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The potters' perspectives: A vibrant chronology of ceramic manufacturing practices in the valley of Juigalpa, Chontales, Nicaragua (cal 300 CE - present)

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7 Ceramic technologies in the valley of Juigalpa

This chapter embarks on a journey to explore the different trajectories involved in ceramic manufacture, which serves as the fundamental—yet not exclusive—interweaving thread of the chronological narrative in Chapter 8. Ceramic production is reviewed from a technological perspective, taking into account the socially learnt recipes, gestures, the universes of possibilities, of certain "do's and don'ts" of different dwellers in the valley of Juigalpa. These itineraries intersect with landscape relationships, human mobility, social organization, household perceptions, and many other factors that remind us that pots are a developing part of human vibrant lives. Like people (but not *as* people), ceramics are palimpsests of intertwined trajectories that involve continuity and change. Therefore, microhistories of technical traditions are necessary in order to understand the lives—and sometimes also the deaths—of people beyond morphological and aesthetical appreciations, including the vitality of materiality, viewed as embodied practices.

To reconstruct these microhistories, this section will provide an overview of the results of my ceramic analysis, which aimed to reconstruct situated production choices from clay procurement through paste preparation, fashioning, finishing, surface treatment, decoration, and firing techniques, as well as some insights into consumption. Therefore, the results are grouped according to archaeological site (Aguas Buenas, Alberto Obando, Barillas, Oporta, Josefa Ocón Robleto, Rosa Dolores Oporta, and La Aventura). Each section starts with a general description of the ceramic assemblage, followed by the results from the different analytical approaches included in this ceramic research: macrofabric, petrographic, technological, morphostylistic, and decorative characterization. Finally, the reconstruction of proposed operational sequences for ceramic manufacture is provided, discussing their variability and connections.

From the 30178 sherds that were quantified, measured, weighed, and preliminarily classified according to vessel type, and after several sampling procedures (see Chapter 6), a total of 3710 sherds were analyzed and classified in macrofabric groups, and then 167 were sampled for petrographic analysis and thorough macrotrace characterization. A stylistic examination was conducted of all rim and base sherds, as well as of 100.0% of the decorated samples. All of the ceramic fragments included in this dataset were excavated, washed, labeled, sampled, and analyzed in a team-based approach, under my supervision and coordination. The petrographic analysis was conducted by Simone Casale, who provided key insights into mineralogical and technological aspects of the samples.

7.1 ALBERTO OBANDO

The two excavation units placed at the Alberto Obando site yielded 875 ceramic fragments (3498.1 grams). In general, fragments were small, with an average length of 29.0 mm; 82.0% of the sherds were smaller than the average, while 18.0% were larger. Sherds were extremely homogeneous in wall thickness, with all fragments—except for two—measuring between 4.0 and 7.0 mm wide. Therefore, unlike other sites, only one group was created in relationship to wall thickness. Moreover, 74.0% of the sherds corresponded to unrestricted vessels, 16.0% to restricted vessels, and the remaining 10.0% to undetermined shapes. The assemblage features several vessel parts, such as rims, rim/necks, shoulders, shoulder/necks, bodies, bases, handles, lugs, and supports. Decorating techniques included double slips, incisions and appliqués (geometric, zoomorphic, and possibly anthropomorphic), as well as one *acanaladura* example. Additionally, a seal fragment was documented featuring an inverted Z inscribed with a wide tool (**figure 100**).

Figure 100: Seal fragment retrieved from excavation unit Alberto Obando 1 (EAO1) featuring a "Z" shaped motif.

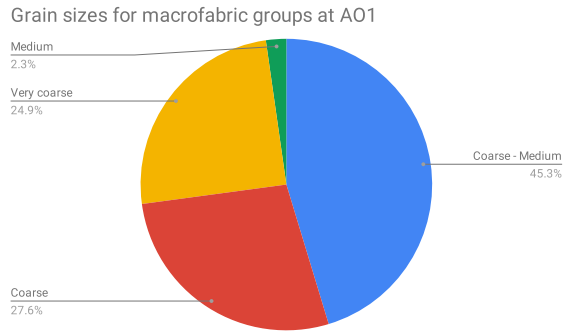

Figure 101: Distribution of the different textures identified in the macrofabric groups of EAO1.

Fragmentation was high, and sherds typically featured subrounded edges, two characteristics that, when combined, indicate trampling and erosion. In particular, the excavation unit 1 (EAO1) sample was one of the most eroded of the entire analyzed assemblage. Fragments were of trapezoidal, triangular, and quadrangular shapes, which are typical for the fashioning of assembled elements, in particular the coiling technique. Also, sherds were very powdery and soft, with light colors (salmon, orange, light brown), and breakable by applying a minimal pressure with the fingers. Moreover, fragments featured fire marks visible both on the inside and outside surfaces, possibly related to use-alteration. Firing possibly took place in an oxidizing atmosphere at very low temperatures (<750 °C). A total of 281 sherds (1855.9 grams) were sampled from excavation unit AO1 for further analysis.

7.1.1 PASTE ANALYSIS

Macrofabric groups

The analyzed assemblage was classified into six different macrofabric groups that formed homogeneous ceramic series in their composition. The same clay recipes, which span from very coarse to medium, were mainly composed of rounded clay pellets, feldspars, and ores combined with subangular quartz and dark micas. The groups were created according to differential grain size and frequencies. Groups featuring very coarse grains amounted to 24.9%, those containing coarse grains comprised 27.6%, and coarse-medium made up 45.3%, while medium was represented by 2.3% (**figure 101**). Therefore, the samples were characterized as mainly coarse, with minimum amounts of medium sherds and a complete absence of fine-grained vessels. Frequency of inclusions varied from 20.0 to 30.0% for most of the groups, except for one. Subangular to rounded inclusions were common in the assemblage, with a clear tendency towards low sphericity, with quartz crystals as an exception. The orientation of the inclusions was usually concentric and chaotic, which is consistent with the coiling technique for preforming vessels. Voids were generally of a plate-like and oval-sphere shape, and their orientation was highly variable. Regarding firing technology, variability in the core-margin relationship as well as cross-section and surface Munsell colors suggest different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source. These variables explain the range from complete oxidation to different varieties of incomplete oxidation. Fire marks due to production were not identified, while carbonization in internal surfaces, derived from use-alteration, was common. Since a kiln structure was not identified and the site lacked areas with high surface ceramic densities, production—if it was indeed conducted within the site—possibly took place at very low intensities, and firing might have been undertaken without the use of kilns but avoiding contact between the flames, the fuel, and the pots.

Petrographic Groups

The 23 samples examined through a polarizing light microscope were classified into three petrographic groups and two subgroups, while two sherds were

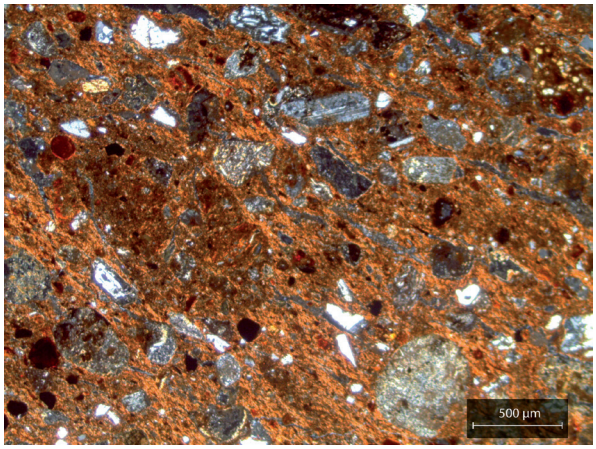

Figure 102: Example of a typical fabric for petrographic Group 1. Sample AO1.5.12 was photographed in XP (credit: Simone Casale).

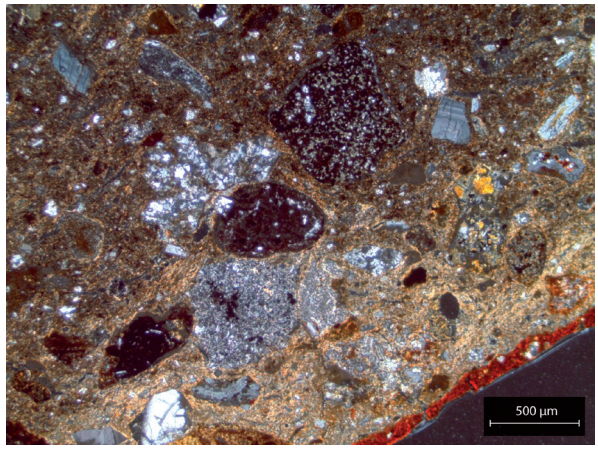

Figure 103: Example of petrographic Subgroup 1A, featuring coarse inclusions of granite, chert, and clay pellets. Sample AO1.6.5 was photographed in XP (credit: Simone Casale).

identified as outliers, since their main characteristics did not match any of the groups (Casale *et al.* 2019). Observations under the petrographic microscope matched the ones undertaken during macrofabric analysis: paste groups are homogenous in their intermediate volcanic composition. The geology is mainly granite and andesite as well as unidentified weathered volcanic rock but also contains the presence of basalts and minerals such as quartz, feldspars, olivine, ortho and clinopyroxene. Variation in clay recipes resided in differences related to grain size and frequency of inclusions, as well as firing temperature and duration. In comparison to other sites, the assemblage excavated at AO1 shows very high homogeneity in clay procurement choices and moderate variability in clay preparation and firing practices.

In general, the assemblage analyzed was defined by granule to medium inclusions of extrusive intermediate igneous rocks (100-3000 µm), mainly identified as granite, andesite, and basalt. Accessory minerals consisted of pyroxene (both ortho and clino, 200-500 µm), augite (150-500 µm), quartz (50-650 µm), plagioclase feldspars (100-600 µm), olivine (50-600 µm), volcanic ash and glass (200-600 µm), and iron-rich inclusions (100-500 µm). Voids were present (50-250 µm) in mostly elongated shape and exhibited variability in their orientation (to the walls, around coils, or coarser inclusions). **Group 1** (**figure 102**) is the main cluster of Alberto Obando, containing nine of the samples examined for petrography, and is interpreted as a local clay source due to its strong connections with the Güegüestepe ethnographic sample (see below). The group is characterized by an iron-rich matrix with fine to coarse inclusions (200-600 µm) and some isolated very coarse grains (1000-2000 µm). Inclusions are mainly comprised of clay pellets and intermediate volcanic rocks, mostly represented by granite and andesite, with rare basalt (200-1200 µm). Weathered volcanic rock inclusions are also present and might be related to weathering processes associated to riverine clay deposits. Other common inclusions within this group are iron-rich fragments (100-500 µm), quartz (50-500 µm), feldspars (plagioclase and sanidine), volcanic ash and glass (200-600 µm), and olivine (100-400 µm). Voids display an elongated shape (150-250 µm) and are either not oriented or moderately oriented to the borders or to coils. As all matrices are optically active, firing most likely took place at temperatures lower than 750 °C, in a completely oxidizing atmosphere. Some samples within the groups have differences in frequency (AO1.6.7) or grain size (AO1.6.S2) but share the same mineralogical and technological profiles, so their variability is considered within the group.

Petrographic Group 1 yielded two subgroups: 1A and 1B. **Subgroup 1A** is characterized by a very similar composition to the main cluster, featuring a high frequency of coarse volcanic rock inclusions, mainly comprised of granite, andesite, and weathered fragments (**figure 103**), with a rare occurrence of

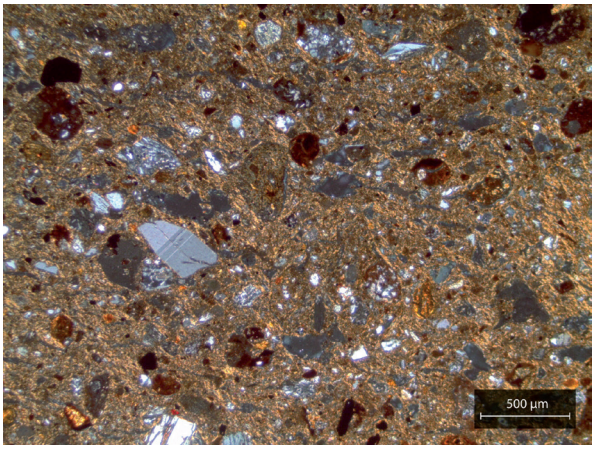

Figure 104: Example of petrographic Subgroup 1B. Sample AO1.5.3 was photographed in XP (credit: Simone Casale).

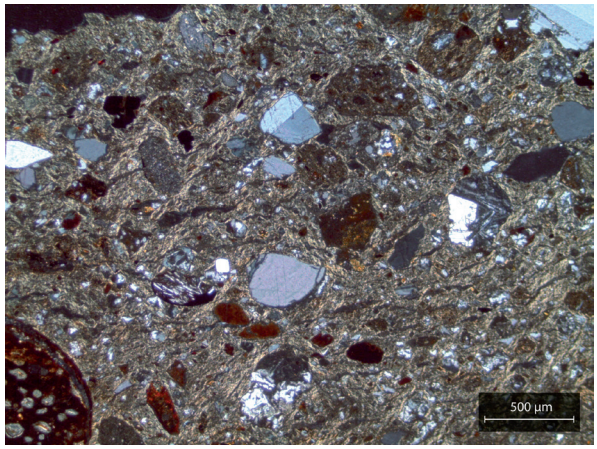

Figure 105: Example of petrographic Group 2, featuring andesite, sanidine, chert and clay pellets inclusions. Sample AO1.5.2 was photographed in XP (credit: Simone Casale).

basalt—except for sample AO1.5.4, which contains higher frequencies of basalt. The main difference between Group 1 and Subgroup 1A is in the size of inclusions; while Group 1 usually ranges between 200 and 600 µm, Subgroup 1A averages 500 to 800 µm, and smaller fragments (<300 µm) are rare. This could suggest sieving practices or selection of a clay outcrop with slightly less transport and erosion. Also, orthopyroxene and augite (100-600 µm), as well as angular and subangular K-feldspars and plagioclase (100-600 µm), are present. Elongated voids (50-250 µm) were usually found around coarser inclusions, with no orientation in relationship to the walls.

