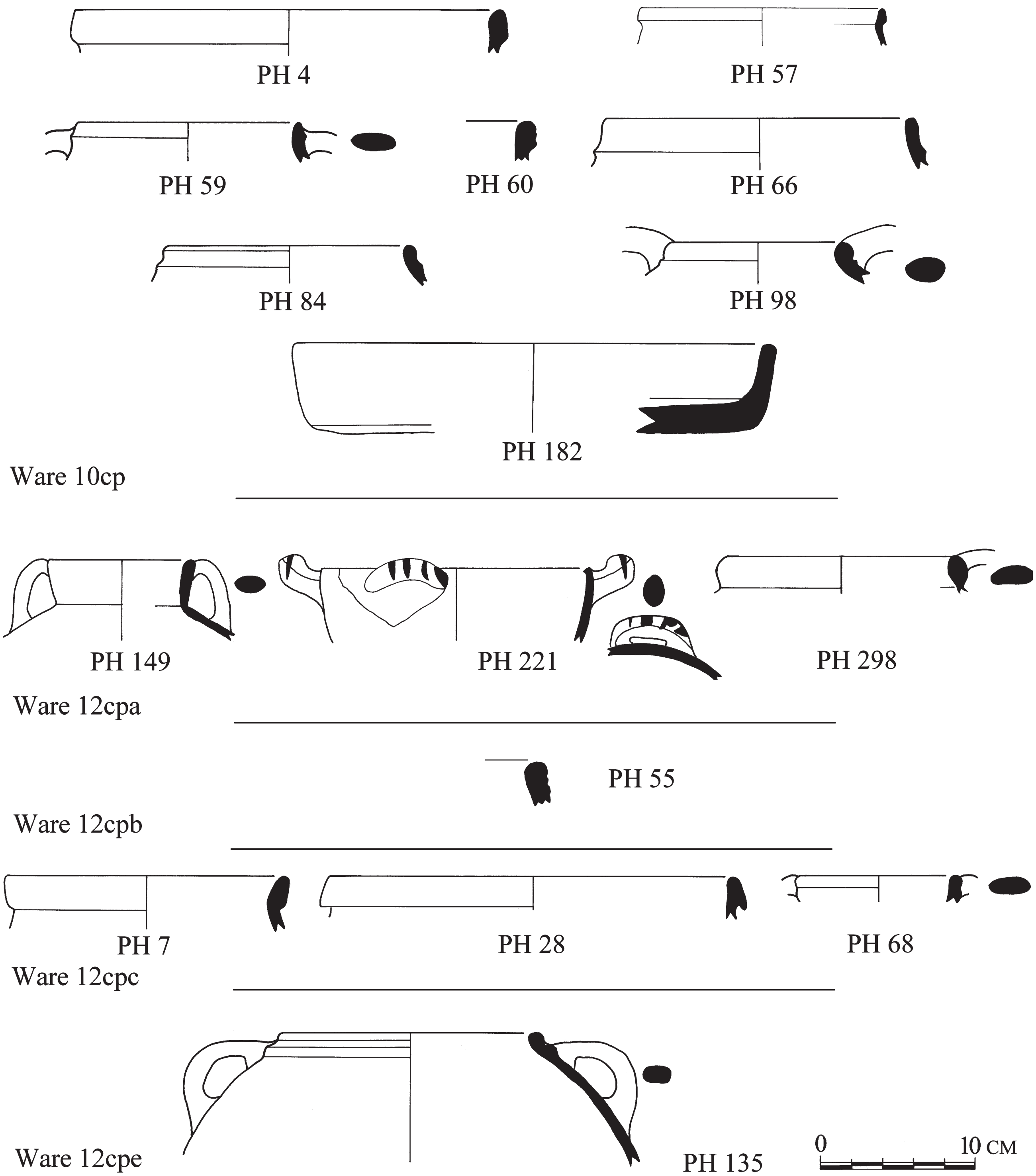

Figure 2. Cookware with predominantly calcite inclusions: Ware 10cp (PH 4-182). Cooking pots with basalt traces: Ware 12cpa with quartz (PH 149-298); Ware 12cpb with limestone (PH 55); Ware 12cpc with calcite (PH 7-68); and Ware 12cpe with a mix of quartz/calcite/limestone (PH 135).

