The Ghassulian Ceramic Tradition: A Single Chaîne Opératoire Prevalent throughout the Southern Levant

Valentine Roux

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ABSTRACT

This study examines Ghassulian ceramic assemblages from sites located in various parts of the southern Levant using the *chaîne opératoire* approach. The goal is to assess whether the Ghassulian communities were loosely integrated or, on the contrary, closely connected to each other. Results show that a single *chaîne opéra-toire* was shared at the level of the whole of the southern Levant testifying to its transmission within the same social group. They also suggest interactions between the different communities, arguing in favor of a dense social network from which new shared norms may have emerged. In conclusion, we suggest that this highly connected society could be linked phylogenetically to the previous local groups—which would explain both the embeddedness at the population level and the regional differences developed over time.

KEYWORDS: Ghassulian communities, Late Chalcolithic, southern Levant, *chaîne opératoire*, ceramic tradi-tions, technology, social networks

The structure of the Late Chalcolithic (abbreviated LC, and also called Ghassulian, see Gilead 2011) populations in the southern Levant is still widely debated. Over the last decade, two hypotheses have fueled discussions, one suggesting that Ghassulian society was organized in social ranks and hierarchies (Levy and Holl 1988; Levy 1998a, 1998b), the other that it was egalitarian (Gilead 1988). Both hypotheses have been challenged for some time: the first by the limited evidence for non-egalitarian societies, the second by the rich copper finds of the Nahal Mishmar hoard (Rowan and Golden 2009: 66). Now, there are hints at increasing socio-economic complexity, such as craft specialization, the high incidence of artifacts manufactured from non-local materials found in contexts such as caches, ritual deposits or group mortuary deposits, or the increased capability for storage. This has led some authors to conclude that LC socio-economic organization was highly varied and loosely integrated, with some regions witnessing ephemeral hierarchical formations but without any influence on other areas (Rowan and Golden 2009). Other authors suppose that religion was the inclusive principle (Joffe 2003). As a general statement, societal differentiation is now acknowledged.

In this article, the social links between the Ghassulian communities and their potential inclusive role are revisited by examining the ceramic technical traditions. These are ways of making transmitted from generation to generation. As such, they are highly relevant proxies for tracing social links between sites and indicate whether communities are connected to each other and belong to the same social group. In the first part of this article, I will detail the methodology applied. In the second part, the results will be presented. As we shall see, they suggest that one and the same ceramic technical tradition predominated in the southern Levant during the Ghassulian period, testifying to its transmission within the same social group; they also suggest interactions between the different communities, arguing in favor of a dense social network from which shared norms could have emerged, notwithstanding differences between communities.

Methodology and Material

Technical Traditions as Proxies for Linking Sites

Technical traditions are powerful proxies for signaling whether individuals belong to the same social group because learning craft techniques necessarily requires a tutor who is usually selected from one's own social group. In the domain of craft techniques, guided transmission of skills consists of educating the learner about the information available in the environment, be it the properties of the material, the tools used, or the effects of the gestures employed (Reed and Bril 1996; Bril 2002). This is done according to a "program" whose final objective is for the learner to reproduce the "objects" that the tutor himself can make (Bril 2002). This guidance not only facilitates the learning process, but also directly participates in the reproduction of the task (Tehrani and Riede 2008). It is the key to the *cultural transmission* of ways of making things. At the end of the learning process, the skills learnt are literally incorporated. Not only does the learner build up motor and cognitive skills for making objects according to the model used in his/her culture, and only those; but he/she also uses this model for building up a representation of the technical act, a representation shared by all the members of his/her social group (Foster 1965; Nicklin 1971; Arnold 1985; Gosselain 1992; Dobres 2000). It is then very difficult for the subject to conceive and manufacture objects other than in the manner learned. From this point of view, the learning process is a true "fixer" of the current cultural model. It contributes directly to forming and maintaining traditions.

On a collective level, tutors are traditionally selected within the learner's social group (parents, neighbors, elders, etc.). As a result, technological boundaries conform to social boundaries, defined as the social perimeter of transmitting the way to do things (Stark 1998; Ingold 2001; Knappett 2005; Degoy 2008; Roux et al. 2017). The nature of the community in which the same way of doing is passed on is variable. It may correspond to a group, a tribe, a clan, a faction, a caste, a sub-caste, a lineage, a professional community, an ethnic community, an ethno-linguistic group, a population, or to gender (exclusive transmission of women's or men's ways of doing things). In archaeology, contextual data should enable us to approach the nature of these groups.

Let us note that within ceramic technological traditions the longest stage to learn is the forming stage because of the general difficulty of mastering motor skills (Ericson and Lehman 1996). Forming techniques are taught with a tutor over years usually within private spaces, while shapes of objects, decorative features, or even clay recipes can be learned through individual learning after seeing objects in public spaces and/or discussing with retailers (e.g., interactions with shopkeepers; see Roux 2015). As a consequence, forming techniques tend to be more resistant to change than easily transmissible traits such as style (shapes and decor of objects; see Hegmon 1998; Gosselain 2000; Stark, Bishop, and Miksa 2000; Gelbert 2003; Gallay 2007; Mayor 2010; Roux 2015). In this respect, forming technique is a better variable to socially connect individuals/communities over time than shapes and decorations whose evolutionary mechanisms make them more subject to rapid changes even within the same social group.

The Chaîne Opératoire

A *chaîne opératoire* is defined as "the series of actions that transform raw material into finished product, either consumption or tool" (Creswell 1976: 13). The ceramic fashioning *chaîne opératoire* comprises a series of operations that transform the clay paste into a hollow volume. It can be described in terms of methods, techniques, gestures, and tools (Roux 2016). A method is defined as an ordered sequence of functional operations carried out by a set of elementary gestures for which different techniques can be used. A technique is defined by the physical modalities used to transform the raw material. Fashioning *chaînes opératoires* are a unique combination of sequences, gestures, and techniques. This unique combination enables us to distinguish between traditions linked through the transmission of information and convergent solutions to specific situations (Shennan 2002: 73).

Identification of the different technical operations carried out during the fabrication process of a recipient (the *chaîne opératoire*) implies examining the sherds with two complementary and inseparable observation scales: on one hand, the macroscopic scale and on the other, the microscopic scale. The first includes observation with the naked eye or at low magnifications. The second includes observation with the stereomicroscope (from 1 to 40 x magnification) and the microscope. The reconstruction of the *chaînes opératoires* is more detailed and reliable when it is based on both of these observation scales. The analysis grids are based on the same principle: the parameters and variables used are in a position to record the deformations and transformations that the paste goes through when wet or leather-hard and dry. Macroscopic observation precedes the microscopic scale and the first examination of a sherd is carried out with the naked eye.

The macro- and microscopic traits are interpreted by reference to significant surface features and microfabrics highlighted during the course of experiments and ethnographic observations. Experiments are designed to test hypotheses about ancient ceramic manufacturing techniques. We detail below an experiment aimed at highlighting surface features indicative of finishing techniques (smoothing) and surface treatments (clay coating) (Roux 2017b). The goal is to provide well-founded reference data to interpret the Ghassulian surface treatments. The experiments were conducted changing one parameter at a time.

Attributes indicative of smoothing and clay coating: Smoothing is a finishing technique aimed at evening the superficial layer of the clay vessels (Ionescu et al. 2015). It can be achieved on wet or leather-hard clay surfaces, with soft or hard tools, dry or wet tools.

Clay coating, also called stuccoing (Schiffer et al. 1994), is a surface treatment aimed at covering wall surfaces. It is made of a thick grainy slip obtained by adding water to the clay paste. It differs from slip, which has a "liquid cream" viscosity and is obtained from finely sieved clay materials mixed with water and possibly with oxides. It differs also from clay slurry, which is a clayey material obtained from finely sieved clay material with the viscosity of "thick cream" and used for favoring the adhesion between coils. Clay coating can be applied on wet, leather-hard, or bone-dry surfaces before firing, although there are ethnographic examples of clay coating applied after firing (Heidke and Elson 1988). Clay coating is smeared on with soft or hard tools. One effect is to hide any traces left by the roughing out and/or the shaping operations. Another effect is to diminish thermal spalling and cracking (Schiffer et al. 1994: 208). Identification of clay coating may be difficult when it is made with the same clay material as the clay paste. Indeed, unlike colored slip, even at high magnification no discontinuity is visible in section, that is, no visible clear-cut grainy slip layer. It is then easily confused with smoothing operations.