Subgroup 1B is also very similar to Group 1 and Subgroup 1A in composition, but most of the inclusions are finer, between 50 and 100 µm with a few measuring 300 to 500 µm (**figure 104**). Therefore, sieving and sorting practices can be deduced. Additionally, sample AO1.11.1 yielded high frequencies of fine quartz inclusions (100-200 µm), which were interpreted as temper.[77] Elongated vughs and vesicles (50-150 µm) were moderately oriented to not oriented to vessel walls.

Group 2 contrasts with Group 1 in three main ways. First, it features a lower density of volcanic rock inclusions, such as granite, andesite, and weathered fragments. Second, the matrix seems to either contain less iron than Group 1, or differential firing conditions (a shorter time) could have stopped the complete oxidation of iron, resulting in a lighter matrix color (**figure 105**) (L. Jacobs, pers. comm. 2017). Third, quartz and feldspars (300-1000 µm), sometimes featuring angular and subangular edges, are most common within Group 2, suggesting tempering practices (**figure 106**). However, according to Casale *et al.* (2019), the high frequency

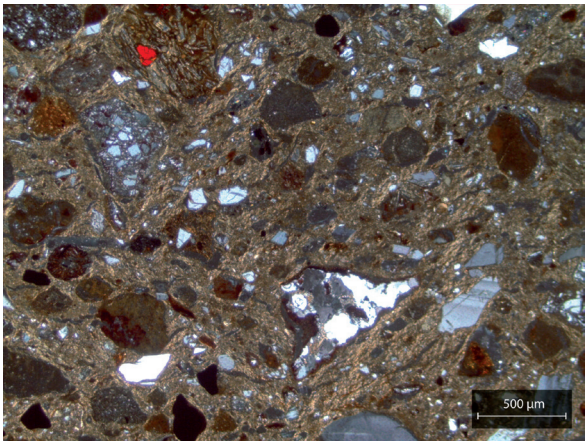

Figure 106: Subangular inclusions (i.e. granite) in petrographic Group 2. Sample AO1.6.1 was photographed in XP (credit: Simone Casale).

77 This hypothesis was strengthened by macroscopic analysis, in which fire marks associated with cooking practices were identified. Quartz tempering of cooking vessels might have been a functional choice related to heat transfer and thermal shock.

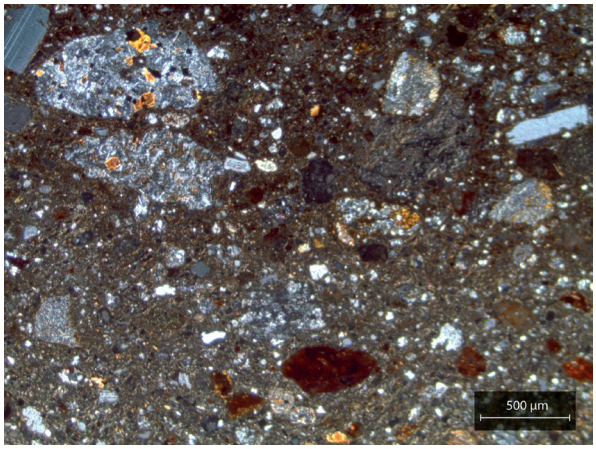

Figure 107: Petrographic Group 3 featuring granite, clay pellets, chert, and quartz inclusions. Sample AO1.6.4 was photographed in XP (credit: Simone Casale).

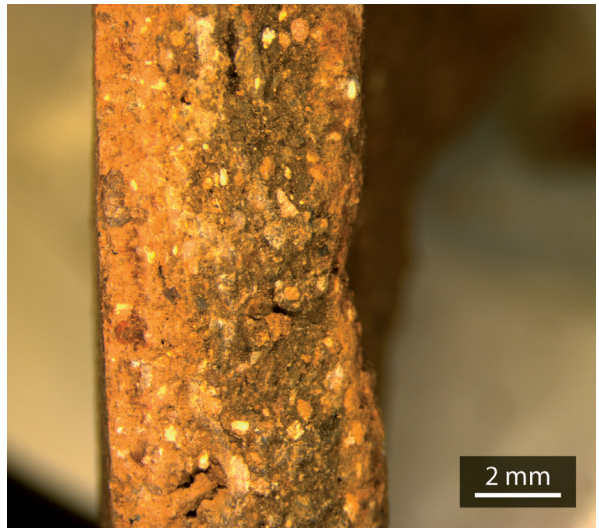

Figure 108: Cross-section from the ceramic assemblage EAO1 featuring coils.

of fine quartz and feldspar inclusions, together with the occurrence of some coarser granite grains, might suggest a clay outcrop related to a weathering granite parent material instead. Therefore, it is not clear if the differences between the groups are related to clay procurement or preparation practices. Either way, both their mineralogical and technological profiles support the classification of these samples into a different cluster. Within Group 2, voids with an elongated shape were oriented to the borders and measured between 100 and 200 µm; also, some large cracks (600-3000 µm) were visible.

Group 3 is characterized by a matrix featuring less iron content or a shorter firing duration, as in the previous cluster. However, the distinctive characteristic of the group lies in the high frequency of angular to subrounded granite inclusions, featuring a wide range of grain sizes (200-2000 µm), accompanied by angular to subrounded quartz inclusions (100-600 µm) (**figure 107**). This could be the result of a clay outcrop with granite parent materials, but it does not necessarily discard the intentional addition of freshly ground rock fragments from the same geological background as temper. Elongated voids (100-200 µm) were not oriented to the walls. Outliers featured similar mineralogical profiles as the samples that were grouped; however, certain distinctive characteristics prevented them from fitting into the classified clusters.

7.1.2 MACROTRACES OF MANUFACTURING PRACTICES

A general overview of the assemblage suggested preforming through assembled elements mainly due to the shape of the fragments, the orientation of inclusions, and irregular surface topography of the sherds—which feature marks of discontinuous pressure as well as different wall widths—all traits that support coiling as the main fashioning technique. Then, even though the general first impression of the assemblage suggested a preference for leather hard clay for working from preforming through surface treatment—evinced by the occurrence of inserted grains, for example—it is possible that traces of earlier steps were erased by later gestures. However, after macroscopic inspection of the different macrofabric groups, data pointed to wet clay preforming followed by leather hard clay surface treatment. In particular, wet clay preforming and finishing implied the use of a dry tool (fingers, calabash, or ceramic tool are feasible options) that left thin-threaded striations (gestures were usually parallel to the vessel mouth), combined with protuberant grains. Surface treatment involved smoothing on leather hard clay with a soft tool and burnishing, which did not leave any visible marks on the surface. Apart from that, coating with clayish slips was applied.

The 23 samples submitted to petrographic characterization were also thoroughly examined

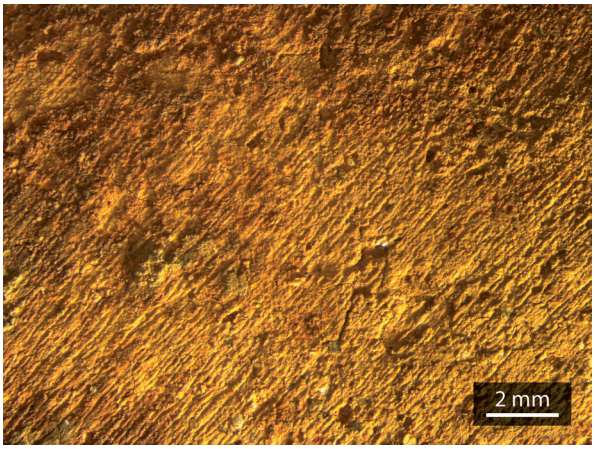

Figure 109: Sample AO1.5.S1, external surface featuring threaded striations produced by smoothing on leather hard clay with rehydrated fingers.

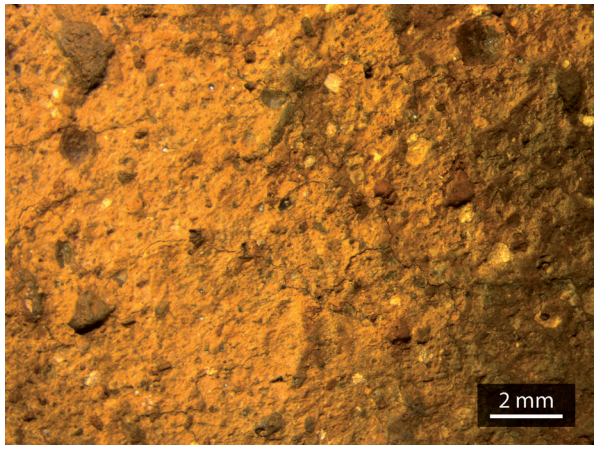

Figure 110: Sample AO1.5.S1, internal surface featuring wet clay surfaces.

for macrotrace identification of manufacturing practices (see **Appendix 8**). All samples featured fashioning through assembled elements (coils), which measured between 5.0 and 10.0 mm wide in 17.0% of the cases (unrestricted shapes, wall width between 3.0 and 5.0 mm) and from 11.0 to 15.0 mm wide in 65.0% of the cases (all unrestricted shapes except for one, wall width between 3.5 and 7.0 mm), while 9.0% ranged between 15.0 and 25.0 mm (unrestricted vessels, wall width 3.5-5.5 mm and a restricted vessel, wall thickness 10.0 mm), and in 9.0% of the cases coil measure was not possible due to the fragmentary nature of the sample. Coils were positioned equidistantly and mainly in an oblique fashion (**figure 108**), either with gestures from the outside to the inside of the vessel (26.0%) or vice versa (26.0%). In 13.0% of the samples, coils were placed in an alternating manner, while in 35.0% of the cases it was not possible to assess this gesture due to the high fragmentation rates in the sample analyzed.

Apart from that, lip coils were positioned either from the outside or inside and were either the same size as body coils or larger. Preforming was carried out through pinching and drawing; finishing was usually done on wet clay with a soft tool, leaving threaded striations in combination with protuberant grains, but four samples (AO1.6.6, AO1.5.S2, AO1.6.2, and AO1.5.S1) show partial evidence of leather hard clay finishing (also referred to as shaving) as well. Sample AO1.5.S1 is of special interest because it features both kinds of finishing: wet clay in the interior and leather hard clay in the exterior (**figures 109** and **110**).

Future experimentation is required to assess this hypothesis because it seems that some traces—particularly threaded striations, present in 90.0% of the samples—are found in combination with both protuberant and inserted grains. Therefore, they might be connected to a specific tool and gestures that, regardless of the hygronomic state of the clay, left similar marks on the surfaces. Therefore, it is also possible that all finishing gestures were performed on wet clay and later leather hard clay work obscured the traces. Indeed, surface treatment involved leather hard clay smoothing, some burnishing, and coating with *barbotine* or slips rich in iron and mica, of generally red, brown, or orange colors, and in very limited cases white (less than ten sherds in the whole sample).

Fragmentation of the sample analyzed did not allow for a full reconstruction of the operational sequences of whole vessels. However, several preferential fractures as well as scars related to assembled elements point to staged fashioning of individual parts of the vessels (i.e. start with the base, continue with the body, add a neck or rim), requiring some drying in between. Also, drying/cooling cracks are present in the sample, which suggests an uneven drying/cooling process.

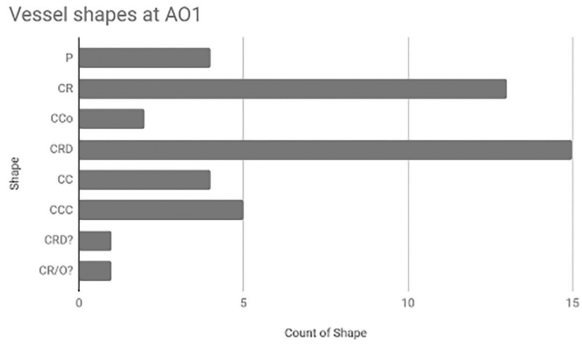

Figure 111: Vessel shapes at EAO1.

7.1.3 MORPHOMETRIC ANALYSIS

Vessel shapes at Alberto Obando were extremely homogeneous, featuring mostly thin-walled unrestricted vessels (70.0%) and sometimes composed silhouettes (see **figure 111**, **Appendixes 6 & 8**). The largest group of forms, unrestricted vessels, was dominated by outflaring straight walled jars (CRD), which measured between 13.0 and 40.0 cm in diameter, with a wall thickness ranging from 4.0 to 7.0 mm. On average, their diameter was 21.0 cm (31.0% <20.0 cm, 63.0% between 20.0 and 25.0 cm and 6.0% >25.0 cm). The next common shape, straight walled jars (CR), featured diameters between 13.0 and 30.0 cm, with wall thickness ranging between 3.5 and 6.0 mm. On average, their diameter was 20.0 cm (43.0% <20.0 cm, 43.0% between 20.0 and 25.0 cm and 14.0% >25.0 cm). Convergent curved jars (CCC) had diameters between 4.0 and 21.0 cm, while their walls ranged between 3.0 and 5.0 mm. Curved jars (CC) yielded diameters between 10.0 and 25.0 cm, and their walls ranged from 3.0 and 5.0 mm. Plates (P) measured between 6.5 and 30.0 cm in diameter, and their walls were 3.0 mm thick; however, one plate measured 40.0 cm diameter and had a 5.0 mm wall thickness. Convergent jars (CCo) yielded diameters between 30.0 and 33.0 cm, and their walls were thin, only 4.5-5.0 mm wide.