Ware 6cp: For limestone rich PH 91, the rim has an exterior ridge, as found on Iron II holemouth cookers from ʿUmayri (Herr 1997: 40 and fig. 3.17.25) as well as Hisban Stratum 18 (Ray 2001: fig. 3.6.10) with parallels at Taʿanach (Ray 2001: 52).

Ware 10cp: Based on rim morphology and stance, one might hesitate to group these seven pots with calcite tempering together. The triangular rim of PH 57 stands slightly outward, as does a Late Bronze Age form from ʿUmayri (Herr 1997: fig. 7.7.11). For PH 59, the upright, almost pointed rim (diameter 13.7 cm), with an exterior ridge resembles a Late Bronze Age cooking pot excavated at ʿUmayri (Herr 1997: fig. 7.7.12) with parallels from southern Israel (1997: 236). A rounded, thickened rim, with ridges on the exterior of holemouth cooking pot PH 60, is comparable to an ʿUmayri example (Herr 1989: fig. 19.10.18) and another from Hisban (Ray 2001: fig. 3.8.15). With an inward slant, PH 66 has a wide mouth (diam. 18.5 cm) and a rounded rim with a slight exterior thickening resembling a Hisban Stratum 18 example (Ray 2001: fig. 3.6.13). A standard Iron II cooker is red fired PH 84, with a small mouth (diam. 14.5 cm) and a rounded inward slanting rim, like a Stratum 18 pot from Hisban (Ray 2001: fig. 3.6.10). PH 84 has 98% calcite temper, but withstood a kiln temperature high enough to fire red. Larger calcite rhombs would decompose before a red-firing color was achieved, but the secret to the success of this pot is the ground calcite measuring no larger than 0.01–0.4 mm.

Ware 12cpa: The slightly pointed, upright rim of PH 298 resembles the rim on a closed globular body form known at ʿUmayri and limited to Transjordan (Herr 1989: 332, fig. 19.11.1, 2, and 5). Rim diameter for this red-firing quartz-rich cooker is small, estimated to be 14 cm. In form, the rim is most similar to quartz rich PH 299, which lacks basalt, but both have predominantly quartz temper. Similarities of rim shape and non-plastics for the two samples could imply that the presence of basalt was an unintentional by-product of grinding the quartz, but the large size of the quartz grains (as big as 2 mm) might negate the idea that the quartz was crushed. An unusual feature of PH 298 is the horizontal orientation of the elongated voids from burned-out organic material. Pronounced orientation is indicative of wheel or turntable work. Few of the other cookers show a specific orientation direction for the voids.

Ware 12cpb: Limestone-rich PH 55, a thickened rim slanted inward, has three shallow ridges on the exterior wall. In form, it resembles examples excavated at ʿUmayri (Herr 1989: fig. 19.10.20; Herr 1997: fig. 3.17.26) with parallels from the Transjordanian Plateau, Dibon (Herr 1989: 306), and Hisban Stratum 17 (Ray 2001: fig. 3.8.13).

The other Iron Age limestone-rich cooker, PH 91, fabricated from Ware 6cp, lacks basalt but resembles the holemouth form with a thickened rim and ridge below as found throughout the 9th to early 7th centuries region-wide and considered the standard Iron II cooking pot. In both fabric and tempering, PH 91 belongs to the millennia-long Bronze Age tradition of carbonate tempering material in cooking pots. The rim form, however, belongs to the newer Iron II tradition. These counter-indications of the old versus the new traditions imply that not every aspect of a ceramic tradition changed simultaneously. At times, rim shapes changed firstly. Potters were more conservative with their choice of clay bodies and probably impervious to political and social events.