Table 1 indicates the main parameters tested. Three technical operations were carried out: smoothing wet clay, smoothing leather-hard clay, and clay coating. They were carried out on clay pastes presenting three sizes of coarse temper (small [200–500μ], medium [500μ–1mm], large [1–2 mm]) with two types of tools (hard, soft), combined with two hydric states (dry, wet). Granularity of the coating material was coarse or fine and its degree of viscosity thick or semi-liquid. Smoothing and coating hard tools included: flint, wood, calabash, stone, and bone. Smoothing and coating soft tools included: fingers, cloth, leather, horsehair, and paint brush.

Experiments were conducted on complete vessels as well as on briquettes for the sake of replicating the results obtained. In total, 104 pieces were obtained.

TABLE 1 MAIN VARIABLES TESTED FOR HIGHLIGHTING ATTRIBUTES SIGNIFICANT OF SMOOTHING WET CLAY, SMOOTHING LEATHER-HARD CLAY, AND CLAY COATING

		Smoothing wet clay	Smoothing leather-hard clay	Clay coating
Clay paste	Fine	✓	✓	✓
	Medium	✓	✓	✓
	Coarse	✓	✓	✓
Smoothing tool	Hard	✓	✓	
	Soft	✓	✓	
	Dry	✓	✓	
	Wet	✓	✓	
Coating grain size	Fine			✓
	Coarse			✓
Coating viscosity	Semi-liquid			✓
	Thick			✓
Coating tool	Hard			✓
	Soft			✓

The results are as follows (for the details and illustrations, see Roux 2017b):

1. Depending on whether smoothing is done on wet or leather-hard clay paste, with tools loaded or not with water, clay surfaces are characterized by irregular/fluid or compact microtopography, threaded or ribbed striations, thickened or scalloped overthicknesses.
2. Clay-coated surfaces are characterized by lumpy topography combined with clusters of floating grains and fluid microtopography.

Analysis of ceramic assemblages based on the chaîne opératoire *concept*: The classification of assemblages using the *chaîne opératoire* concept is an original approach in that artifacts are no longer classified by shape and/or fabrics, but rather in terms of technical processes and objects (shape and decoration; see Roux 2011, 2017a).

Ideally, the classification includes three successive sorting stages: sorting by technical groups; by techno-petrographic group (by petrographic groups within each technical group); by techno-morphological and stylistic groups (by morphological and stylistic types within each techno-petrographic group). The first two sorting stages reveal the different *chaînes opératoires* present in the assemblage. The last sorting stage reveals the potter's intention, which can be clarified by the functional analysis of the vessels. The combined analysis of the *chaînes opératoires* and the potter's intention leads to the characterization of ceramic assemblages in terms of technical traditions, that is, in terms of inherited ways of making a given functional range of containers. This is a prerequisite for evaluating the sociological complexity underlying the techno-stylistic variability of assemblages. There are two types of scenarios: either the function of the vessels determines the variability of the *chaînes opératoires*; or by default this variability is determined by social factors. In other words, when a *chaîne opératoire* is associated with a single type of recipient (e.g., culinary vessels) and when the function of the recipient accounts for the difference in the *chaîne opératoire*, in this case variability can be interpreted in functional terms as opposed to variability created by social boundaries.

Now, how can we presume that a set of sherds was made using the same *chaîne opératoire* when only several sherds bear diagnostic surface features? The postulate is that all the sherds within an archaeological ceramic assemblage that present the same attributes were made under the same conditions. Although the same traces can be produced using different techniques, methods, or tools, groups of sherds with sets of analogous traits within the same assemblage, on the inner surface, the outer surface, or in cross-section, are necessarily related to analogous technical actions, given physical and cultural constraints. On the one hand, vessels of the same type of clay that are produced in the same manner will fea-ture comparable deformations and marks. On the other hand, the number of ways vessels are manufactured at a given site is generally limited. Thus, we can legitimately progress from statements about several specimens to an interpretation that applies to all the sherds comparable to these specimens (Roux 2016).

As for sampling, we used an empirical approach; that is, not statistical sampling based on random distribution, but a reasoned selection in view of the technological aim, which is to characterize the technical traditions repre-sented. This reasoned selection consists on the one hand of examining and classifying batches of sherds and stop-ping when the proportions from the different technical groups cease to change (for a given excavation context), and on the other of examining all the different types of vessels (different shapes and size) considered as repre-sentative of the assemblage (the ones published). This procedure ensures that the different technical practices observable at the site are recorded.

Body of Data

The Ghassulian assemblages include vessels made with-out and with rotary kinetic energy (abbreviated RKE). The former include the whole range of mundane vessels whose function may have been well diversified (consump-tion, service, transport, storage). The latter include open vessels, among them mainly small bowls (V-shaped bowls), whose function has been interpreted as ceremo-nial (Roux 2003).

The vessels here examined are the ones formed without RKE. They are supposedly made on a domestic scale and are therefore good candidates for identifying transmission between individuals linked by close social relationships.

Ceramic assemblages from sites located in different parts of the southern Levant have been examined.[1] They all belong to well-established Late Chalcolithic horizons even though the chronological span can cover a few hun-dred years from 4500 BC to 3900 BC. They are found in the Jordan Valley and the Dead Sea basin (Tuleilat Ghassul, Fazael, Abu Hamid, Pella, Tel el-Far'âh [North, cave U], Neve Ur), in the Negev (Abu Matar, Safadi, Grar), in the Shephelah (Modi'in), in the coastal plain (Azor), in the Galilee (Kafr Kanna, Levels 112–115; Megiddo, Stratum 5), in the Hulah Valley (Tel Teo, Turmus) and in the Golan (Rasm Harbush) (Fig. 1). Except for Kafr Kanna and Megiddo, all the ceramic assemblages are published. Each main type of vessel illustrated in the publications has been examined. Batches of sherds served to verify the general scope of the observations made on the types of vessels.

Results

First, we describe the surface treatments and then the manufacturing *chaînes opératoires*.

Ghassulian Surface Treatments

Vessel surface treatments were examined macroscopi-cally and at different levels of magnification. The main result is that all the mundane Ghassulian ceramics made without RKE are clay coated, whatever their shapes and sizes. The general use of clay coating all over the southern Levant is unmistakable.

Clay coating has been systematically identified on the outer walls of a wide range of vessels. They are charac-terized by an irregular topography, a lumpy surface cre-ated by clusters of floating grains covered with a clay