One of the most important observations regarding vessel shapes at AO1 is not ubiquity but absence: there are no *olla* fragments among the 281 sherds examined in the sample. This is a very relevant caveat when thinking of cooking and storing practices. Charred remains on the interior of the vessels, combined with a lack of soot on the outside surfaces, point to roasting practices. However, the presence of soot on preferential sections of the outer vessel walls without internal carbonization could suggest boiling as well, with no traces of overboiling (as in JOR, see below). Also, several samples evince possible fermentation traces, represented by differential internal wall erosion that involved the removal of superficial clay layers. Apart from that, sizes of vessels imply both communal and individual ways of serving, storing and cooking, though the sample is too fragmentary to actually infer specific eating habits.

7.1.4 DECORATING TECHNIQUES

Slipped fragments make up of 75.0% of the samples (either external or internal walls, or both). Other decoration practices were almost entirely lacking within the assemblage analyzed—only representing 5.0%—and consisted mainly of double slipping practices, followed by appliqué decoration, incisions, and one *acanaladura*, or corrugated surface. Double slips were by far the most common decorating practice, mainly featuring red-on-white (43.0%), red-on-orange (38.0%), orange-on-white (14.0%) and brown-on-red (5.0%) combinations. Sample AO1.6.S1, a base featuring a mammiform support (2.8 cm diameter, with one 0.6 cm diameter orifice on one of its sides), was also decorated with a triple slip (red-on-orange-on-white), so it is the only polychrome sample within the assemblage, which is largely bichrome. Incisions consisted of parallel thin lines usually below 0.5 mm wide (although one sample has lines between 0.5 and 1.0 mm). They were placed on the outer surfaces, parallel to the mouth of the vessels. Since grains are inserted on the incised sections, it is possible that they were done on leather hard clay. Incisions were usually combined with slipping on other areas of the vessels. Appliqué decoration was scarce; sample AO1.5/AO1.A1 featured red slip and an applied thin coil (3.5 mm wide) on the external wall and parallel to the vessel base, while sample AO1.11 yielded the same technique but with a wider coil (9.0 mm). Sample AO1.6 is a zoomorphic adorno representing a bird (possibly a duck) in combination with red slip (**figure 112**). The rest of the applied decorations actually consist of appendages, such as mammiform supports (n=3), handles (n=2, one cylindrical with 1.3 cm diameter, one is a crushed coil measuring 19.0 by 13.0 mm wide), and lugs (n=1 with oval base and conical tip). Among the handles, it is important to mention sample AO1.5.6, a CCC (possibly *tecomate*) that features the scar of either a lug or handle next to

Figure 112: Zoomorphic adorno (EAO1).

its base, which could be related to the function of the vessel. Finally, sample AO1.6 features a double slip combined with an external *acanaladura* parallel to the vessel mouth.

7.1.5 CERAMIC MANUFACTURING SEQUENCES AT AO

The AO1 sample yielded homogenous results in terms of macrofabric, petrographic, macrotrace analysis, vessel shape, and decorating techniques, so differences in the steps of the operational sequence are minimal. In spite of this, two different production sequences were identified. Based on clay procurement, preparation, and firing practices, a third sequence (corresponding to petrographic Group 3) is possible; however, the fragmentary nature of the evidence (only two samples and one is too small to examine for fashioning) makes it difficult to characterize a whole sequence.

Operational sequence AO-I

This category corresponds with petrographic Group 1 and its subgroups 1A and 1B. While clay procurement practices seem to be similar between the subgroups, clay preparation practices might have diverged. All mineralogical profiles are characterized by a matrix with high iron content, combined with inclusions corresponding to intrusive igneous rocks (granite and andesite, and basalt to a lesser extent). However, the main group does not feature any paste preparation practices, while Subgroups 1A and 1B could have involved differential sieving and/or tempering practices. After paste preparation, coils between 1.0 and 1.5 cm (three exceptions: coils <1.0 cm in Group 1 and Subgroup 1A, as well as coils measuring 2.5 cm on Subgroup 1A) were positioned equidistantly in an oblique manner, either from outside to inside or vice versa. Only one sample (AO16.7) featured alternate coiling placement. Lip coils were positioned either from outside to inside or vice versa and were of the same size or larger than the coils forming the vessel body. Preforming involved pinching and drawing, done in a manner that left the topography of the sherds irregular; finishing was undertaken on wet clay (prominent grains) with a technique that left very fine threaded striations, most likely with a dry tool or finger. Group 1 and Subgroup 1A features samples that could have been finished on leather hard clay, but later surface treatment might have altered the traces, and even though grains are inserted on those samples, the same threaded thin striations are present. Therefore, the leather hard clay finishing hypothesis is inconclusive but not discarded completely. In any case, one sample (AO1.5.S1) features both examples, so in a case of differential techniques, they did not necessarily involve different social contexts of production, but rather the convergence of dissimilar techniques within the same group of potters. Surface treatment involved leather hard clay smoothing and coating with slips (mainly red, and some brown). Double slips were also applied (red-on-white and red-on-orange). Apart from this, surface treatment involved burnishing and polishing (sample AO1.5.12), while decorations were incised (sample AO1.6.6, Subgroup 1A). The samples were fired in an incompletely oxidizing atmosphere at temperatures around 750 °C. The end products associated to this sequence consisted mainly of CRD (Ø 15.0-40.0 cm), but also CC (Ø 16.0-25.0 cm), CCC (Ø 24.0 cm), CR (exclusive to Subgroup 1A, Ø 17.0-25.0 cm), and CCo (exclusive to Group 1, Ø 30.0 cm). This sequence was found within the core cultural stratigraphic unit (SIII) but also in the one underneath (SIV).

Operational sequence AO-II

This category corresponds to petrographic Group 2, which is—as Group1—characterized by volcanic rock inclusions, such as granite, andesite, and, rarely, basalt, but in lower densities. Clays featured less iron content than Group 1, which could be related to differences in clay procurement and firing practices.

Figure 113: Example of colander fragments excavated at Aguas Buenas.

Figure 114: Example of colander fragments excavated at Aguas Buenas.

Also, possible tempering practices can be inferred due to the presence of angular and subangular quartz and feldspars (300 - 1000 µm). Fashioning involved the assembling of coils between 0.5 and 1.1 cm—smaller coils when compared to sequence AO-I—which were positioned in an alternate manner. The lip coils were either larger or the same size as those used for the vessel body and were placed either from the inside or the outside. Preforming involved pinching and drawing; finishing was undertaken on wet clay (prominent grains) with a technique that left thin-threaded striations performed with dry fingers or with a tool. However, leather hard clay smoothing might have erased previous steps of the operational sequence. Apart from this leather hard clay smoothing, surface treatment also involved the application of a red slip and polishing (only on sample AO1.5.2). The samples were fired in an incompletely oxidized atmosphere at temperatures <750 °C. Firing conditions, especially a shorter duration of the process, might explain the lighter tones of the matrix when compared with Group 1 instead of necessarily meaning the exploitation of a different clay outcrop. The end products associated with this sequence consisted of CRD (Ø 13.0-20.0 cm) and CR (Ø 17.0 cm); wall thickness ranged from 3.0 to 4.0 mm. This sequence was found exclusively within the core cultural stratigraphic unit of the excavation (SIII).

7.2 AGUAS BUENAS

The six excavation units placed at Aguas Buenas yielded 3020 ceramic fragments (16513.5 grams), featuring several vessel parts, such as rims, rim/necks, shoulders, shoulder/necks, bodies, bases, lugs, and supports. Decorating techniques included incisions, and it is relevant to mention the presence of colanders (**figures 113 & 114**).

Since radiocarbon dates obtained from the excavation units were divergent, all of the analyses—except for the mineralogical characterization—were done individually. Data is integrated at the end of this section, when reconstructing the different manufacturing operational sequences. **Table 22** provides an overview of the ceramic assemblage per unit, including basic data such as average length and wall thickness of the sherds, as well as the distribution of vessel shapes (restricted, unrestricted, or non-identified). Percentage and descriptive data were not added for excavation unit AB5 due to its reduced sample size (see **Appendix 5**).

Fragmentation and conservation status also varied among the excavation units. Fragments in all units featured angular edges, and their shapes were mostly quadrangular, triangular, and trapezoidal, which are typically from assembled elements fashioning, in particular the coiling technique. However, differences were found in hardness. Sherds from excavation units 1 and unit 2 were well-preserved and were hard upon touch, with tones usually

Excavation unit	Average length (mm)	Average wall thickness (mm)	% Restricted vessels	% Unrestricted vessels	% N/I Shapes
AB2	33,5	6,0-9,0	8	88	4
AB3	25,8	5,0-7,0	15	77	8
AB4	25	5,0-7,0	27	62	11
AB5	19	4,0-9,0	N/A	N/A	N/A
AB6	22,5	5,0-6,0	51	43	6

Table 22: Summary of general characteristics of the ceramic assemblages retrieved from Aguas Buenas.

between brown and orange. Minimal fire marks related to production were observed (i.e. AB2.57.2), but traces that could be related to use-alteration were also identified. Fragments from the rest of the units yielded a much lower conservation status, as shown by the high number of eroded surfaces—both internal and external—which were interpreted as post-depositional. This poor conservation status, especially identified for excavations units AB4, AB5, and AB6, affected the analysis of macrotraces derived from manufacturing practices. Vessels were fired at low temperatures (below 750 °C), with a few possible exceptions of higher temperatures. Firing atmospheres varied; most sherds were subjected to partial or complete oxidation, while others were reduced. This variability was preliminarily interpreted as the result of diverse firing techniques, mainly involving open hearths, but possibly also the use of kilns. A total of 689 sherds (11428.7 grams) were sampled from excavation units AB2, AB3, AB4, AB5, and AB6 for further analysis.

7.2.1 PASTE ANALYSIS

Macrofabric Groups

Excavation unit AB2

The analyzed assemblage was classified into ten different macrofabric groups that formed a compositionally homogeneous ceramic series (see **Appendix 9**). The same clay recipes, spanning from very coarse to medium, were mainly composed of feldspars, volcanic rock inclusions, quartz, dark mica, rounded clay pellets, and iron ores, so they were grouped according to differential grain size, frequencies, and firing technologies. Groups featuring very coarse and medium grains made up 30.0%, while groups with both coarse and fine grains made up 27.1% (**figure 115**). Those containing coarse and medium grains were 20.2% and granule and coarse were 19.7%, while fine and very fine groups were 3.0%. Therefore, the samples were characterized by bimodal matrices mainly containing very coarse to

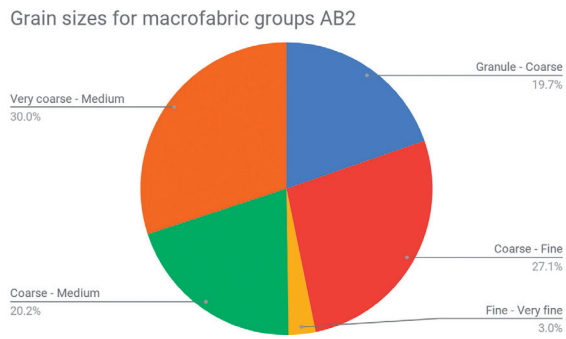

Figure 115: Distribution of the different textures identified in the macrofabric groups of EAB2.

coarse inclusions, with minimum amounts of fine-grained vessels. The frequencies of inclusions were highly homogeneous, with all macrofabric groups featuring between 20.0 and 25.0%, apart from two exceptions: groups AB2.A with up to 30.0% and AB2.F (the fine group) with 10.0-15.0%. Subangular to rounded inclusions predominate, with a clear tendency towards low sphericity, with only group AB2.A as an exception combining both low and high sphericity inclusions, as well as group AB2.L, which featured angular grains in combination with subangular and subrounded ones. The orientation of the inclusions was usually oblique, subparallel, concentric and chaotic, which is consistent with the coiling technique for preforming vessels. Generally, voids were of plate-like, oval-sphere, and irregular shapes, mostly featuring chaotic and subparallel orientations.

Regarding firing technology, variability in the core-margin relationship as well as Munsell colors of cross-section and surfaces suggest different temperatures, duration of firing, and position of the vessel (or vessel part) in relation to the fuel source of an open hearth. These variables explain the range

from complete oxidation to different varieties of incomplete oxidation, yielding surface and cross-section tones usually brown (including yellowish, light, and grayish brown), as well as orange. Production fire marks were minimally identified, while carbonization derived from use-alteration was common and was usually represented by charred encrustations on internal surfaces with transfer into the wall, as well as some examples of external deposition of soot (i.e. samples AB2.H1(4) and AB2.L4(1)). Macrofabric group AB2.F stands out due to its bright orange surface and cross-section colors, suggesting a complete oxidizing atmosphere with very good control of firing temperature and duration, possibly a kiln.

Excavation unit AB3

The ceramics retrieved from this excavation unit were divided into five different macrofabric groups that formed homogeneous ceramic series (see **Appendix 9**). The same clay recipes, which mainly featured feldspars, volcanic rock inclusions, and clay pellets, were combined in diverse sizes and textures. The ceramic series span from coarse to fine, share similar paste texture, types of inclusions and voids in the different grain size options. The variability in the clays might be connected to a multiplicity of geologically similar clay sources but could also relate to differential paste preparation and firing practices.