Ware 12cpc: Rim morphology and stance vary noticeably for the three calcite-rich cooking pots with basalt. The minimally out-flaring, slightly pointed rim of PH 7 is thickened in common with the older style. The wide diameter (17.5 cm) is also diagnostic of Bronze Age traditions. Morphologically, it resembles Iron I ʿUmayri examples that Herr (1997: 82, fig. 4.27.22 and 25; 243 n. 1) noted as potentially useful for differentiating from the earlier Iron l settlement. For PH 28, the rounded rim, slightly inclined inward, has a long flange with a groove underneath comparable to a published Hisban example (Ray 2001: fig. 3.3.14**)**. It resembles ʿUmayri cooking pots described as a triangular rim with a slight flange and reminiscent of the Late Bronze Age forms (Herr 1997: fig. 4.27:24; fig. 7.7. 17; and

PH No.	No.	Stratum	Square	Locus	Pail	Reg. No.	Type	Description	Period	Ware
4	16	18 (B)	CW 1	141	976	83145	cook pot	wide rim diameter	Iron I	10cp
7	18	18 (B)	CW 1	140	974	82976	cook pot	wide rim diameter	Iron I	12cpc
28	24	20 (A)	D 4	137	289	31677	cook pot	wide rim diameter	Iron I	12cpc
43	none	NA	CW 1	110	973	82961	cook pot	clay as PH 57; small rim	Iron I	/
55	39	NA	CW 1	0	0	82303	cook pot	wide diam.; ridges below rim	Iron I	12cpb
57	41	18 (B)	CW 1	133	937	28359	cook pot	moderately wide rim diameter	Iron I	10cp
58	none	18 (B)	CW 1	138	959	81950	cook pot	clay as PH 59; han from rim ridge	Iron I	/
59	42	18 (B)	CW 1	139	965	82973	cook pot	narrow diameter; rim as PH 58	Iron I	10cp
60	43	18 (B)	CW 1	139	965	82573/4?	cook pot	wide diam; 2 ridges as PH 55	Iron I	10cp
61	50	NA	D 4	62	201	35798	cook pot	wide rim diameter	Iron I	1cp
64	none	18 (B)	CW 1	126	905	24470	cook pot	narrow rim diameter	Iron I	/
66	52	18 (B)	CW 1	0	0	25247	cook pot	wide rim diameter	Iron I	10cp
67	n	18 (B)	CW 1	124	909	24818	cook pot	moderately narrow rim	Iron I	/
68	53	18 (B)	CW 1	124	901	24121	cook pot	narrow rim diam. with handle	Iron I	12cpc
78	none	17 (B)	C 1	118	861	25709	cook pot	narrow rim	Iron II	/
84	67	17 (B)	C 1	118	863	26005	cook pot	moderately narrow rim diamater	Iron II	10cp
91	71	21 (B)	CW 1	123B	883	20866	cook pot	narrow rim diameter; handles	Iron II	6cp
93	none	17 (B)	CW 1	0	886	21776	cook pot	narrow ridged rim; handles	Iron II	/
98	101	16 (A)	B 1	0	326	1072?	cook pot	narrow diam; handle from rim	Iron II/Per	10cp
124	109	16 (A)	B 1	143	372	12951	cook pot	ridges below narrow rim diam.	Iron II/Per	4cp
132	none	16 (A)	B 1	0	392	13239	cook pot	thickened rim; gray firing	Iron II/Per	/
135	114	16 (A)	B 1	0	376	13130A	cook pot	moderately wide diam; handles	Iron II/Per	12cpe
149	127	NA	D 1	0	201	32719	cook pot	two handles; high neck	Hellenistic	12cpa
171	296	NA	D 6	33E	W90	31335A	baking tray	1% grog inclusions	Medieval	6cp
182	285	NA	D 6	33H	110	32495	baking tray	rounded corner base	Medieval	10cp
184	287	NA	D 6	33 I	114	31931	cook pot	calcite inclusions 2 mm in size	Medieval	10cp
186	270	NA	C 2	9	317	20616	cook pot	calcite inclusions 1.5 mm in size	Medieval	12cpa
193	277	NA	C 2	0	315	20498	cook pot	small loop handle	Medieval	1cp
194	281	NA	C 2	0	305	20161	baking tray	10% grog inclusions 0.4–1.5 mm	Medieval	6cp
203	260	NA	C 2	0	321	20785	cook pot	loop handle	Medieval	12cpa
204	261	NA	C 2	0	320	20563	cook pot	horizontal side handle	Medieval	1cp
221	251	NA	C 4	0	256	22988	cook pot	white; painted hor loop handle	Medieval	12cpa
222	252	20 (A)	C/D4	39	301	94385	cp lid/bowl	slight carination	Medieval	1cp
225	212	NA	A 1	0	0	870	cook pot	gray clay; 96% quartz inclusions	L. Byz.	1cp
228	215	NA	A 1	0	0	873	cook pot	loop handle	L. Byz.	1cp
242	228	NA	A 1	0	0	873	cook pot	95% quartz inclusions	L. Byz.	1cp
247	193	NA	B 3	0	29	11872	cook pot	black exterior	L. Byz	1cp
248	194	NA	B 3	0	8	10236	cook pot	thick walled unusual gray clay	E. Byz.	1cp
250	196	NA	B 1	58	209	10256	cook pot	buff color; 4% iron oxides	E. Byz.	1cp
251	197	NA	D 4	0	69	35841	cook pot	92% quartz; ridged rim	E. Byz.	1cp
252	198	NA	D 4	4	34	32624	cook pot	two thin loop handles	E. Byz.	1cp
253	199	NA	D 4	0	69	35856	cook pot	rare brown clay; 5% pyroxene	E. Byz.	12cpa
257	203	NA	D 4	0	209	10258	cook pot	pyroxenes in the clay	E. Byz.	12cpa
258	204	NA	D 4	0	69	35836	cook pot	90% quartz inclusions	Byzantine	1cp
260	175	NA	D 3	43	112/172	37398	cook pot	ridged shoulder	Roman	1cp
264	178	NA	D 3	0	189	38188	cook pot	carinated	Roman	1cp
265	179	NA	D 3	0	189	38220	casserole	white; pie crust handle	Medieval	1cp
266	180	NA	D 3	48	138	36014	cook pot lid	also used as a bowl?	Medieval	1cp
274	167	NA	A 6	0	155	21914	cook pot	loop handle rim to shoulder	Roman	1cp
283	156	NA	B 4	0	106	14942	cook pot	95% quartz; 1% pyroxenes	Roman	12cpa
291	143	NA	B 4	0	325	14427	cook pot	high neck; handle rim-shoulder	Roman	1cp
298	80	NA	B 2	98?	0	14926	cook pot	narrow diam.; red; han at rim	Iron II	12cpa
299	81	NA	B 1	269?	0	15469	cook pot	narrow rim diam.; red firing	Iron II	1cp
300	82	NA	B 1	0	274	14249	cook pot	narrow rim diam.; red firing	Iron II	1cp
301	83	NA	B 2	0	118	15498	cook pot	narrw rim diam.; red/orange firing	Iron II	1cp