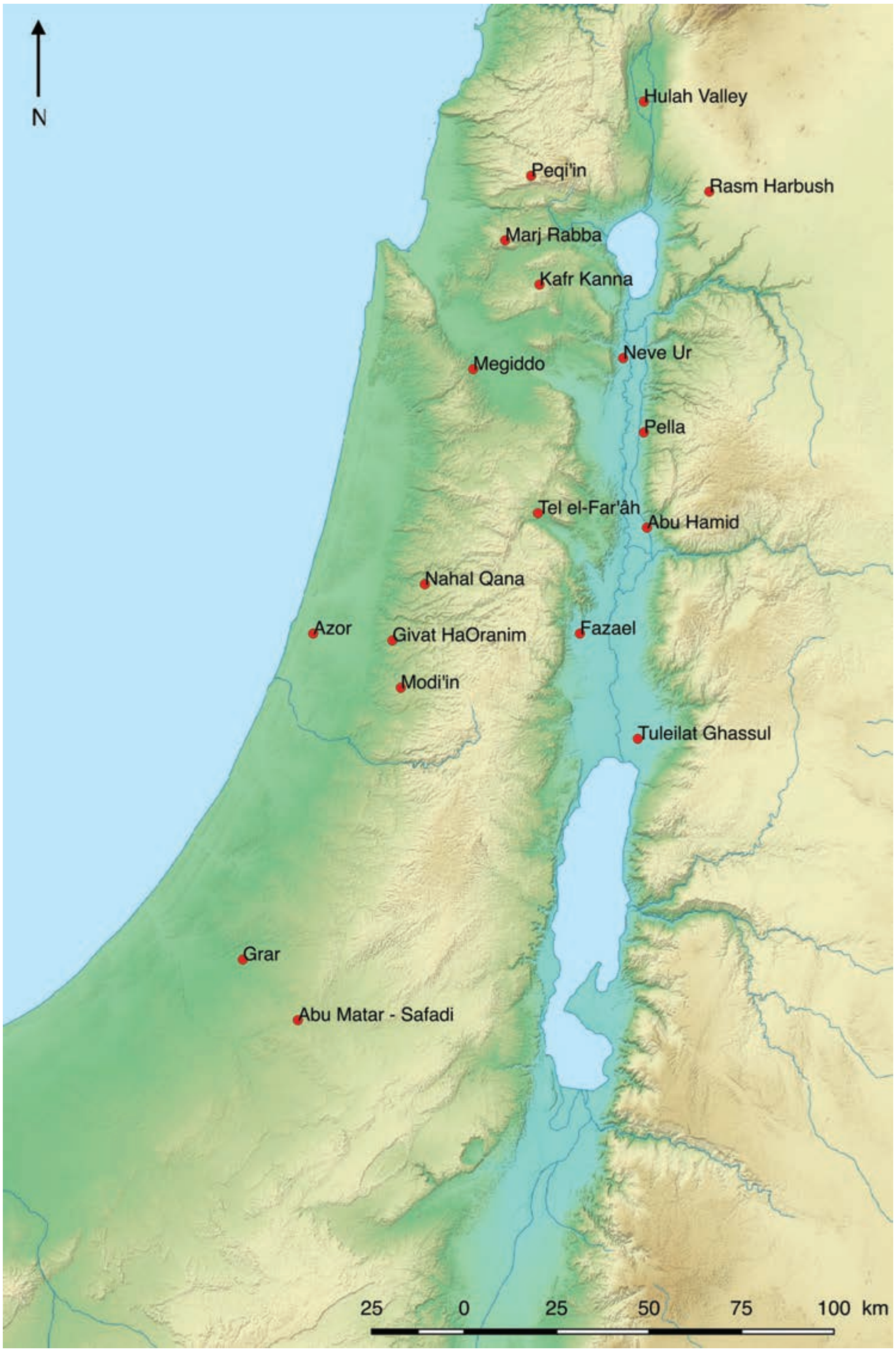

FIG. 1

Location of the sites cited in the text from which ceramic assemblages were examined.

(Courtesy of *Centre de recherche français à Jérusalem.*)

layer, floating grains and overthicknesses overlapping smoothed surfaces or corresponding to successive layers of coating (Fig. 2). Clay coating has been identified on both closed and open vessels. The former are coated on their outer face only, the inner face is smoothed. It is usually applied with vertical or oblique gestures, from the rim or from below the rim, down to the base. When it is applied from the rim, a small overthickness may be visible on the inner side of the rim. It can also be applied with a rotary motion (with or without rotary instrument). The open vessels are coated on the outer and inner faces, with horizontal gestures on the inner face. The type of striation suggests that clay coating was applied with the fingers.

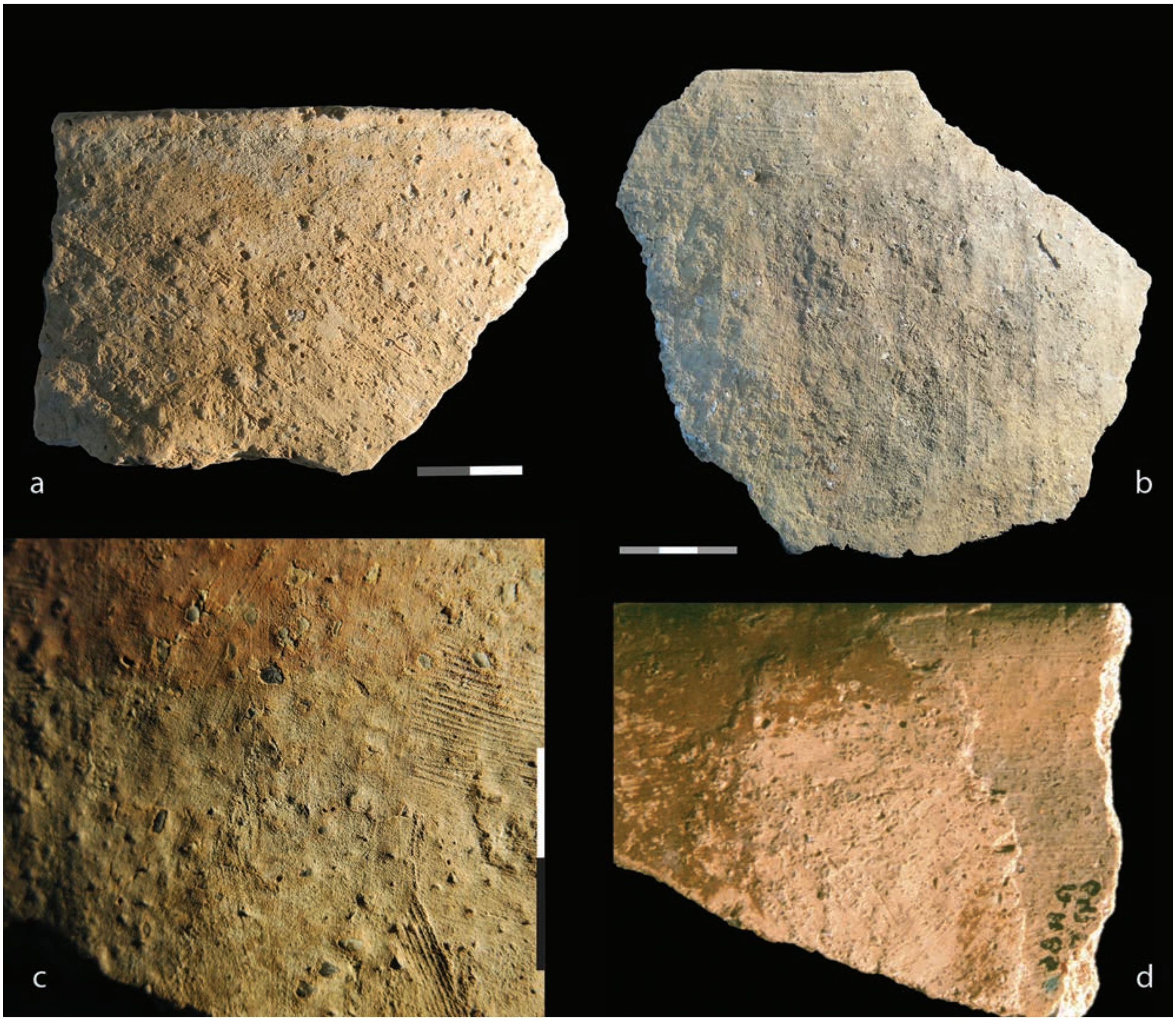

FIG. 2

Examples of clay-coated surfaces: (a) overthickness below the rim indicating the start of the coating (Fazael)
(b) holemouth showing vertical overthicknesses left by successive vertical passages of coating (Fazael);
(c) lumpy surface and clusters of floating grains (Safadi); (d) coating applied on a previously smoothed surface (Abu Hamid).
(Photos courtesy of V. Roux.)

The clay coating material can be semi-liquid or viscous. It is made with the clay material used for manufacturing clay vessels, which, as a general rule, includes coarse grains larger than 1 mm in size. However, the coarseness of this clay material can vary depending on the size of the vessels. For small vessels and small-size grain paste, the clay coating is finer than that applied on bigger vessels and its identification requires high magnification (Fig. 3). Lumpy clay-coated outer walls contrast with the evenly smoothed inner walls (Fig. 4).

Ghassulian Chaînes Opératoires

The question is whether clay coating is a surface treat-ment proper to a social group or shared between different social groups, that is to say, whether it is related to a single *chaîne opératoire* or several *chaînes opératoires*. Clay coating is not indeed sufficient to assess the degree of connection between sites, because it could have been copied through indirect interactions (e.g., Roux 2015).