Groups featuring mainly coarse-medium grains made up 47.5% of the sample and those containing medium grains were 29.5%, while medium and fine groups were represented by 23.0% each (**figure 116**). Very coarse and exclusively fine-grained sherds were absent in the sample. Frequency of inclusions was varied, averaging 15.0% except for the group featuring coarse and medium grains, which yielded an inclusion frequency up to 25.0%. Sphericity of inclusions was classified as low, with subangular and subrounded as the most common shapes, and with the presence of angular inclusions only on macrofabric group AB2.A. This points to riverine clay sources, characterized by weathered materials and an absence of recent transport episodes. Orientations of the inclusions varied between subparallel, concentric, and oblique, as well as chaotic, which are consistent with the coiling technique for preforming vessels. Voids were generally of plate-like, oval-sphere, and irregular shapes, and their orientation was subparallel, concentric, oblique, and chaotic.

Variability in the core-margin relationship, cross-section and surface Munsell colors suggest that firing practices involved different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source, possibly an open hearth. These variables explain the range from complete oxidation to different varieties of incomplete oxidation and reduction, yielding surface and cross-section tones of brown, light brown, and orange. Internal smoked surfaces were present, but production fire marks were not identified, and carbonization derived from use-alteration, especially on internal surfaces (i.e. sample AB3.C4.1) was common.

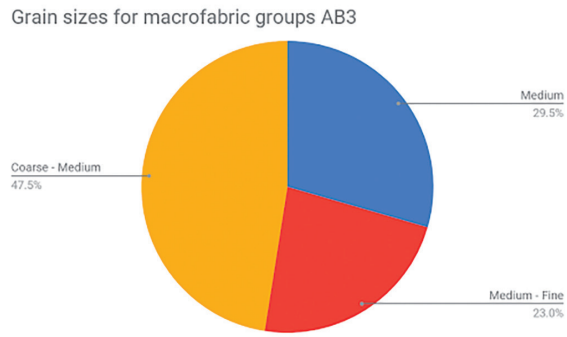

Figure 116: Distribution of the different textures identified in the macrofabric groups of EAB3.

Excavation unit AB4

In total, ten different macrofabric groups were identified in the sample analyzed, as well as several outliers (see **Appendix 9**). The groups were homogenous, featuring clay recipes that mainly contain feldspars, dark mica, rock fragments, and quartz. These sets of inclusions were repeated in different sizes and frequencies, resulting in a homogenous assemblage comprised of several groups.

Groups featuring mainly coarse and fine grains consisted of 55.7% of the sample, while the ones containing coarse and medium grains were 42.3%, and exclusively coarse grains were identified in 2.0% of the sample (**figure 117**). No very coarse or fine groups were identified in the assemblage, which was characterized by bimodal and trimodal matrices. Frequency of inclusions was homogeneous, usually between 15.0-20.0%, with the exception of group AB4.A (coarse-medium), which featured 30.0%.

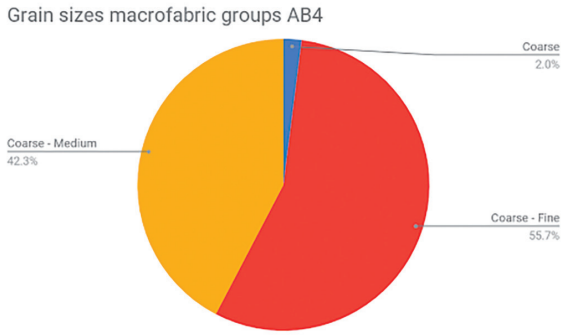

Figure 117: Distribution of the different textures identified in the macrofabric groups of EAB4.

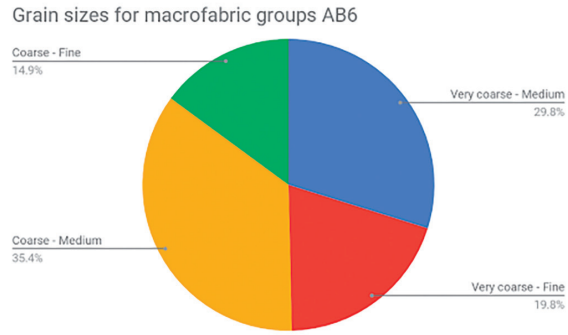

Figure 118: Distribution of the different textures identified in the macrofabric groups of EAB6.

Apart from that, inclusions tended towards low sphericity, with subangular, angular, and subrounded shapes. Orientation of the inclusions was usually chaotic, but also subparallel and concentric. Voids were generally of a plate-like, oval-sphere, or irregular shape, and their orientation was mainly subparallel and oblique.

As mentioned above, the sample from excavation unit AB5 was too fragmentary, so no description will be included. However, the characteristics of the only macrofabric group identified (AB5.A, see **Appendix 9**) matched macrofabric group AB4.A, suggesting connections between the two. Therefore, the analysis of AB4.A will also encompass AB5.A in this section.

Variability in the core-margin relationship, cross-section and surface Munsell colors suggest that firing practices involved different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source, possibly an open hearth. These variables explain the range from complete oxidation to different varieties of incomplete oxidation, yielding sherds with reddish brown and brown colors. Smoked internal surfaces were common, while fire marks from production were not identified. Deposition of soot was observed on sample AB4.E4(1), but erosion and threshing are strong biases for these kinds of surface examinations. Calcite encrustations on surfaces were interpreted as post-depositional because they are present not only on the surface of sherds, but also on the fractures. This was previously noted by Casale for the assemblage at M1 (Casale 2017, 80, 115), who proposed that this calcareous layer may either be related to an intentional calcareous water mixture wash or to post-depositional processes, such as water percolation.

Excavation unit AB6

Seven macrofabric groups were characterized for excavation unit AB6 (see **Appendix 9**). The assemblage was similar to AB4 and AB6 in the multimodality of the clay matrices, featuring a wide range of sizes of inclusions, which could be related to differential paste recipes in relation to AB2 and AB3 (i.e. sorting strategies in the latter) or divergent clay procurement practices (preference for other clay outcrops featuring several grain sizes of inclusions). For AB6, groups were predominantly coarse-medium (35.4%), very coarse-medium (29.8%), very coarse-fine (19.8%), and coarse-fine (14.9%) (**figure 118**). Their composition was very similar, mainly featuring feldspars, dark mica, rock inclusions, and quartz. Since differences among groups were only found in texture and frequency, it is possible that one single clay outcrop was used for most of the sherds. Frequency of inclusions was usually around 20.0%, with merely the groups featuring very coarse grains exceeding this trend to up to 30.0%. Apart from that, inclusions tended towards low sphericity, with subangular, subrounded, and angular shapes. The predominant orientation of the inclusions was chaotic, subparallel, and concentric. Voids were generally of an oval-sphere shape, and their orientation was mainly chaotic.

Variability in the core-margin relationship, cross-section and surface Munsell colors suggest that firing practices involved different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source, possibly an open hearth. These variables explain the range from complete oxidation to different varieties of incomplete oxidation. The assemblage is too eroded

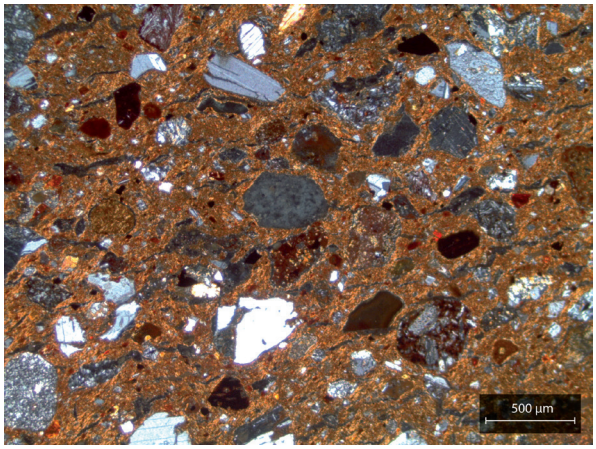

Figure 119: Example of a typical fabric for petrographic Group 1. Sample AB4.81b was photographed in XP (credit: Simone Casale).

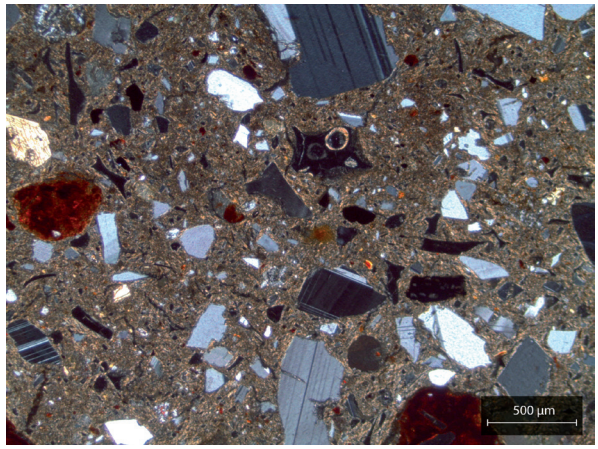

Figure 120: Example of a typical fabric for petrographic Group 2. Sample AB2.35.S2 was photographed in XP (credit: Simone Casale).

and fragmentary to make any observations regarding traces of firing techniques or use-alteration marks on the surfaces of the sherds.

Petrographic Groups

The 43 samples examined through a polarizing light microscope were classified into seven petrographic groups and four subgroups, as well as several outliers (Casale *et al.* 2019). Even though all the groups are connected to volcanic geological settings, their mineralogical content was very distinctive. Also, it seems that paste preparation practices might have included sorting, tempering, and some sieving. In general, the assemblage analyzed was defined by very coarse, coarse, and medium inclusions of intermediate extrusive igneous rocks (200-2000 µm), quartz (50-900 µm), feldspars (100-900 µm), iron-rich inclusions (50-500 µm), and volcanic ash and glass (200-600 µm). Accessory minerals included ortho- and clinopyroxene (50-600 µm), augite (50-600 µm), olivine (100-650 µm), and clay pellets (200-600 µm). Voids tended to be of elongated shapes between 50 and 250 µm, and moderately oriented to vessel walls. Even though the sample was mineralogically homogenous, the size, frequency, and proportion of inclusions was variable, which allowed for the creation of several groupings.

Group 1, the main cluster, is characterized by a high frequency of very coarse to fine angular to subrounded intermediate extrusive igneous rock inclusions (200-1700 µm), mainly connected to andesitic and weathered unidentified fragments. Apart from that, this group features basalts in combination with angular to subrounded iron-rich inclusions (100-500 µm), volcanic ash and glass (200-600 µm), and olivine crystals (100-400 µm). Quartz and feldspars are also present but have subangular shapes of a considerably smaller size (300 to 500 µm) (**figure 119**).

Fragments classified as a subgroup of Group 1 yielded higher frequencies of subrounded to round basalt inclusions and were only found in samples excavated in unit AB2. Elongated voids (150-250 µm) are moderately to not oriented to the walls. Estimated firing temperature is between 650 and 750 °C. Contextually, most samples within this group were recovered from excavation units AB3, AB4, and AB6, with only one fragment from AB2. The subgroup only comprised samples excavated at AB2, with the exception of one from AB3. **Group 2** is dominated by fine to coarse angular to rounded quartz and feldspar inclusions (100-900 µm)—which were possibly added as temper—in combination with volcanic ash and glass (200-600 µm) and rare subangular to rounded volcanic rock inclusions (200-600 µm) mainly related to andesites but also to unidentified weathered rock (**figure 120**).

The regular size of volcanic inclusions suggests sieving practices prior to tempering. Voids were long and elongated (100-250 µm) and oriented to the borders. Estimated firing temperature is between 650 and 750 °C, except for sample AB4.81c that featured a less optically active matrix, possibly suggesting a higher firing temperature. A subgroup within this cluster is represented by sample AB2.22.2, which yielded a very

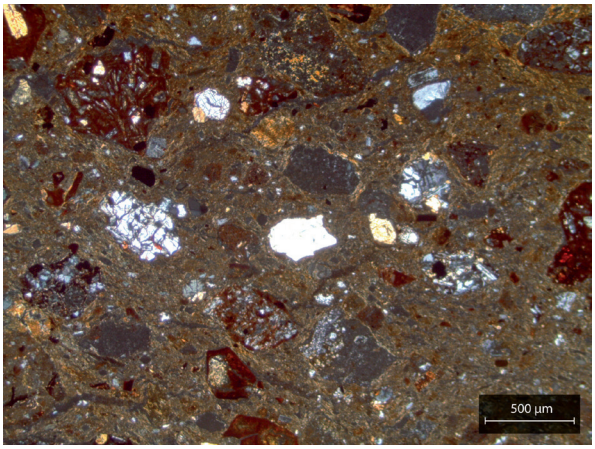

Figure 121: Example of a typical fabric for petrographic Group 3. Sample AB5.173 was photographed in XP (credit: Simone Casale).