Figure 3. Descriptions of cookware samples according to PH number followed by sherd number. Archaeological periods approximate those assigned by J. Sauer when the material was excavated and do not always reflect current terminology.

fig. 7.9.13; and p. 243). The large diameter of 25 cm and the rim shape signal the older style, as does the calcite temper. In contrast to the large calcite rhombs typical of the Bronze Age, the calcite here was crushed and sieved to measure 0.1–0.3 mm. PH 68, with a handle rising above the rounded rim with a ridge below, contained even finer (0.01–0.10 mm) powdered calcite than PH 28. Both the presence of the handle and the narrow aperture (diam. 9.5 cm) indicate the new tradition. A comparable rim was found at Hisban, Stratum 17 (Ray 2001: fig. 3.8.14, but with a larger diameter). The rim of PH 68, considered a hallmark of Iron II, resembled PH 84, 98, and 135, which all contain some calcite (30–98%). Under the microscope, PH 68 displayed a mildly parallel orientation detected for the elongated voids, possibly indicative of wheelwork or simply a turntable, a feature in common with PH 135 dated to the Iron Age/Persian Period.

Ware12cpe: The rounded rim of PH 135 preserves remnants of a handle. The rim slants inward in style with the new silhouette of Iron II holemouth cooking pots. Also indicative of a new tradition is the red-firing color. The rim resembles a Stratum 17 cooking pot at Hisban (Ray 2001: fig. 3.8.15) and examples from ʿUmayri (Herr 1989: 330, fig. 19.10.24 and Herr 1997: 40, fig. 3.17.25). In addition to rim stance and red-firing color as evidence of the new tradition, calcite is limited to 35%, with an increase in quartz at 55%. Finally, concentric circles made by the finger on the vessel interior could approximate wheel rotation, but probably not wheel-throwing. Voids resulting from the burned out organic material were rounded or elongated, with the latter aligned rather than randomly situated.