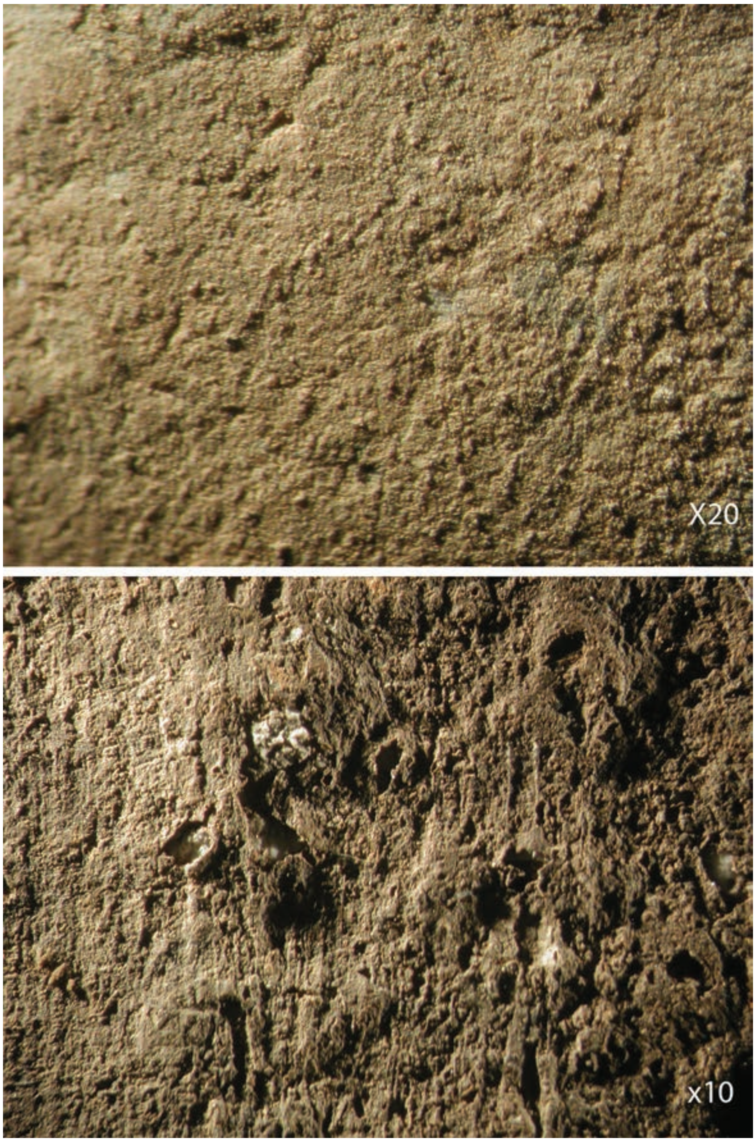

FIG. 3
Different coating grain sizes characterized by floating grains and clusters of floating grains covered with a fine layer of clay (Fazael). Above: fine grainy coating (20x); below: coarse grainy coating (10x). (Photos courtesy of V. Roux.)

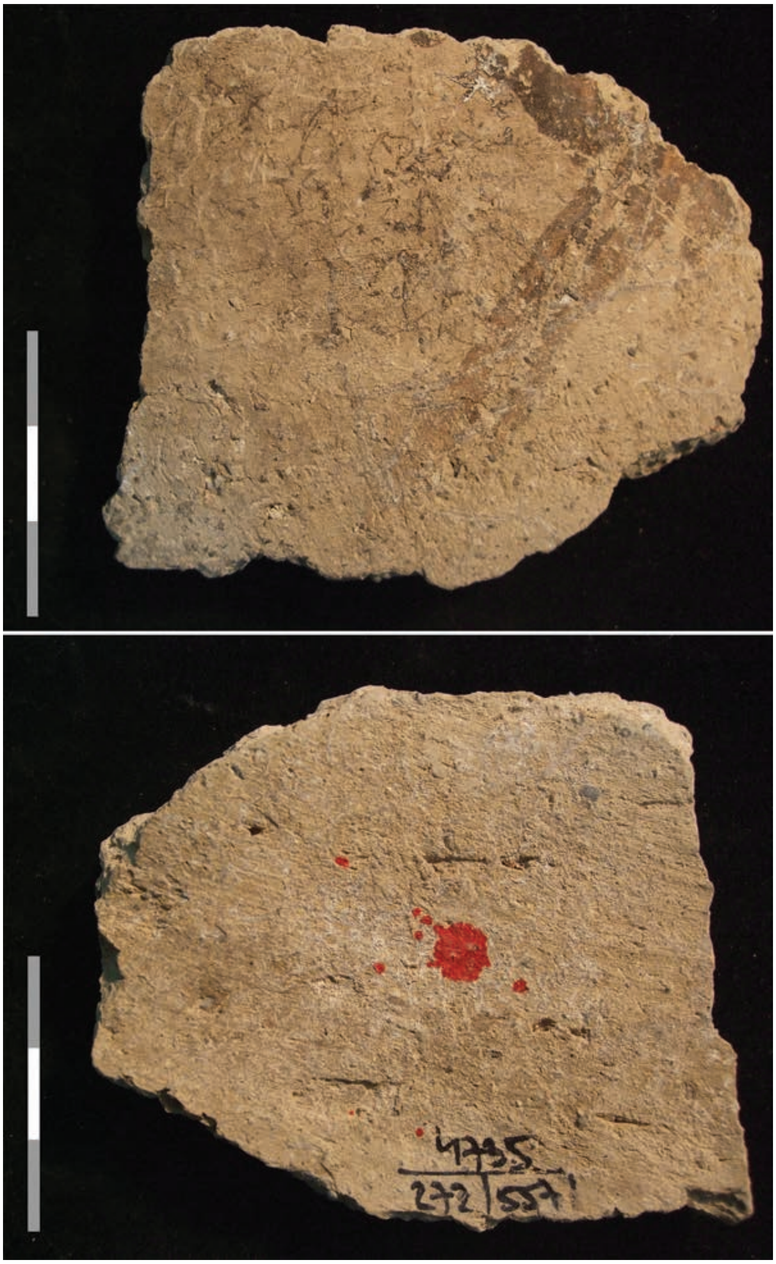

FIG. 4
Contrast between clay-coated outer wall (above) and smoothed inner wall (below) (Modi'in). The clay-coated wall is characterized by a lumpy topography and a fluid microtopography, whereas the smoothed wall is characterized by a regular topography, threaded striations and an irregular microtopography. (Photos courtesy of V. Roux.)

Our results show that all the LC ceramic vessels testify to the same *chaîne opératoire*. The following description is valid for all the mundane ceramic types made without RKE and for all the ceramic assemblages that have been examined:

Clay paste is generally tempered with coarse mineral inclusions (even when vegetal material is present as in the potteries of northern Negev sites) whose size depends on the thickness of the walls. Their quantity is around 20–30% (Fig. 5). Petrographic studies show local production at almost all sites studied, even though movements of vessels between sites are acknowledged (Gilead and Goren 1989; Rowan and Golden 2009).