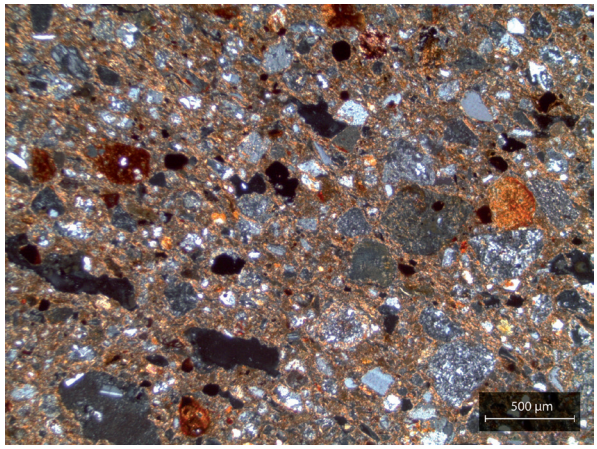

Figure 122: Example of a typical fabric for petrographic Group 4 featuring rock fragments, voids, clay pellets, quartz, plagioclase, and iron-rich inclusions. Sample AB2.57.3 was photographed in XP (credit: Simone Casale).

similar geological substrate but a lower frequency of quartz and feldspars and a higher frequency of volcanic rocks, possibly representing the raw clay materials without the paste preparation applied to the general group—sieving to remove the naturally occurring inclusions related to rock fragments followed by tempering with crushed quartz and feldspars. **Group 3** is defined by a >30.0% frequency of subrounded to rounded, very coarse to medium basalt inclusions (250-1500 µm) characterized by lamellar plagioclase inclusions, yellowish olivine, and augite phenocrysts, as well as an absence of unidentified weathered rock fragments, which are present in the other groups (**figure 121**).

The ubiquity and shape of basaltic inclusions suggest their presence in the raw material outcrop, discarding tempering in favor of differential clay procurement practices when compared with the rest of the groups. Frequent accessory minerals include orthopyroxene and augite (100-500 µm), crystals of olivine (100-650 µm), volcanic ash (200 µm), and subrounded clay pellets (200-500 µm). Long elongated voids (100-200 µm) are oriented to the walls. Estimated firing temperature is between 650 and 750 °C. The subgroup within this cluster is also characterized by a high frequency of basaltic inclusions of different sizes and subrounded to rounded shapes, in combination with unidentified weathered rock fragments and colorful and pale yellow olivine and augite. **Group 4** features >35.0% frequency of subangular to subrounded coarse to medium inclusions (100 to 600 µm and isolated grains of up to 2000 µm), mostly andesitic, unidentified weathered rock fragments, with (rarely) basalts, in combination with subangular to angular quartz (150-650 µm) and angular to subangular K-feldspars and plagioclase (100-600 µm) (**figure 122**).

Accessory minerals commonly observed were orthopyroxene and augite (100-600 µm), subrounded to subangular iron-rich inclusions (50-500 µm), and irregularly shaped volcanic ash and glass (100-600 µm). Rock inclusions are usually between 500-600 µm, suggestive of sorting practices. Voids were elongated (50-250 µm) and were oriented to the walls but often surrounded by coarse inclusions. Estimated firing temperature is between 650 and 750 °C. A subgroup within this cluster was created for sample AB4.81d, which yielded different firing conditions that resulted in a darker brown matrix. Also, inclusions within this sample are mineralogically similar to the group but feature more variability in size. Therefore, this sample was probably manufactured from a similar clay, but paste preparation and firing techniques are dissimilar. This might have contextual explanations, since the group is comprised of samples from AB2 and AB3, while this technological subgroup is represented by a sample from AB4.[78] **Group 5** yielded a bi-modal matrix with coarse and very

78 See Chapter 5.3.1 for a description of the location of the different excavation units within Aguas Buenas and their hypothesized chronological differences.

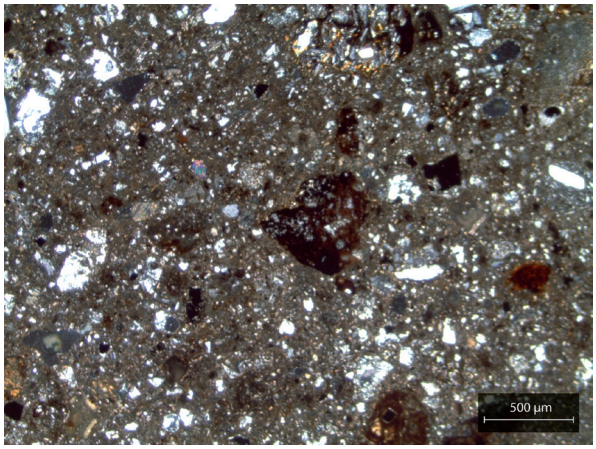

Figure 123: Example of a typical fabric for petrographic Group 5, a bimodal matrix featuring coarse intermediate extrusive volcanic rock inclusions with rare basalt in combination with smaller quartz and plagioclase feldspars. Sample AB2.35.S3 was photographed in XP (credit: Simone Casale).

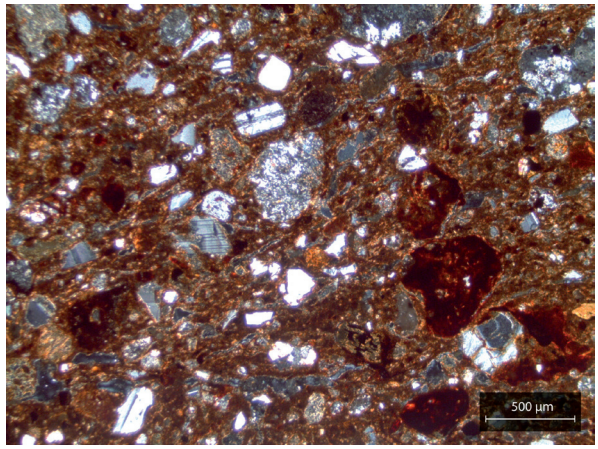

Figure 124: Example of a typical fabric for petrographic Group 6. Sample AB2.57.1 was photographed in XP (credit: Simone Casale).

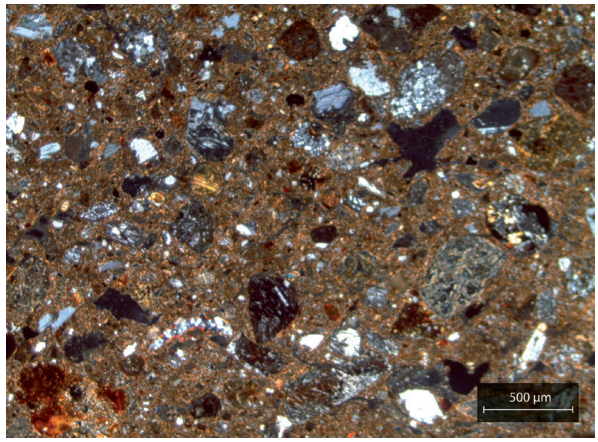

Figure 125: Example of a typical fabric for petrographic Group 7. Sample AB3.90 was photographed in XP (credit: Simone Casale).

coarse subangular to subrounded intermediate extrusive volcanic rock inclusions (500-1600 µm) composed of microphenocrysts of plagioclase and pyroxenes, globular quartz minerals, and reddish-brown inclusions with lamellar plagioclase (**figure 123**).

A distinctive characteristic is that basalts are very rare. Rather, this group is composed of ortho- and clinopyroxene (150-400 µm), subangular to subrounded quartz (usually around 150, but up to 500 µm), subangular to rounded iron-rich minerals (100-500 µm), subangular plagioclase feldspars (usually 200 µm, but up to 500 µm), olivine (150-300 µm), subrounded to rounded volcanic ash (200-400 µm), and glass (200-500 µm). Elongated vughs and vesicles (50-150 µm) were from moderately to not oriented to the walls. Firing temperature was estimated between 650 and 750 °C. **Group 6** featured a mineralogical composition strongly related to andesite, with several coarse to medium inclusions of subrounded to rounded intermediate extrusive igneous origin (200-800 µm), characterized by fine quartz minerals and mainly connected to andesites as well as isolate angular to rounded quartz crystals (300-600 µm) (**figure 124**).

It is distinctive that feldspars are considerably fewer than quartz and always feature angular shapes between 200 and 600 µm, which could suggest limited tempering practices. Elongated voids (150-250 µm) were oriented or moderately oriented to the walls. Firing temperature was estimated between 650 and 750 °C. **Group 7**, the only cluster not containing samples excavated at AB2, is characterized by a coarse to fine matrix with subangular to rounded intermediate volcanic rock inclusions that feature very fine quartz crystals, mostly connected to andesites and (rarely) basalts (500-800 µm) (**figure 125**). Apart from that, angular to subrounded quartz crystals of two different size ranges (100-300 µm, abundant / 500-600 µm, few) and angular to subangular feldspars (150-500

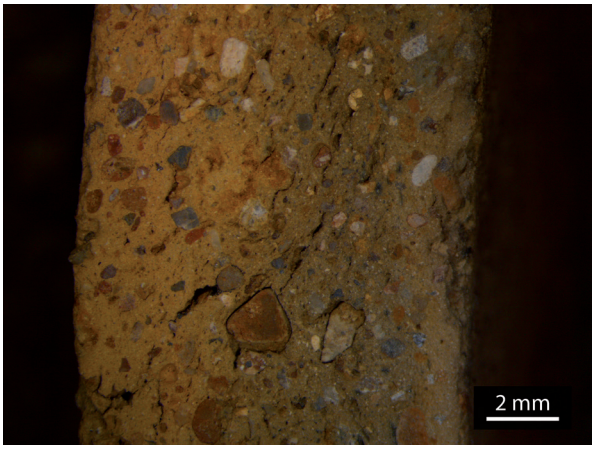

Figure 126: Cross-section from the ceramic assemblage EAB2 featuring coils.

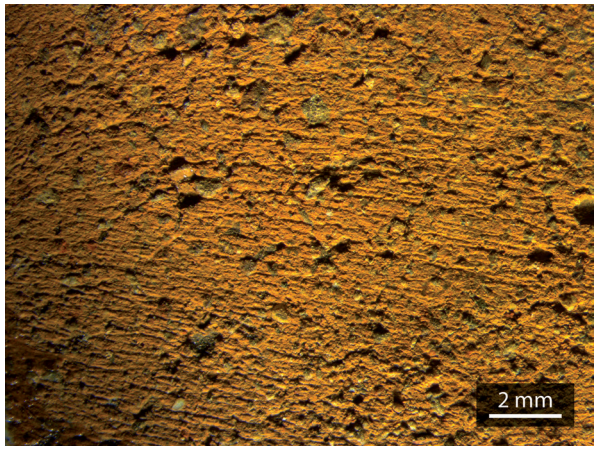

Figure 127: Wet clay traces (prominent grains combined with threaded striations), internal surface of sample AB2.35.S3.

µm) are common. Volcanic ash and glass (200-500 µm) are also commonly identified. Long, elongated voids (100-250 µm) were moderately oriented to the walls. Firing temperature was estimated between 650 and 750 °C.

7.2.2 MACROTRACES OF MANUFACTURING PRACTICES

The general overview of the assemblage suggested preforming through assembled elements, following several lines of evidence. First, the shape of the fragments and orientation of inclusions support coiling as the main fashioning technique. Second, the topography of the sherds is irregular, thinning and thickening at regular intervals, and coil junctures are often visible in cross-section (**figure 126**). Third, excavation unit AB2 evinced a preference for wet clay fashioning and finishing (**figures 127** and **128**), followed by extensive leather hard clay smoothing as surface treatment (**figure 129** and **130**), performed with a soft tool and with an absence of burnishing gestures.

AB3 possibly combined both leather hard clay and wet clay fashioning, but leather hard clay smoothing usually obscures the previous traces of the operational sequence. AB4 also seems to combine different techniques, but poor conservation of surfaces did not allow for a full macrotrace study. For excavation units AB5 and AB6, only a few selected samples were studied, since most of the assemblage featured threshed surfaces that are not suitable for examination.

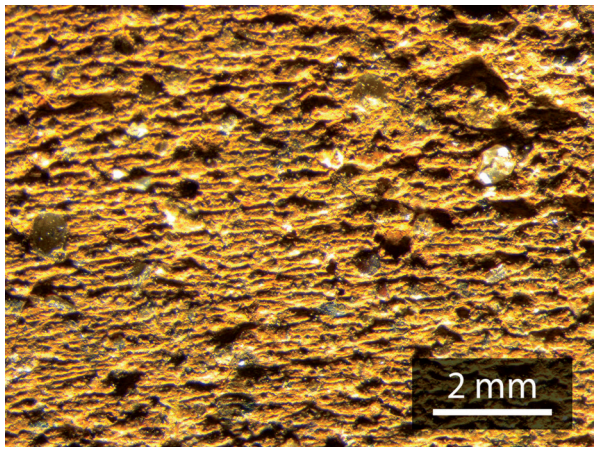

Figure 128: Wet clay traces (prominent grains combined with threaded striations), internal surface of sample AB2.35a.

In general, surface treatment of the Aguas Buenas assemblage is characterized by extremely minimal traces of burnishing (only at AB2 and AB4) and a lot of investment in coating with slips, also featuring combinations of two colors as decoration (mainly at AB2 and AB3, but also one sample from AB4). Other decorative techniques include incisions in both leather hard and wet clay (also one sample from AB6), along with some paint, appliqués, and appendages.

The 43 petrographically characterized samples were also examined for macrotrace identification

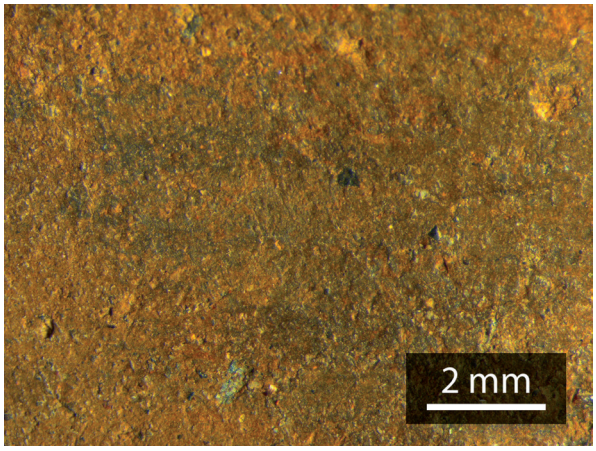

Figure 129: Leather hard clay traces (inserted grains), external surface of sample AB2.35.1.