Chronological Span of the Iron Age Hisban Cookware

Published parallels for the Hisban cookers span the LB, Iron I, Iron II, and Iron II/Persian Period. Cookers most resembling Late Bronze Age parallels have calcite-rich clay bodies, as do those of Iron I date. Iron II–Persian Period sherds display quartz, limestone, grog, or calcite temper. When the wares with basalt are collapsed into their dominant inclusion group, the result is a preponderance of calcite temper in Iron I, but quartz temper in Iron II/Persian Period times. Quartz-rich cookers did not overwhelm the Iron II market. Calcite-tempered cooking pots remained in use during a period in which potters experimented with unusual tempering materials (grog and limestone). In our current sample the calcite tradition remains absent until the medieval period and in the interim, quartz dominated for practically all ceramic shapes.

Social Implications of the Petrographic Study of Hisban Cookware

The strengths of the Hisban cooking pot sample are the diversity of rim shapes, clay bodies, and the long time span, which allow one to detect change or continuity over two millennia at a single rural site. One of the major changes occurs in the clay bodies of cookware. The calcite tradition begun even before the EB (Franken 1996–97: 21) reveals signs of weakening, but it was not a clean break.

The only Iron Age vessel type with exclusively quartz temper is the cooking pot at Hisban. All post-Iron Age shapes, including cookers, show a predominance of quartz inclusions. Nevertheless, the calcite liberation in cookers had ramifications throughout the entire ceramics industry. The shift to quartz meant that more potters than ever could make cooking pots, with a resultant rise in variation within rim forms, overall vessel proportions, etc. If cooking-pot specialists were responsible for certain mold-made LB and Iron Age cookware, specialists were no longer necessary. Many more potters were suddenly capable of making cookware. The explosion of rim shapes in the 8th century described by Geva (1992: 141) could be attributable to the rejection of calcite as a necessary component of the clay bodies. In addition, potters could not only shape cookers, but they were now free to fire them in the same kilns as the rest of the repertoire. In creating fabrics with pulverized inclusions of calcite or quartz, rather than the angular rhombs of calcite, the potters produced clay bodies suitable for higher firing temperatures and fully oxidized kiln atmospheres. High kiln temperatures pose less risk to ground calcite than to large calcite inclusions. In addition to the shift to finely-ground inclusions, another important change appeared in the orientation of voids in those cookers, with non-calcite temper implying the use of a turntable or wheel capable of some momentum. If the cooking-pot makers were the first to use crushed quartz tempering, they opened the door to important changes that reverberated throughout the ceramics industry. The crushed temper permitted wheel-throwing, perhaps for the very first time.

Experimentation with Recipes for Cooking Pot Clay Bodies

Potters who made cookware pioneered the use of quartz temper, which came to dominate post-Iron Age wares, but there was no sudden upheaval in the ceramics industry or in patterns of trade to mark the event. Cooking-pot makers slowly and perhaps hesitantly adopted the quartz temper during a period of unknown length, while they and their customers experimented with a variety of clay bodies. Shoval et al. (1993) demonstrated and recorded in the laboratory the reaction of various carbonates to heat, but ancient potters and their customers knew what worked best. Evidence of experimentation with different clay bodies and non-plastics is inferred from the sparse examples with grog and limestone inclusions. They are two unusual and unlikely choices for cookware. Limestone was undesirable, given its propensity to decompose at moderately high firing temperature unless it was ground into a powder. There is never any doubt that grog was intentionally ground and added to a clay body. In the Hisban assemblage, grog is usually reserved for "special" labor-intensive pottery; half of the grog-tempered pots are Iron II black-burnished bowls. We assume that the single grog and limestone-rich cooking pots represent experiments. Another unusual clay body for cookware has a mixture of inclusions, minus calcite. The inclusions have a maximum upper size-limit, which suggests sorting and sieving prior to use. The temper and rim forms could also indicate their manufacture in different production locations and/or in slightly different time frames, but INAA proves this to be the wrong conclusion (London et al. 2008). PH 91 contains a mixture of non-plastics, yet chemically it corresponds to the bulk of the pottery assumed to have been produced not far from Hisban.