The bases are modeled into a disk shape from a lump of clay whose edges were raised up over around 1–2 cm in order to start the body. A peripheral coil is then placed on

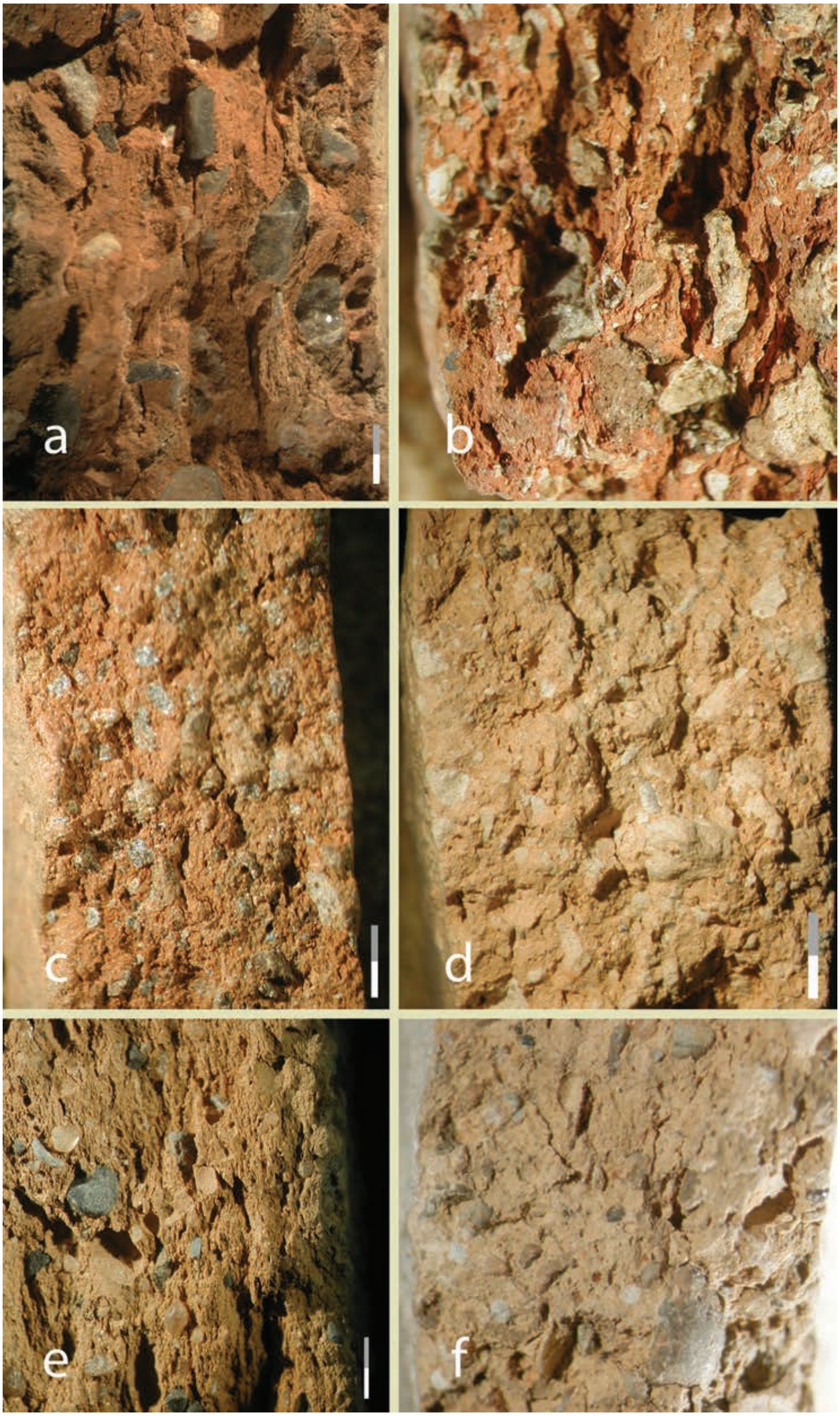

FIG. 5

Examples of coarse inclusions in LC pastes from different sites: (a) Fazael; (b) Tuleilat Ghassul; (c) Rasm Harbush; (d) Kafr Kanna; (e) Safadi; (f) Modi'in. (Photos a, c, d, e, f courtesy of V. Roux; photo b courtesy of the Pontifical Biblical Institute.)

the disc, against the raised edges, and joined to the base by discontinuous pressures. *Diagnostic features*: at high magnification, bases are characterized by sub-parallel elongated voids and alignment of the inclusions (Fig. 6); the raised edges are visible in the continuity of the porosity system and the alignment of the coarse inclusions at the junction between the base and the body; the adding of an internal peripheral coil is visible in the void and inclusion pattern of the body section. It is characterized by a vertical pattern related to the raising of the edges, contrasting with the elongated oblique voids of the inner peripheral coil against the raised edges (Fig. 7). To the naked eye, fissures at the junction between the inner base and the body indicate the placing of a peripheral coil on the base (Fig. 8).

The next successive coils are fixed internally by spreading against the inner face; the joints are oblique. The coils are quite small (between 1 and 2 cm). Their size depends on the thickness of the vessels: their height is around one and a half times the thickness of the vessels. *Diagnostic features*: at high magnification, in section, fissures indicate oblique joints of coils whose direction is inward (from the outer face to the inner face); the strong sub-parallel oblique porosity running from one side of the wall to the other suggests a strong compression of the coil, which is the effect of the coiling-by-spreading technique (Fig. 9). To the naked eye, the apposition of the coils on the inner face is sometimes visible in the form of concentric overthicknesses (Fig. 10).

Once the body is formed, the rim is shaped with a wet soft tool (fingers or piece of cloth) with or without rotary motion. *Diagnostic features*: At high magnification, fluid microtopography and ribbed sub-parallel striations indicate the use of water (Fig. 11).

After the shaping of the rim, the wet inner faces of vessels are smoothed with dry or wet soft tools (fingers or piece of cloth). *Diagnostic features*: At high magnification, on inner face of closed vessels, irregular microtopography, threaded striations, and inner-body striations overlapping inner-rim striations indicate a smoothing operation with a dry soft tool after shaping of the rim (Figs. 11 and 12). Fluid microtopography and ribbed striations indicate smoothing with a wet tool (Fig. 13).

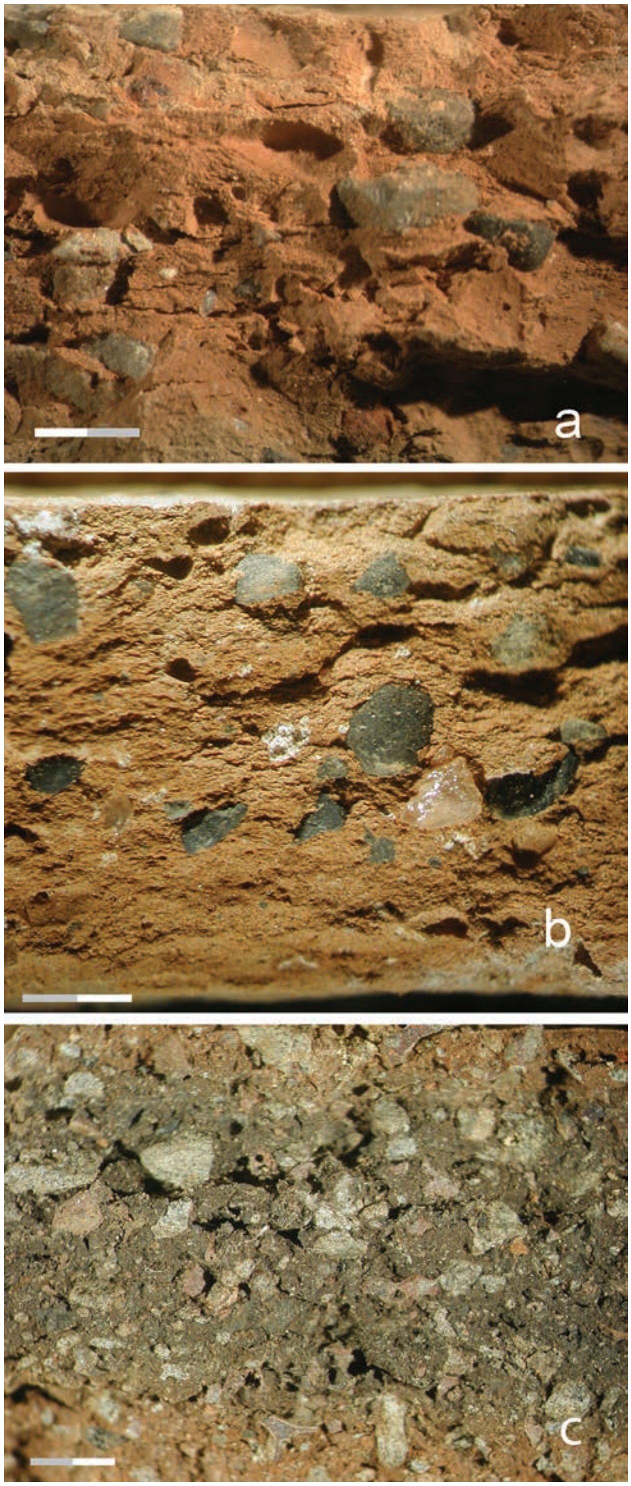

FIG. 6

Examples of modelled bases characterized by subparallel elongated voids and alignment of the inclusions: (a) Fazael; (b) Safadi; (c) Turmus.