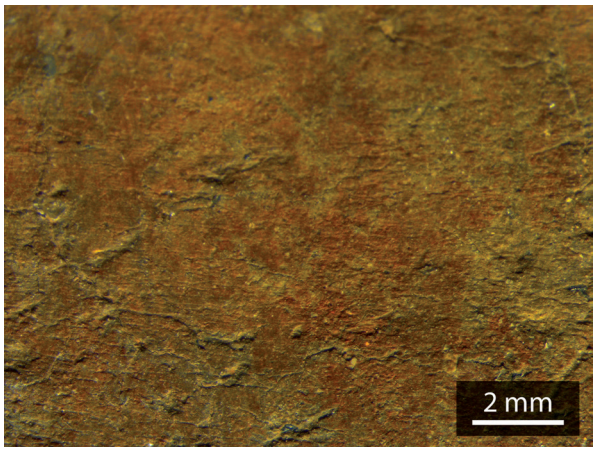

Figure 130: Leather hard clay traces (inserted grains) and red slip, external surface of sample AB2.35.2.

of manufacturing practices. All samples featured fashioning through assembled elements (coils), which measured between 10.0 and 15.0 mm wide in 62.0% of the cases (both restricted and unrestricted shapes, wall width between 3.5 and 11.0 mm), while 26.0% of the coils ranged between 15.0 and 19.0 mm (restricted and unrestricted vessels, wall width 5.0-10.0 mm, one sample 3.5 mm), and 12.0% measured between 7.0 and 9.0 mm (restricted and unrestricted vessels from AB2 and AB3 only, wall thickness 3.5-6.5 mm). Assembled elements were always possible to measure with only one exception, suggesting less intensity in roughing-out gestures.

Coils were positioned equidistantly and in an oblique fashion, either with gestures from the outside to the inside of the vessel (26.0%) or vice versa (31.0%), spiral (12.0%, only in AB2), and alternate (7.0%); in 24.0% of cases it was not possible to assess this gesture. Also, lip coils were positioned either from the outside or inside and were generally the same size as body coils, but occasionally larger. Preforming was carried out mainly through pinching and drawing; 62.0% of samples featured wet clay finishing, either scraping with a soft tool or with the fingers (dry or re-hydrated). It is not possible to determine accurately the technique applied or the specific tool in all of the cases, since surface treatment practices in leather hard clay as well as erosion may have erased almost all evidence of the previous finishing gestures. Leather hard clay gestures for shaping and finishing were identified in 31.0% of the sample and possibly involved shaving and smoothing with re-hydrated fingers. Sample AB2.A2(4)/AB2.57b is of relevance since it might evince the combination of wet clay techniques on the internal surface of the vessel combined with leather hard clay gestures on the external one, suggesting that both practices were shared by the same community of potters. Surface treatment might have erased the variability of these stages in the operational sequence. Striations were frequent, present in 70.0% of samples, and were connected either with wet clay or leather hard clay finishing gestures, leaving distinguishably different traces. Combinations of types of striations and grain position was very useful for sorting out traces. Surface treatment consisted of leather hard clay smoothing with a soft tool, unusual burnishing, and most commonly coating with slips or *barbotine*. Slips varied contextually; AB2 was dominated by red, reddish-brown, brown, white (only present in macrofabric groups AB2.F and outliers), and a unique bright orange that is characteristic of the assemblage (**figure 131**), departing from the red preferences observed within the rest of the sample (including other sites), but combined with a red slip on top of it (**figure 132**).

AB3 featured brown, orange (not bright), reddish-brown, dark red, and white slips, while AB4 yielded minimal coated fragments on red and brown, sometimes applied over a layer of *barbotine*. AB5 and AB6 were too eroded and fragmentary, but the latter yielded a white-slipped fragment. Decorating techniques were usually applied on leather hard clay, with the exception of some incised fragments done in wet clay.

Figure 131: Bright orange slip, characteristic of the AB2 assemblage.

Figure 132: Red-on-orange slip, characteristic of the AB2 assemblage.

Figure 133: Example of a fragmentary annular base (AB2).

Figure 134: Example of an annular base from La Pachona (trench, unit 3, layer I, level 4).

The fragmentation and erosion of the sample prevents a full macrotrace analysis and does not allow for a full reconstruction of the operational sequences of whole vessels. However, at least for AB2, bases were shaped spirally and could include annular bases, which are absent in the rest of the sample (and are characteristic of sites not included in this book, but dated between cal 900 and 1250 CE, such as Sabana Grande, Roberto Amador, and La Pachona) (**figures 133** and **134**). Apart from that, two fragments of bases at AB3 feature a double layer of coils pinched together. Additionally, junctures between different vessel parts yield preferential fractures and sometimes reinforcements, suggestive of the fashioning of vessels in different parts that were assembled after a short drying period.

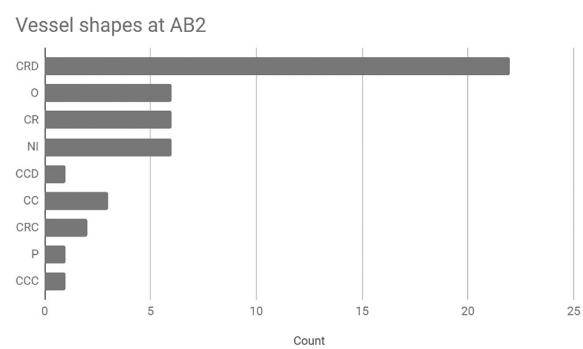

Figure 135: Vessel shapes at AB2.

7.2.3 MORPHOMETRIC ANALYSIS

Due to the sample size, a quantitative assessment of vessel shapes is only possible for excavation unit AB2, which showed a strong tendency towards unrestricted vessels (**figure 135**). This group was dominated by CRD, which measured between 8.0 and 30.0 cm in mouth diameter and had a wall thickness ranging from 4.5 to 8.5 mm. On average, their diameter was 17.2 cm (68.0% <20.0 cm and 32.0% >20.0 cm). The rest of the unrestricted vessels consisted of straight walled jars (CR) with diameters between 17.0 and 45.0 cm, while their walls ranged between 5.0 and 7.0 mm in thickness. Curved jars yielded diameters between 15.0 and 50.0 cm, and their walls ranged between 4.5 and 9.0 mm. Convergent straight walled

jars (CRC) measured between 5.0 and 18.0 cm in diameter, and their walls ranged between 5.0 and 7.0 mm. Also, one large plate was identified, with a 40.0 cm diameter and 4.0 mm wall thickness. The restricted vessels were comprised of only *ollas*, with diameters between 7.0 and 30.0 cm and a wall thickness of 4.0-12.0 mm. Excavation unit AB2 also included six fragments of colanders (see **figure 114**), four corresponding to unrestricted vessels and two to restricted ones. Wall thickness was homogenous, usually measuring between 2.5 and 3.5 mm, with one thick exception (AB2.60, 7.5 mm). Orifice ranges were generally between 2.0 and 2.5 mm, with regular and irregular circular shapes (suggesting different tools and gestures), always crafted from the outside to inside of the vessel. Only one sample featured orifices smaller than 2.0 mm (AB2.39.S1), a choice that might be connected to the vessel use.

For excavation unit AB4, only a CRD of 15.0 cm diameter and 8.0 mm wall thickness was identified, while AB6 featured plates (20.0-40.0 cm diameter, 4.0-5.0 mm wall thickness) and jars (CCO and CRC) measuring 5.0-20.0 cm diameter and 6.0 mm in wall thickness.

Even though excavation unit AB1 was not sampled for analysis, a morphometric assessment was also conducted for comparative purposes, both synchronic (mainly in relationship to excavation unit AB2) as well as diachronic (with units AB4, AB5, and AB6). In spite of a similar proportion between restricted (8.5%) and unrestricted vessels (88.0.0%), the most ubiquitous confirmed shapes at AB1 were *ollas*, with diameters between 7.0 and 15.0 cm and wall thicknesses between 3.0 and 9.0 cm. The unrestricted vessel group was dominated by CRD (15.0-35.0 cm diameter, 4.0-8.0 mm wall thickness), followed by jars (CC, CR, CCC) measuring 15.0-35.0 cm diameter, 3.0-9.0 mm wall thickness.

7.2.4 DECORATING TECHNIQUES

The AB2 sample featured fragments with slipped surfaces—either internal, external, or both—on 71.0% of the sample analyzed. Slips were variable in color, which included red, reddish brown, a bright orange[79] that was distinctive for this assemblage, brown, and white only present in macrofabric group AB2.F and outliers. However, only 15.0% of the samples featured other forms of decoration, which were dominated by coating vessels with a double slip, followed by incisions, appliqué, appendages, painted, and impressed decoration.

Coating with two layers of slips mainly featured red-on-orange (92.0%) applied to external or internal surfaces, sometimes in combination (see **figure 132**). Only two samples—both belonging to the particular AB2.F macrofabric group—yielded red-on-white, while sample AB2.B3(3)/AB2.58 was decorated with an orange slip applied on a previous layer of white slip. Only one fragment (AB2.F3(1)/AB2.57, also within AB2.F) evinced polychromy, achieved through the application of one 3.0 mm wide painted black line on the external surface of the rim, parallel to the lip, while red was applied on the internal surface, all with a white slip base. Incised decoration can be separated into two different groups. The first one featured subparallel incised lines (<0.5 mm) usually done on leather hard clay on the external surface of the vessel, with sample AB2.A1(2)3/AB2.54 as the exception, with incisions cut into the internal surface of the vessel on wet clay, suggestive of a *molcajete* shape. Incisions were as also made as bands of subparallel lines (0.5-1.5 mm), either on external surfaces generally belonging to *ollas*, specially the necks and shoulders, featuring criss-crossed or oblique (geometric) patterns and done either on leather hard or wet clay (**figure 136**). The geometric pattern was the only one identified on internal surfaces, so the criss-cross one is exclusive to *ollas* and to external surfaces. This type of decoration on *ollas* is also present in other sites, such as Sabana Grande, Roberto Amador, and La Pachona.

In two cases, incised and appliqué decoration was combined. Sample AB2.D1(1)/AB2.58.6 featured an applied coil (4.0 mm in height) on the juncture between the base and body/rim of a plate, with subparallel incisions (1.0 mm). Sample AB2.B4(5)/AB2.35 yielded subparallel incisions (<0.5 mm) oblique to an appliqué coil (6.5 mm wide), which could be a reinforcement for assembling another part of the vessel, but smoothing of its surface makes the interpretation unclear. Appendages include mainly annular bases (coils 13.0-15.0 mm wide, only one sample features a thinner 7.0 mm version), but also scars possibly related to supports or handles, as well as one oval support (16 by 20 mm), which also features white slip. One outlier (sample AB2.58) features a possible support or adorno with impressed decoration.

79 Comparable to the one present in sample OP1.176.

Figure 136: Diagnostic incised *olla* from AB2.

Coating with slips at AB3 was present in 80.0% of the samples, while other decoration practices mainly consisted of double slipping, red-on-orange and red-on-white, covering either one or both surfaces, which were identified mainly on macrofabric group AB3.B. Minimal incisions featuring similar techniques to AB2 were identified, and appendages such as lugs and supports were recorded. Fragment AB3.C1(5)/AB3.133 was the only one to feature *acanaladura* in the whole AB assemblage. AB4 yielded only 25.0% of slipped fragments, but this underrepresentation could be linked to conservation issues. One sherd featuring a double slip (red-on-white) was identified at AB4, while a fragmentary sherd with appliqué was observed in the AB6 assemblage.

7.2.5 CERAMIC MANUFACTURING SEQUENCES AT AB

Based on the data analyzed above, two different manufacturing sequences are proposed for the assemblage excavated at Aguas Buenas. The first sequence, AB-I, is related to raw material procurement connected with a basaltic rich source, while AB-II is connected to an outcrop characterized by andesite as the parent material. Within sequence AB-II, subsequences were formed according to paste preparation practices. For example, AB-IIa evinced sieving followed by tempering, whereas AB-IIb suggested only tempering, with both composed of coarse grains. In contrast, AB-IIc consisted of a very coarse fabric that was sorted. Sequences AB-IId and AB-IIe were both very coarse and did not yield evidence of specific paste preparation; yet, their characterization suggests differential procurement choices. A subgroup within sequence AB-IId reconnects with AB-I due to its higher basaltic content.

Operational sequence AB-I

This category corresponds with petrographic Group 3, characterized by its coarse volcanic (basalt) inclusions. The materials were used with no apparent paste preparation practices to produce both restricted and unrestricted vessels (including CRD and *ollas*), of 10.0-30.0 cm in diameter and 4.0-10.0 mm wall thickness. Fashioning involved coils between 1.2 and 1.9 cm, which were positioned in an oblique manner, from inside to outside or vice versa. Lip coils were positioned either from the outside or the inside. Preforming involved pinching and drawing, and finishing was generally undertaken on wet clay, as evinced by the prominent grains and threaded striations on the surface of the sherds. Sample AB2.G1(3)/AB2.56.S2 featured leather hard clay fashioning, indicated by inserted and ejected grains in combination with threaded striations and a compact microtopography. Surface treatment involved leather hard clay smoothing and coating with slips (red or orange). Sample AB2.D3(3)/AB2.58.4 featured incised decoration, comprised of bands of subparallel lines done possibly on wet clay, criss-crossing each other on the external surface of the vessel. The samples were fired in an incompletely oxidized atmosphere at temperatures around 750 °C. This sequence was found in excavation units AB2, AB4, and AB5.