Following a period when cookware was made with a variety of rocks as inclusions, quartz came to dominate. Potters outside the Madaba Plains region similarly abandoned calcite, but not necessarily for quartz. In the basaltic region of northern Israel, most Iron II cooking pots excavated at Bethsaida have basalt non-plastics (London and Shuster 1999: 179–86). However, in the Iron Age deposits at Jerusalem and Jericho, quartz temper replaced calcite (Franken and Steiner 1990: 79, 106).

Changes in Pottery Technology

A quick way for people in antiquity to identify the new cookware was the red firing color. Brown, gray, and black cookers represented the older tradition. Large calcite rhombs necessitated a low firing temperature to prevent their decomposition. As a result, the pots were not fully oxidized and remain dark in color. The finely-ground calcite or quartz of the newer clay bodies permitted potters to fire cookers at high temperatures, along with the rest of the ceramic repertoire, except for burnished wares. Lower temperatures were always required for burnished pottery in order to maintain their sheen. After the Persian era, burnish on pottery became extinct, since it is a surface treatment that signals the absence of wheel throwing. The break with calcite roughly coincided with the demise of burnished wares. Dark firing surfaces were replaced by fully oxidized red pottery achieved through the higher temperatures made by possible by the use of crushed tempering material and the absence of large calcite,