(Photos courtesy of V. Roux.)

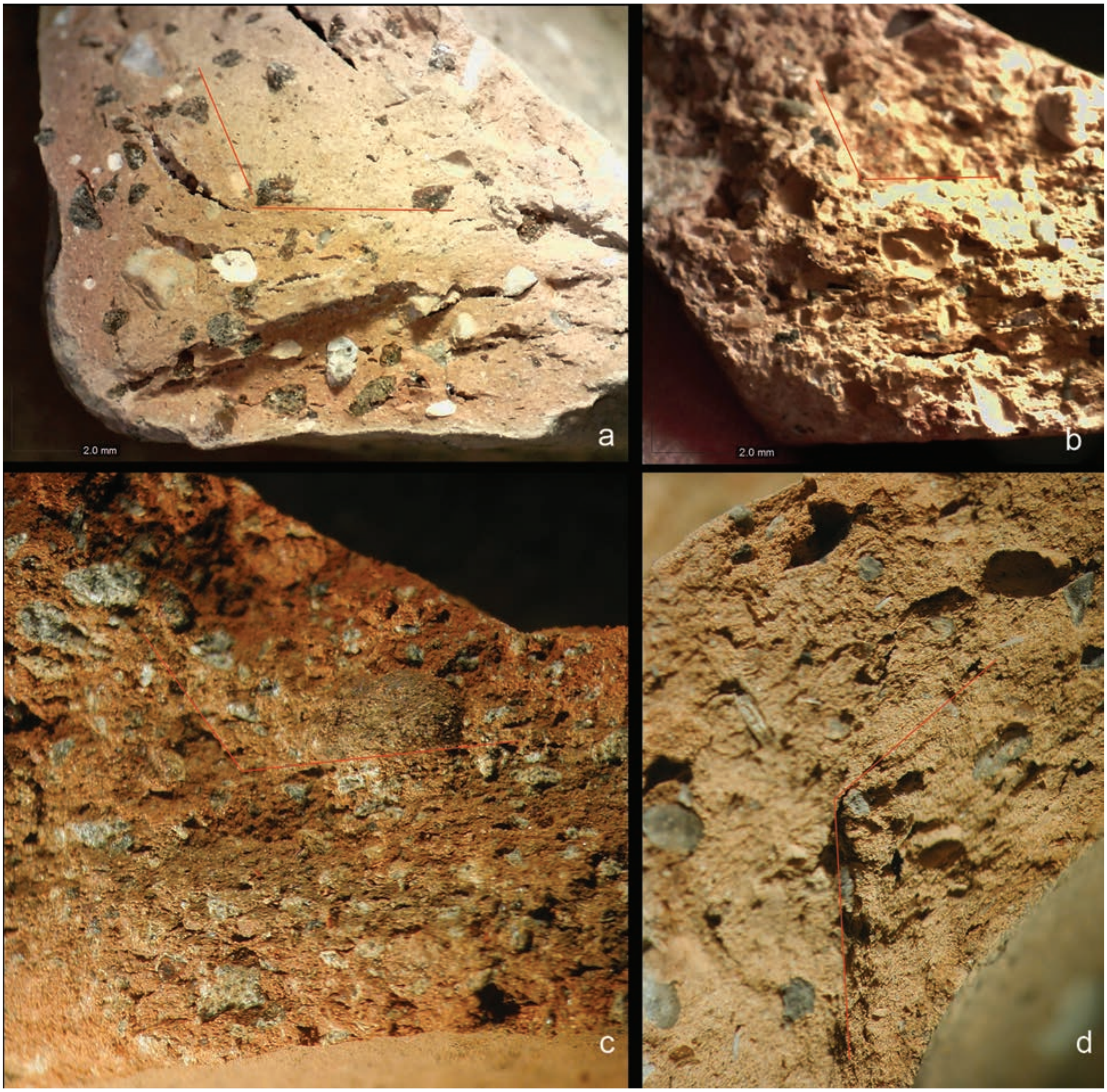

FIG. 7

Examples of bases showing poral pattern significant of modelled bases with raised edges and internal peripheral coil: (a) Kafr Kanna; (b) Fazael; (c) Rasm Harbush; (d) Safadi. (Photos courtesy of V. Roux.)

The vessel is then left to dry until its consistency is leather-hard. Elements are applied at that point: decorative bands, handles, and—for all the vessels—an extra peripheral coil around the external base. This coil probably reinforced the junction between the base and the body. Thus, potters employed three different means to render the junction solid: they raised the base's edges, and added an inner as well as an outer peripheral coil. *Diagnostic features*: to the naked eye, overthickness on the lower outer face and around the external base (Fig. 14). In some cases, the overthickness of the outer peripheral coil is folded either against the body, or

FIG. 8
Fissure at the junction between the base and the inner wall indicating an inner peripheral coil placed against the raised edges of the base. (Above: Ghassul, courtesy of the Pontifical Biblical Institute; below: Fazael, courtesy of V. Roux.)

against the surface of the outer base (Fig. 15). Let us note, however, that when the outer coil is strongly smeared against the wall and covered by a thick coating, the overthickness on the lower outer face is hardly visible.

Next, the clay coating was applied. As said above, it was applied on the outer/inner face of the vessels using vertical/oblique gestures (or in some cases with a rotary motion), from below the rim—or from the rim itself—down to the base, probably with fingers serving as tools. *Diagnostic features*: to the naked eye, lumpy and irregular topography; at high magnification, floating grains; on closed vessels, edge of the rim coating visible on the edge of the inner rim; on the body, coating overlapping the smoothing striations of the rim; coating covering the applied elements (Fig. 16).

The decoration of the bands by finger impression is made after the coating, as is the perforation of the handles. Other decorations are also made at this stage (slip, painting, incision, impression). *Diagnostic features*: to the naked eye, thickened overthicknesses around the perforations/incisions/impressions testify to these operations on wet clay coating (see Fig. 16).

Once dried, the vessels were fired in an oxidized atmosphere, probably in an open fire (no kiln has been found and some vessels feature different colors). They were possibly left to cool in the firing structure. *Diagnostic features*: the surfaces of the pottery are pale; in radial section, the two outer margins are oxidized; the core may be oxidized or reduced, showing a variability in the oxidation process which is expected in open firing structures. The often-oxidized cores and the well-fired vessels may suggest a long exposure within the firing structures.

There are variants to this *chaîne opératoire*. One of the most salient is the use of red slip. It is applied onto the coating using the fingers as seen at Kafr Kanna, Turmus, and Rasm Harbush (as well as at Marj Rabba, Y. Rowan, pers. comm.). The red slip is a variant found exclusively in the north. It is applied on most of the vessels, no matter their shapes or sizes. It may also be applied on the outer bases, which in this case are clay-coated. *Diagnostic features*: multidirectional ribbed striations (Fig. 17).

Other regional variants exist like the forming support of the bases (use of matt at Tuleilat Ghassul) or the co-occurrence of organic and mineral inclusions in the clay paste (e.g., at Safadi and Grar; Gilead and Goren 1989).