Operational sequence AB-II

This sequence is subdivided according to the presence of paste preparation practices (AB-IIa, AB-IIb, and AB-IIc) and the use of very coarse raw materials without any apparent addition or subtraction of materials (AB-IId, AB-IIe, and AB-IIf).

AB-IIa corresponds to petrographic Group 2, characterized by raw materials that were first sieved and then tempered with quartz and feldspars. End products consisted of mostly unrestricted vessels (CRD and MLC) with diameters between 25.0 and 30.0 cm and wall thicknesses from 6.5 to 8.0 mm. One restricted vessel was possibly identified as well,

with a wall thickness of 7.0 mm. Fashioning involved the assembling of coils between 1.3 and 1.7 cm. Assembled elements were positioned equidistantly and in an oblique manner, with gestures exclusively from the outside to the inside of the vessel, followed by pinching and drawing. Finishing was undertaken on wet clay (prominent grains combined with threaded striations and irregular topography). Surface treatment involved smoothing on leather hard clay, as well as coating with red or orange slips. Only the *molcajete* shape (AB2.H4(3)/AB2.35. S2) featured decoration of bands of subparallel incisions (<1.0 mm) criss-crossing each other on the internal surface of the vessel. Samples were fired in a partial to completely oxidized atmosphere at temperatures below 750 °C. Samples were retrieved from excavation units AB2 and AB4. A subgroup in this cluster (sample AB2.22.2) evinces use of a very similar clay outcrop with an absence of paste preparation practices, while the rest of the operational sequence is similar. However, it yielded thicker walls than the rest of the group (on average 11.0 mm), which could suggest a functional reason for not sieving and tempering the paste.

AB-IIb correlates with petrographic Group 6, which is recognizable by its coarse volcanic inclusions combined with quartz and feldspars, the latter in lower quantities but with angular shapes and regular sizes, suggesting tempering practices. End products consisted of both unrestricted vessels (P and CR) with diameters between 17.0 and 20.0 cm and a wall thickness from 5.0 to 7.0 mm. One possible restricted vessel was identified as well, with a wall thickness of 9.0 mm. Fashioning involved the assembling of coils between 1.1 and 1.6 cm, which were positioned equidistantly and in an oblique manner, with gestures from inside to outside and vice versa, followed by pinching and drawing. Finishing was undertaken on wet clay (prominent grains combined with threaded striations and irregular microtopography). Surface treatment involved smoothing on leather hard clay, as well as coating with red, brown, or white slips. Sample AB6.A1(1)/AB6.112.1 evinced threaded striations combined with protuberant grains (as in AO1), and coating with a white slip was done without leather hard clay smoothing. This is an important difference when taking into account that this is the only sample excavated at AB6, potentially contemporary with AO1. Sample AB2.A3(2)3/AB2.57.1 featured burnishing on its external surface, as well as the combination of red slip on its external surface and brown slip on its internal wall. Samples were fired in a partial to completely oxidized atmosphere at temperatures below 750 °C.

AB-IIc correlates with petrographic Group 4, which is identified by inclusions mainly of volcanic rocks, quartz, and feldspars of regular sizes, suggesting sorting practices. End products consisted of unrestricted vessels (CRD) with a diameter of 10.0 cm and wall thickness of 6.0 mm. The restricted vessel within this group (a CCC or T) featured a 17.0 cm diameter and 3.5 mm wall thickness. Fashioning involved the assembling of coils between 0.7 and 0.8 cm, which were positioned equidistantly and in an oblique manner, with gestures from inside to outside and vice versa, then followed by pinching and drawing. Finishing was undertaken on leather hard clay (inserted grains combined with threaded striations and irregular microtopography). Surface treatment involved smoothing on leather hard clay, as well as coating with a red or white slip; the latter was also burnished. Samples were fired in a partial to completely oxidized atmosphere at temperatures below 750 °C. Sample AB4.G2(1)/AB4.81d was classified as a subgroup because, even though it evinces similar clay procurement choices, paste preparation and firing were noticeably different, with no evidence of sorting and a shorter firing time. Also, coils were significantly larger (1.6 cm), and both shaping and finishing were done on wet clay. Surface treatment was similar to the rest of the sequence, with leather hard clay smoothing and coating with a red slip. Samples were retrieved from excavation units AB2, AB3, and AB4.

AB-IId is consistent with petrographic Group 1—the main cluster within the AB assemblage—mainly composed of coarse volcanic rock inclusions (mostly andesites) combined with iron-rich inclusions. End products consisted almost exclusively of unrestricted vessels (CRD), with diameters between 10.0 cm and 25.0 cm and wall thicknesses ranging between 3.5 and 9.0 mm. The only restricted vessel within this group featured walls 8.0 mm thick. Fashioning involved the assembling of coils between 0.7 and 1.6 cm, which were positioned equidistantly in oblique (from inside to outside and vice versa), alternate, and spiral manners, then followed by pinching and drawing. Shaping and finishing was undertaken either on wet or leather hard clay. Surface treatment involved smoothing on leather hard clay, as well as coating with red and brown slips. Sample AB3. C3(2)/AB3.133.3 featured double coating, with a

red slip on top of a white one, while sample AB2. L1(1)2/AB2.22.S1 yielded an annular base (15.0 mm). Samples were fired in a partial to completely oxidized atmosphere at temperatures below 750 °C. The subgroup within this cluster featured a paste composition with increased amounts of natural basaltic inclusions, which was employed for the manufacture of unrestricted vessels (CCC, CSC, CRD) within the same morphometric ranges as the rest of the vessels in the sequence. Coils were slightly larger, between 1.0 and 1.8 cm, but positioned in a similar manner and also featured pinching and drawing—sample AB2.L3(1)/AB2.57.S2, a sample with annular base (15 mm), also shows evidence of possible crushing of coils. The rest of the sequence is similar, featuring both leather hard clay and wet clay shaping and finishing, leather hard clay smoothing, and red slips. Two samples were also burnished. This sequence was present in excavation units AB2, AB3, AB4, and AB6.

AB-IIe matches with petrographic Group 5, with bimodal medium and very coarse volcanic inclusions. The only confirmed end product of this sequence is an unrestricted vessel (CRD) with a diameter of 20.0 cm and a wall thickness of 3.5 mm. A non-identified restricted shape featured a 7.0 mm wall thickness and an annular base 12.0 mm wide (AB2.L1(1)1/AB2.35.S3). Fashioning involved the assembling of coils between 1.3 and 1.5 cm, which were positioned equidistantly and in an oblique manner, with gestures from inside to outside or spirally. Shaping and finishing was undertaken on wet clay (protuberant grains combined with threaded striations and irregular topography). Surface treatment involved smoothing on leather hard clay, as well as coating with a red slip. Samples were fired in a partial to completely oxidized atmosphere at temperatures below 750 °C. Samples were collected from excavation units AB2 and AB3.

AB-IIf is consistent with petrographic Group 7, which is defined by medium to coarse inclusions mainly of volcanic rocks, combined with medium quartz and feldspars. End products consisted of an unidentified unrestricted vessel with wall thickness of 7.5-9.0 mm, a CCo with 5.0 cm diameter and 6.0 mm walls, and a restricted vessel (CCC) with walls 6.0 mm wide. Fashioning involved the assembling of coils between 1.0 and 1.7 cm, which were positioned equidistantly and in an oblique manner, with gestures from outside to inside, then followed by pinching and drawing. The samples diverged regarding shaping and finishing; while one presented wet clay traces, the other evinced leather hard clay techniques. Finishing was undertaken on leather hard clay (inserted grains combined with threaded striations and irregular microtopography). Surface treatment involved coating with a red slip. Samples were too fragmented and eroded to make further interpretations, although one was also burnished. They were fired in a partially to completely oxidized atmosphere at temperatures below 750 °C. Samples belonging to this sequence were excavated exclusively from units AB6 and AB3.

The assemblage from M1 of Aguas Buenas was not integrated into the analysis due to time restrictions. The operational sequences, however, do show overlap with the ones described above. The major differences are the presence of grog tempering (Casale 2017), *ollas* (in minimal quantities), and one modelled vessel within the assemblage of M1. Additionally, M1 does not feature incised *ollas*, annular bases, colanders, or *molcajetes*, which are all diagnostic of the AB2 assemblage.

Outliers within the assemblage displayed similar variability in clay procurement and preparation practices as the sequences described above. Also, fashioning, finishing and surface treatment were coherent with the rest of the sample analyzed. The main differences are the presence of larger vessels of up to 45.0 cm in diameter, as well as the increased occurrence of decoration techniques.

7.3 JOR

Excavations at this site yielded 1079 ceramic fragments (11465.4 grams). In general, fragments were the largest of the dataset, with an average length of 50.7 mm; 55.2% of the sherds were smaller than the average, while 44.8% were larger. There were two distinct groups of vessels regarding wall thickness: the thin ones, which averaged from 4.0 to 7.0 mm wide, and the thick ones, which measured between 8.0 and 13.0 mm. Moreover, 34.0% of the fragments analyzed corresponded to unrestricted vessels, 50.0% to restricted vessels, and the remaining 16.0% to undetermined shapes. The assemblage features several vessel parts, such as rims, rim/necks, shoulders, shoulder/necks, bodies, bases, handles, and supports. Decorating techniques included incisions, punctuations appliqués, *acanaladura*, and slips (almost exclusively red; only one fragment was white-slipped). Other fired clay objects retrieved in

Figure 137: Seal fragment, JOR2.

these excavations include a bead (17.0 mm diameter, 3.5 mm diameter orifice, unpolished surface), a ball of clay (2.3 cm diameter, with two orifices, not clear if related to bead manufacture or another practice, polished), and a seal fragment (grecas and geometric patterns incised, **figure 137**).

Fragmentation was low, and sherds featured angular edges, suggesting breakage not followed by intense erosive processes. Fragments were of quadrangular, trapezoidal, triangular, and irregular shapes, which are typical from assembled elements fashioning, in particular the coiling technique. Also, sherds featured good conservation, light regular surface colors (brown, dark brown, yellowish brown, orange) that imply a good oxidizing firing atmosphere, as well as some fire marks visible on external surfaces. A total of 451 sherds (7966.6 grams) were sampled from the excavation unit for further analysis.

7.3.1 PASTE ANALYSIS

Macrofabric groups

In total, 63 different macrofabric groups were identified in the sample analyzed, as well as several outliers (see **Appendix 10**). Variability was associated with a combination of grain size and certain textural characteristics, so four to five clay recipes were repeated in each grain size, resulting in a homogenous assemblage. These clay recipes

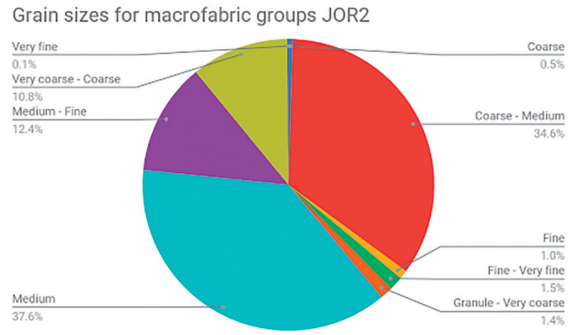

Figure 138: Distribution of grain sizes for macrofabric groups, JOR2.

mainly included feldspars, rock fragments, and quartz, which created ceramic series spanning from granule to very fine despite sharing a similar paste texture, types of inclusions, and voids.

Groups featuring mainly medium grains consisted of 37.6% of the sample, a combination of coarse and medium represented 34.6%, and 10.8% was characterized by very coarse-coarse groups (**figure 138**). Therefore, the samples were characterized as mainly coarse, with an important component of medium grains as well. Frequency of inclusions was ≤ 20.0% in more than 95.0% of the macrofabric groups, so sieving and sorting practices were apparently more common than tempering practices. Apart from that, inclusions tended towards high sphericity and also featured the combination of both high and low sphericity, which points to riverine clay sources with various episodes of transport, both recent and old. The orientation of the inclusions was predominantly chaotic, with oblique and subparallel orientations also occurring, consistent with the coiling technique for preforming vessels. Voids were generally of a plate-like and oval-sphere shape, and their orientation was highly variable, mainly subparallel and oblique.

Regarding firing technology, variability in the core-margin relationship, as well as cross-section and Munsell colors of surfaces, all suggest different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source. These variables explain the range from complete oxidation to different varieties of incomplete oxidation and reduction found in the sample. However, the most remarkable aspect of the

Figure 139: External surface of sample JOR2.95.S1.

Figure 140: Internal surface of sample JOR2.95.S1, featuring charred traces.

assemblage analyzed is the abundance of fire traces that seem to be connected to use-alteration, particularly carbonization processes such as internal encrustrations of charred food as well as external deposition of soot, resulting from the smoke of a fire (Skibo 2013, 190; Forte *et al.* 2018). Apart from occasional dark marks on the external surfaces and more abundant marks on the internal surfaces of vessels, sherds in this assemblage recurrently feature thin, charred encrustations on the internal walls (**figures 139** and **140**). Also, internal carbon deposits were usually transported through the vessel wall, resulting in a cross-section that could be confused with differential firing techniques during the manufacturing process. This phenomenon could be explained, when present on vessel parts connected to the lower body and base, with a wet cooking environment that overboiled, losing moisture and therefore reaching temperatures above 300 °C (Skibo 2013, 191). For upper vessel parts, like shoulders and necks, for example, used in a wet environment (boiling), this could have been the result of food or other materials deposited and charred above the liquid level. Apart from these characteristics, the sample analyzed also showed signs of post-depositional burning, with some sherds charred on old fractures as well as their surfaces.