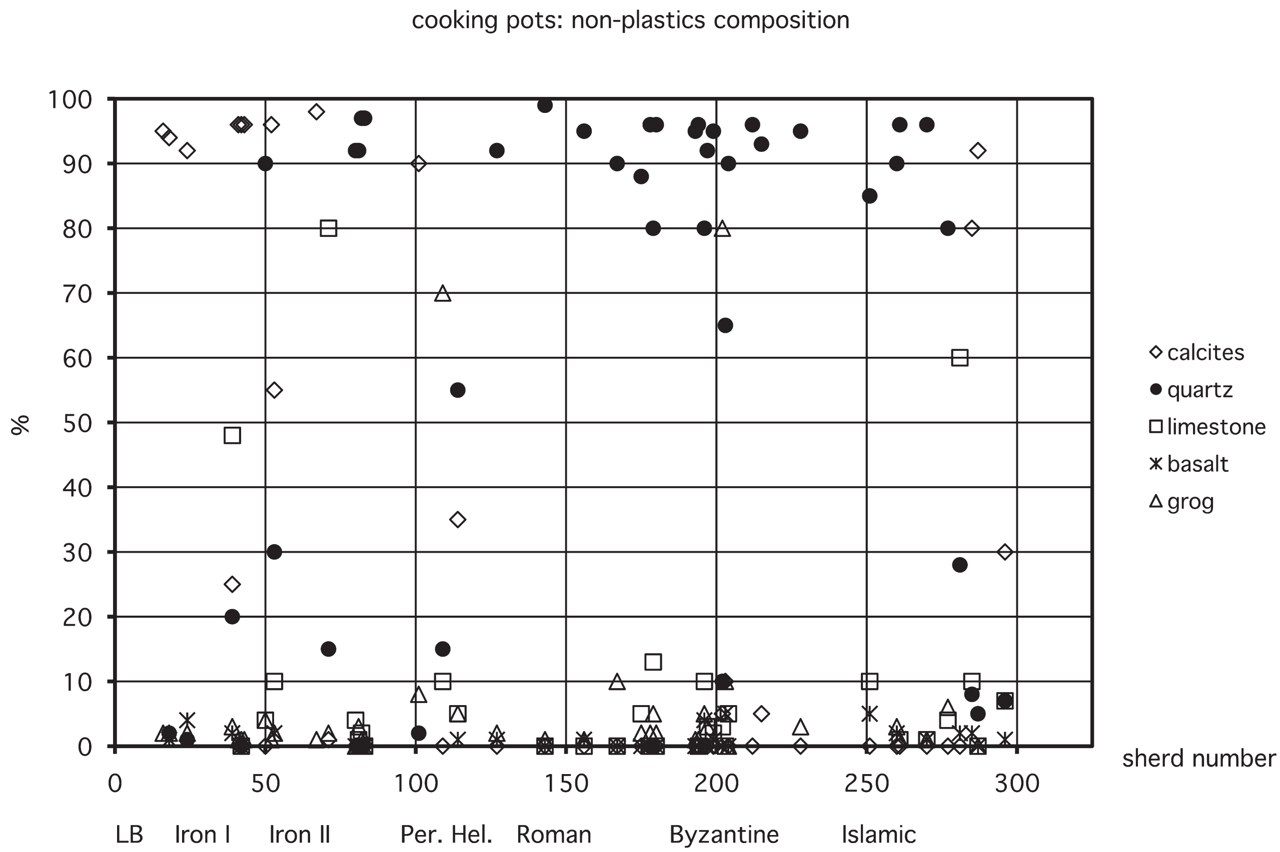

Figure 4. Percentages of non-plastics in cookware excavated at Hisban spanning 2,000 years, arranged according to sherd number.

limestone or burnished surfaces. Red-firing quartz-rich cooking pots exhibit one final feature that is a radical departure from the EB calcite tradition. Pot surfaces show the voids of burned-out organic material whose parallel orientation indicates that wheel-thrown pottery is soon to follow. However, the first pots made on a fast wheel capable of momentum were most likely small bowls, not the cookware (Franken and Steiner 1990: 99).

The calcite tradition did not come to a complete and abrupt demise, as evidenced by the overlap of different wares and the experimentation with clay bodies containing grog and other inclusions. Nor did it conveniently cease at the close of any archaeological period or in conjunction with a definable historical event. As Herr (1997: 244–46) described the continuation of Iron Age II pottery shapes into the Persian Period at Tall al-ʿUmayri, petrographic analysis demonstrates that his observation applies equally to clay bodies. Throughout ancient Palestine and Jordan, in homes of people, regardless of their ethnic, religious, or social affiliations, the cooking pot remains a witness to social changes not recorded in the literature or in destruction debris attributable to any local or foreign ruler.

For Franken (personal communication, 2000), the knowledge of calcite for cooking-pot manufacture never vanished but survived and perhaps flourished in rural settlements. During the medieval era, calcite baking trays and cooking pots become synonymous with the hand-made pottery tradition, including vats and large store jars (Franken and Kalsbeek 1975: 198, 213). The lack of calcite-tempered cooking pots for the Classical periods at Hisban is perhaps due to sampling errors. Although the Hisban evidence implies a "revival" of calcite-rich clay bodies in the Islamic period, it is highly feasible that the virtually self-destructive calcite-tempered pots of post-Iron Age date simply disintegrated in the earth as a result of use or natural conditions such as brackish soil and temperature extremes.

Less than a century ago, Crowfoot (1932) recorded the use of calcite tempering in hand-made cookware of the West Bank villages. More recently, Salem (1998–99: 28) observed a female potter in Yaʾbad who obtained calcite collected by men at a distance of 5 km from the village. These ethno-archaeological data confirm the relative scarcity of calcite, as noted by the geologist (Shoval et al. 1993: 269). In the mountains of northern Jordan, potters continue to collect calcite nodules, which they grind for cookware (Ali 2005: 121–22).

Conclusions

To bring change to a practice begun by potters some 4,000 years or more prior to the Iron Age requires a strong incentive. It did not happen quickly. While people persevered with the old tradition, others simultaneously experimented, before adoption of the new tradition of quartz. The shift from calcite unlocked the cookware industry to all potters. Gone was the need for the special calcite temper or low kiln temperatures. Cookware with crushed and powdered inclusions could now be fired with the rest of the repertoire. In contrast, the coil- and mold-made pots, heavily-tempered lean clays, burnished surfaces, and low firing temperatures with resultant dark colors were all part and parcel of a way of making pots that has deep roots in the EB of ancient Israel and Jordan. The shift to finely-ground quartz temper coincided approximately with wheel-throwing, fully-oxidized kilns, and a wealth of new rim shapes for cooking pots. A progression of small changes resulted in developments of serious consequence that were felt throughout the pottery industry. Wheel-thrown wares have one advantage over coiled pots, namely, production expedience. The ability to mass-produce pots required a large market capable of absorbing the high output and probably reflects new patterns of trade and distribution for the most basic, essential commodity—ceramics.

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