Discussion

The analysis of the *chaînes opératoires* of the southern Levant LC ceramics aimed at assessing whether the same or different *chaînes opératoires* were carried out for making mundane vessels. By reference to anthro-pological models, the use of the same *chaîne opératoire*

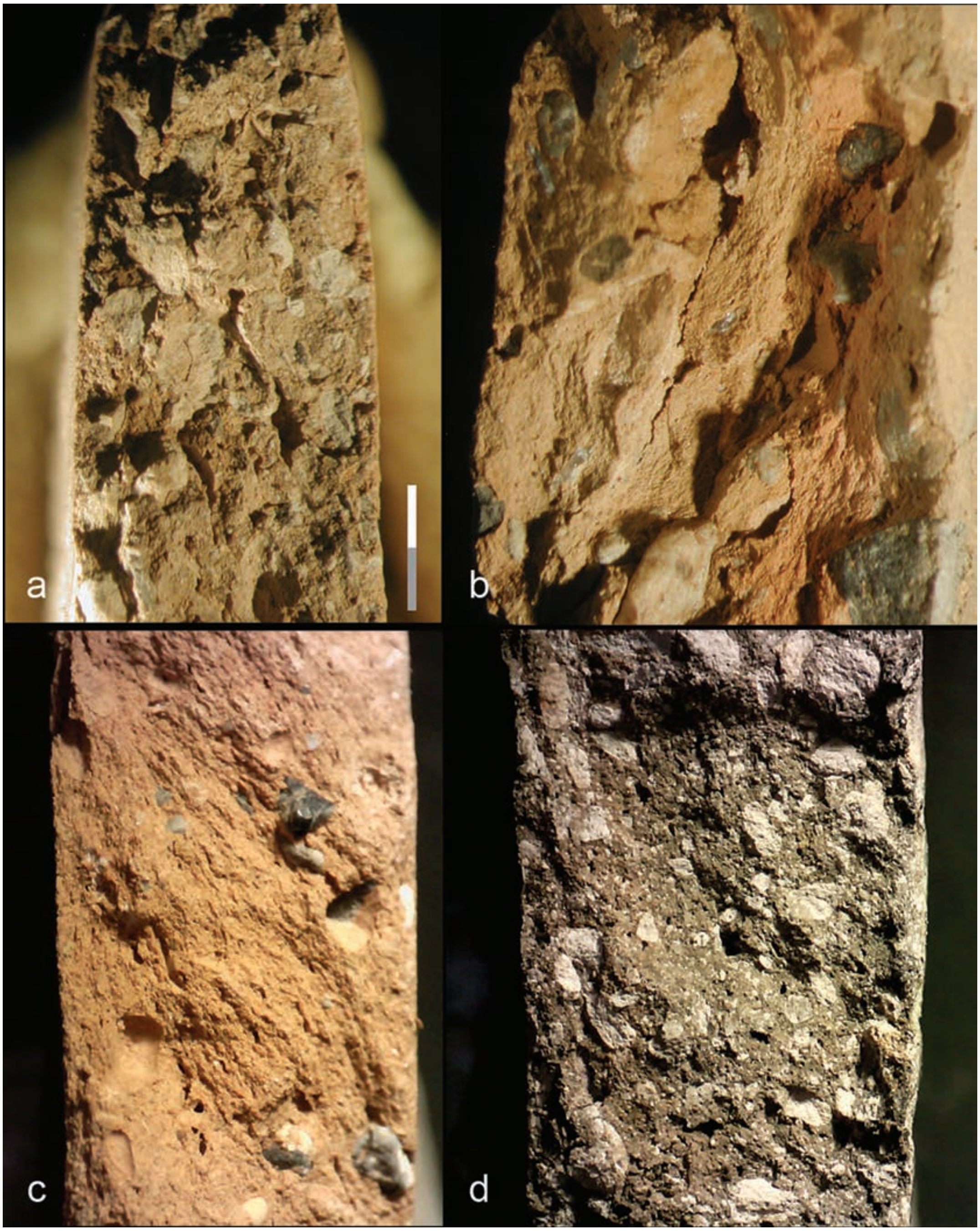

FIG. 9
Oblique porosity marked by elongated voids orientated inward indicating coiling by internal spreading: (a) Kafr Kanna; (b) Fazael; (c) Safadi; (d) Tel Teo. (Photos courtesy of V. Roux.)

for the same range of vessels may indicate a wide learning network and therefore strong social links between the communities. On the contrary, the use of different *chaînes opératoires* for the same range of vessels may indicate different social groups.

Our results show that the Ghassulian communities shared the same *chaîne opératoire*. It is characterized by the following successive steps: tempering clay paste with 20–30% coarse mineral grains; modeling the base from a lump of clay in the form of a disc whose edges are raised

FIG. 10
Concentric overticknesses on the inner walls indicating the internal spreading of the coils (Safadi). (Photo courtesy of V. Roux.)

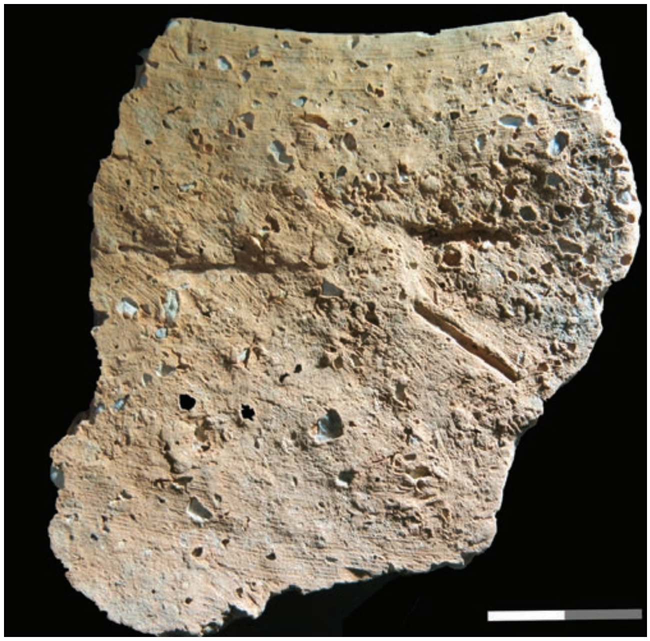

FIG. 11
Rim with fluid microtopography and ribbed striations indicating finishing with a wet soft tool (Fazael). The inner face is smoothed after the rim, as shown by the overlapping of the smoothing striations over the ones of the rim. (Photo courtesy of V. Roux.)

FIG. 12
Irregular microtopography and threaded striations signifying smoothing of a wet surface with dry fingers (10x) (Fazael). (Photo courtesy of V. Roux.)

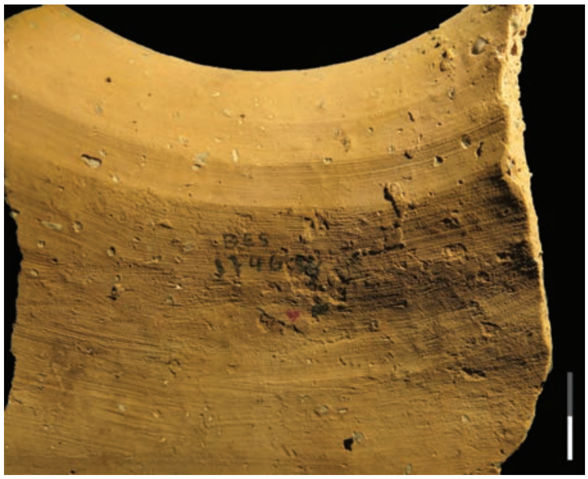

FIG. 13
Rim and inner wall with fluid microtopography and ribbed striations indicating smoothing with wet tool (Safadi). On the rim, the concentric striations suggest the use of a rotary motion (with the help, or not, of a rotary device). (Photo courtesy of V. Roux.)

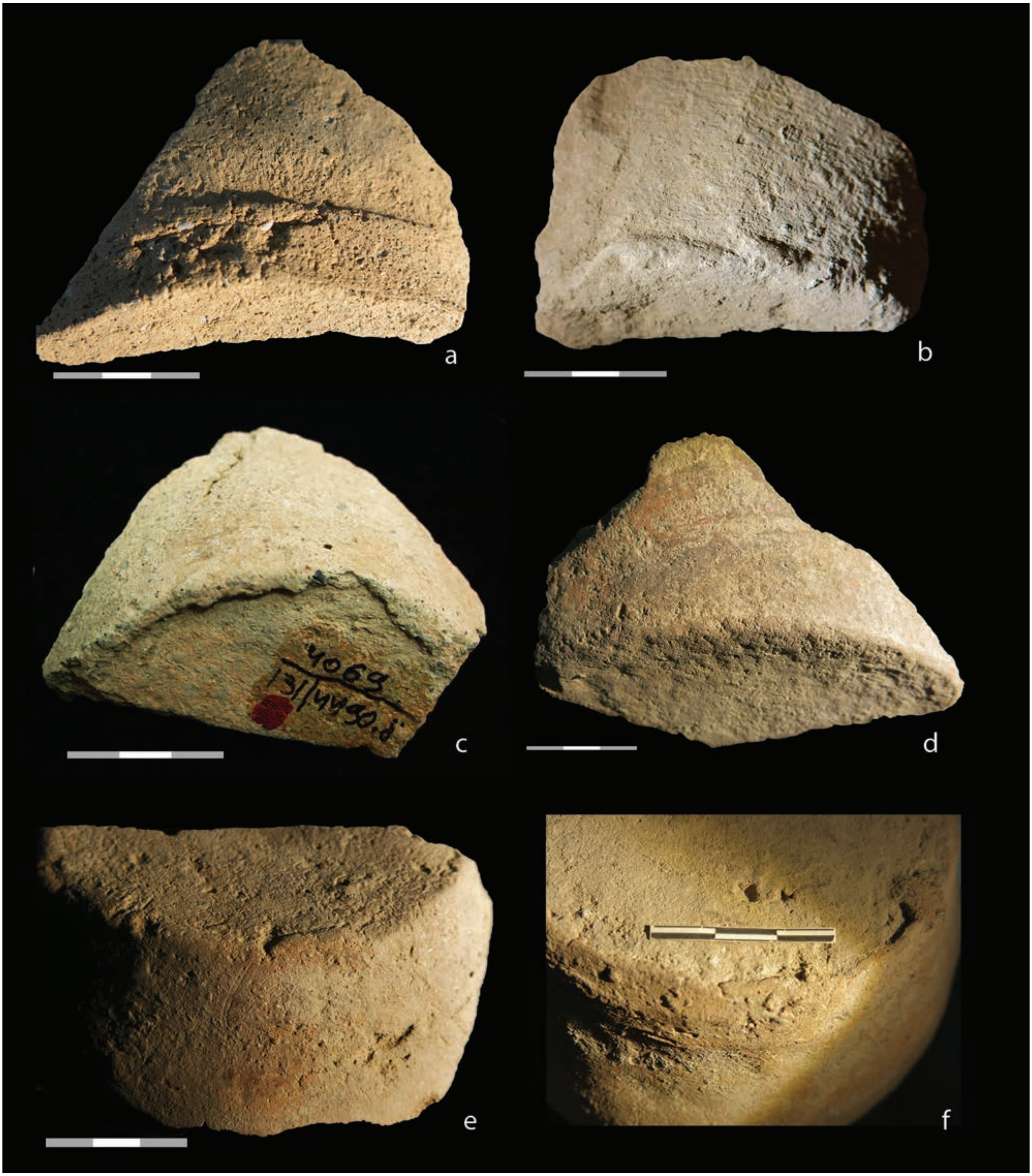

FIG. 14

Overthicknesses on the lower part of the outer wall and around the outer base indicate the adding of an outer peripheral coil: (a) Fazael; (b) Kafr Kanna; (c) Modi'in; (d) Turmus; (e) Safadi; (f) Grar. (Photos courtesy of V. Roux.)

FIG. 15
The outer peripheral coil is folded against the outer base (Fazael). (Photo courtesy of V. Roux.)

up to start the body; reinforcing the junction between the wall and the base by applying an inner peripheral coil; forming the walls by spreading coils along the inner face; shaping and smoothing the rim with a wet soft tool; smoothing inner wet walls with a soft tool; drying until leather-hard; applying an extra peripheral coil around the base; coating the outer face of the vessels while including the applied elements (outer peripheral coils, handles, decorative bands); decorating; and at last firing u nder open firing conditions and oxidized atmosphere.

This *chaîne opératoire* contrasts with those used during the fifth to fourth millennium BC by the neighboring populations. In Egypt, the clay paste was tempered with animal dung, the bases were made from spiraled coils, the bodies were made with horizontally superimposed coils, the external faces were burnished (main *chaîne opératoire* observed on Egyptian lower culture assemblages from Tell el-Iswid and Samara). To the north of the southern Levant, in the central Levant, several traditions were current, including shaping by modeling or by adding large coils. Slip was the main surface treatment and smoothing the main finishing technique. None of them used clay coating (Baldi 2017). These different traditions do not stem from temporal and/or spatial factors: there are no similar technical elements that might signal a common origin. In this respect, the technological analysis of the ceramics indicates a population structure distinguishing the southern Levantine population from its neighbors who passed along other methods of production.

If we now consider the anthropological rule according to which the transmission of a craft requires direct social learning between learner and tutor, and tutors are generally selected within the learner's group, then the sharing of the same, single ceramic *chaîne opératoire* all over the southern Levant testifies to a wide learning network and enables us to view the different communities of the southern Levant as parts of a single social group. Variants such as red slip, matt or shapes are grouped spatially suggesting preferential spatial connections and therefore probably social sub-groups (e.g., such as different clans of the same tribe).

There remains a question as to whether these socially connected communities were interacting at the population level in order to assess whether social links were an inclusive principle. A techno-petrographic study of ceramic assemblages belonging to sites distributed all over the southern Levant shows that there are three main categories of assemblages: (a) homogeneous assemblages (ceramic production made with local clay sources) testifying to interactions between producers at the scale of the village; (b) simple heterogeneous assemblages (ceramic production made with clay sources from a meso-region) testifying to interactions between individuals at the regional scale—they are found in shrines or burial sites (e.g., Gilat, En Gedi, Azor; see Goren 1995; Roux and Courty 2007); and (c) complex heterogeneous assemblages (ceramic production made with clay sources from a macro-region) testifying to interactions between individuals at the population scale. This is the case of one site only, Abu Hamid in the Middle Jordan Valley. The techno-petrographic analysis

FIG. 16
Lumpy topography on applied elements: (a) and (b) decorative bands (Fazael); (c) base (Tuleilat Ghassul); (d) handles (Fazael). (Photos a, b, d courtesy of V. Roux; photo c courtesy of the Pontifical Biblical Institute.)

of the LC ceramic assemblage shows that all the recipients come from all over the southern Levant (Roux and Courty 2007). Abu Hamid has been interpreted as a gathering/pilgrimage site, that is to say, a place frequented by people from all over the southern Levant. In this respect, the ceramic assemblage of Abu Hamid suggests that Ghassulian sites were connected at the population level at a given point in time, and therefore that the Ghassulian population was a homogeneously mixing population (every individual can interact with an other).

These results argue in favor of a dense social network during the LC period. It might explain how new norms were shared between the Ghassulian communities despite regional differences as shown by the goods belonging to different regional networks and found side by side in three pivotal burials, Peqi'in, Nahal Qana, and Givat HaOranim (Chasan and Rosenberg 2018).

FIG. 17
Slip applied on clay-coated wall and base: (a) Kafr Kanna; (b) Turmus; (c) Rasm Harbush.
(Photos courtesy of V. Roux.)

Conclusion

This article discussed whether the differences between the Ghassulian communities signify their loosely integrated organization. In order to assess the social links between the communities, the concept of *chaîne opératoire* was applied to ceramic assemblages of sites located in different parts of the southern Levant. Results show that a single *chaîne opératoire* was used for making mundane ceramic containers. This single *chaîne opératoire* testifies to social links between the Ghassulian communities: a single way of making ceramics was taught—suggesting individu-als belonged to the same social group. These social links might be the inclusive principle, considering also that the Ghassulian communities interacted at the population level as shown by the findings at the site of Abu Hamid.

The roots of such a dense social network may be found in the previous periods as technological evidence provided by the Tel Tsaf and Beth Shean XVIII ceramics suggests (Silvain 2015). The ceramic *chaîne opératoire* is comparable to the Ghassulian one. If such a phylogenetic link between the populations of the early and late fifth millennium BC proves correct, it could explain the coherence of the Ghassulian culture and shed new light on the formation of regional differences within a highly socially connected society.

Notes

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1. Successive studies have been carried out among which the first was published in Roux and Courty 2005, 2007; the second in Roux, van den Brink, and Shalev 2013; the others were carried out in 2016–2017 within the framework of my appointment at the Centre de recherche français à Jérusalem.

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