Since two interphases excavated in JOR2 were interpreted as a possible hearth (IV and IVA), this context may be somehow related to consumption practices involving cooking.[80] However, unlike the rest of the excavation units placed at sites with matching radiocarbon dating results (OP, Sabana Grande, RAI), JOR is the only one that did not yield any zooarchaeological remains. However, the evidence of overboiling cooking practices might partially explain the absence of faunal remains, because cooking bone at such temperatures (above 300 °C) might imply their posterior disintegration (L. Gill, pers. comm.

80 See Chapter 5.3.8.

2019). Therefore, if use-alteration traces on the pots are connected to the lack of faunal remains, then we should think of a cooking context in which the kitchen is kept clean (possibly swiped surfaces), and discard—and maybe also food processing—is done somewhere else. Alternatively, the hearth might have been connected to practices related to the preparation of substances not necessarily related to food, which could explain the contextual differences with the other kitchens excavated. In this sense, it is also important to take into account that the excavation unit was located a few meters away from platform mounds, unlike all the other excavation units related to middens, which were situated right at the foot of the structures. However, units situated within flat, open spaces surrounded by mounds—but away from them, such as OP1, for example—did yield zooarchaeological evidence. Combining all of these possibilities, and of course assuming a possible comparability of the different contexts, we could propose that cooking or preparation of other substances may have taken place off-mound and in between structures—and not necessarily on the open, flat areas surrounded by mounds—while discard was done next to the mounds.

Petrographic Groups

The 26 samples examined through a polarizing light microscope were classified into three petrographic groups, two subgroups, and one outlier (Casale *et al.* 2019). Three samples were impossible to analyze due to a failure during the thin section slide-making procedure that resulting in the ejection of all inclusions.[81] Even though all the groups are connected to volcanic geological settings, their mineralogical content was very distinctive. Also, it seems that paste preparation practices were widespread since all groups show evidence of sieving and sorting practices, as well as the possibility of tempering.

In general, the assemblage analyzed was defined by very coarse, coarse, and medium inclusions of intermediate extrusive igneous rocks (100-1500 µm). Accessory minerals consisted of orthopyroxene (100-300 µm), augite (200-500 µm), quartz (50-1000 µm), iron-rich inclusions (100-500 µm), plagioclase feldspars (50-1000 µm), olivine (50-300 µm) and volcanic ash (100-400 µm). Voids tended towards elongated and vugh shapes (50-250 µm) and did not usually show orientation related to the walls.

81 According to C. Dennett (pers. comm. 2019), this is common in certain ceramics from Rivas.

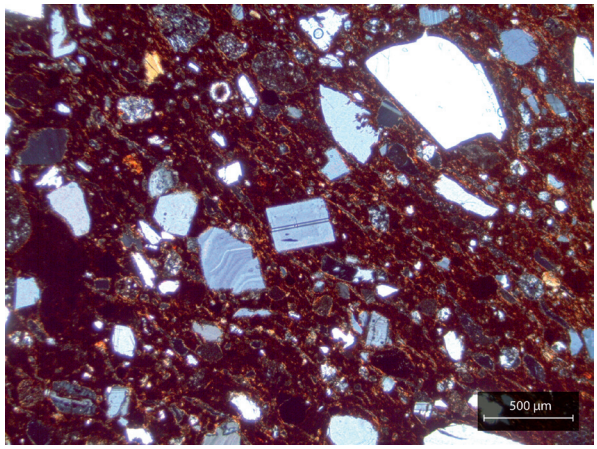

Figure 141: Example of a typical fabric for petrographic Group 1. Sample JOR2.S2(1) was photographed in XP (credit: Simone Casale).

Group 1 (**figure 141**) was characterized by a high frequency of coarse angular to subrounded quartz and plagioclase feldspars (50-1000 µm) in combination with medium-grained intermediate igneous rock fragments (300-500 µm, some coarse up to 1000 µm) connected to andesite, with basalt being absent. Accessory minerals consisted of biotite (100-500 µm), pale yellow olivine (50-100 µm), augite (200-500 µm), and rounded iron-rich inclusions (100-300 µm). Even though it was not possible to assess whether or not some of the inclusions—especially quartz and feldspars—were intentionally added, their angularity and frequency could suggest so. Voids were elongated (150-250 µm) and moderately oriented to the walls. Firing temperature was estimated between 650 and 750 °C.

Group 2, the main cluster within the sample analyzed, is characterized by the combined high frequency of medium to very coarse volcanic rock inclusions between 200-1500 µm, with rare coarse sandstone (500-800 µm), of sedimentary origin, as well as single crystals of quartz (50-400 µm) and plagioclase feldspars (200-600 µm) (**figure 142**). Rock inclusions are divided into two different types, the first of quartz crystals together with interlocked iron minerals, and the second of microphenocrysts of plagioclase, orthopyroxenes and iron minerals. Accessory minerals mainly consist of olivine (50-100 µm). The composition of these fabrics is strongly connected to the Güegüestepe ethnographic sample, but regularity in inclusion sizes suggests the possibility of sieving

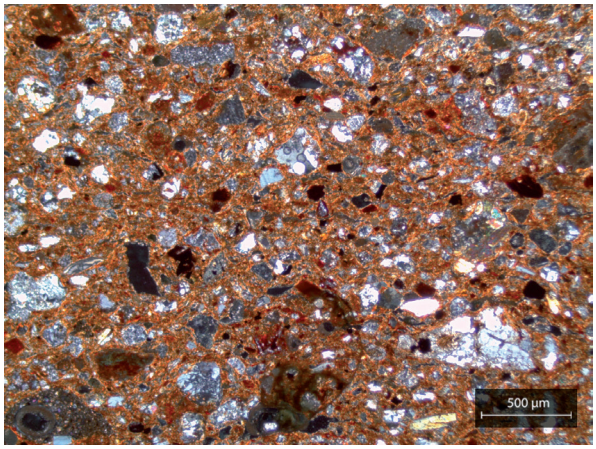

Figure 142: Example of a typical fabric for petrographic Group 2. Sample JOR2.FF4(2) was photographed in XP.

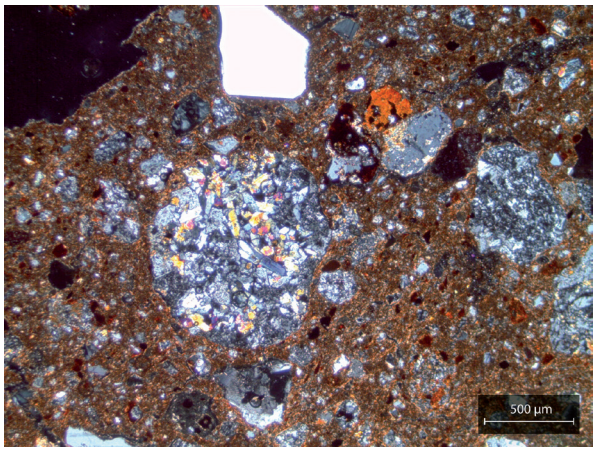

Figure 143: Example of a typical fabric for subgroup within petrographic Group 2 featuring volcanic and sedimentary rock inclusions. Sample JOR2.HH4 was photographed in XP (credit: Simone Casale).

practices. Voids were small and of elongated shape (50-200 µm); vughs were also present, and none were oriented to the walls. Firing temperature was estimated between 650 and 750 °C.

The samples classified within the **subgroup of Group 2** are characterized by volcanic rock inclusions, such as andesite (with microphenocrystals of pyroxene and plagioclase), and basalt in lower frequencies (**figure 143**). Sedimentary rocks, represented by sandstones, were also present, featuring microphenocrysts

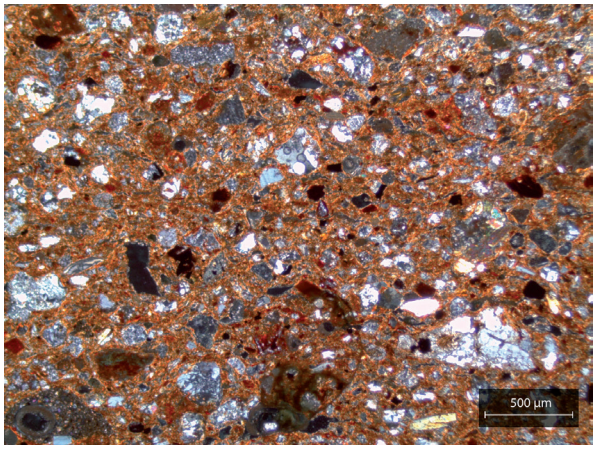

Figure 144: Example of a typical fabric for petrographic Group 3. Sample JOR2.RR4 was photographed in XP.

of quartz. Also, rare quartz crystals (100-400 µm), plagioclase (200-650 µm), and amphibole were identified. Group 2 and its subgroup share mineralogical characteristics; the difference between them is that the main cluster is dominated by both medium-fine and coarse-medium, while the subgroup shows clear preference for medium to coarse inclusions.

Group 3 is dominated by medium to very coarse extrusive intermediate igneous rock fragments (200-1500 µm), mainly made of quartz crystals with iron interlocks; microphenocrysts of plagioclase, orthopyroxenes and iron minerals; basalt with lamellar plagioclase, orthopyroxene, and pale yellow olivine (**figure 144**). Iron-rich minerals (100-500 µm) and clay pellets (200-500 µm) were common, while angular to subangular quartz (150-600 µm) and plagioclase feldspars (100-500 µm) were rare. Accessory minerals were large amphibole (<900 µm), augite (<600 µm), and muscovite/biotite (<700 µm). The absence of single crystals, in contrast to the high frequency of volcanic rock inclusions, may suggest a shorter weathering process and transportation prior to the accumulation and the creation of the deposit but could also be a product of paste preparation practices. Voids were elongated (50-250 µm) and found around coarse inclusions. Firing temperature was estimated between 650 and 750 °C. The **subgroup** within this cluster is characterized by a slightly higher frequency of both quartz and plagioclase feldspars, as well as the presence of olivine (<300 µm) as an accessory mineral. This difference when compared

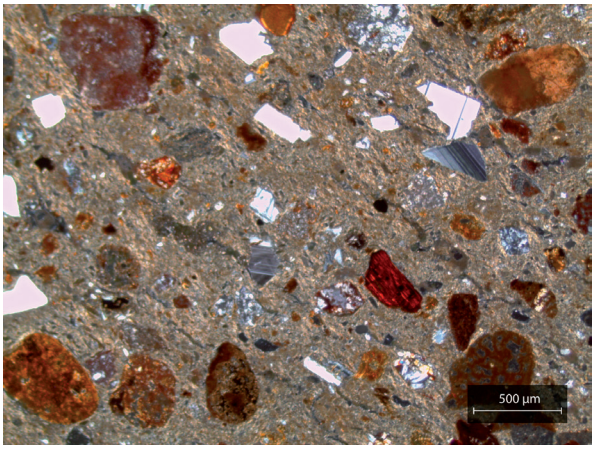

Figure 145: Example of a typical fabric for subgroup within petrographic Group 3. Sample JOR2.E1 was photographed in XP.

to the whole group could be related to tempering practices (**figure 145**).

7.3.2 MACROTRACES OF MANUFACTURING PRACTICES

A general overview of the assemblage suggests preforming through assembled elements based on several lines of evidence. First, the shape of the fragments and orientation of inclusions support coiling as the main fashioning technique, as stated above. Second, topography of several sherds is extremely irregular, with some fragments even featuring undulating surfaces (**figure 146**). Third, coils are visible on the cross-sections of the sherds (**figure 147**).

Figure 146: Example of internal surface with visible coils and preferential fracture (sample JOR2.KKK4).

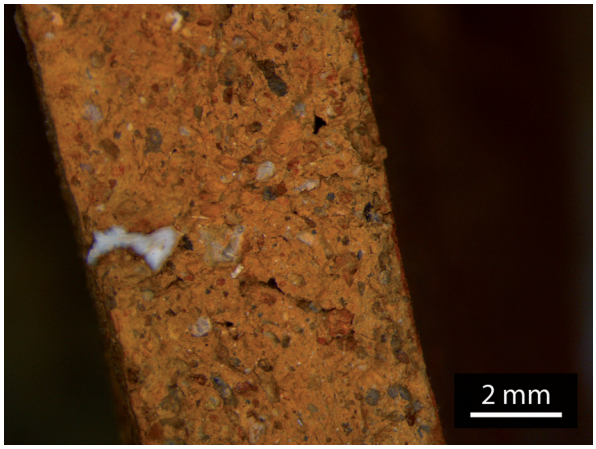

Figure 147: Example of oblique coil juncture visible on the cross-section (sample JOR2.59.1).

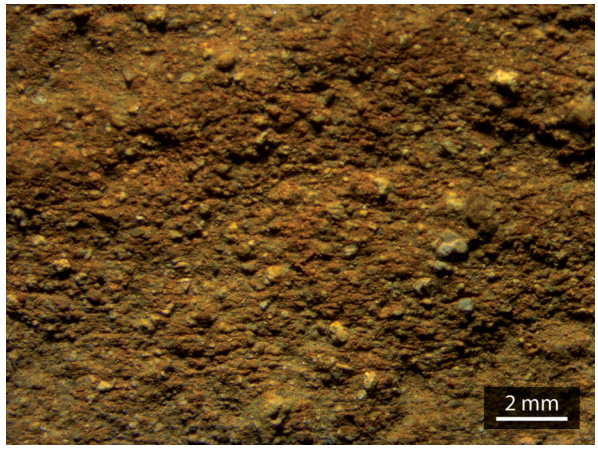

Figure 149: Internal surface of sample JOR2.67, featuring prominent grains in combination with striations, typical of wet clay work.

Figure 148: Internal surface of sample JOR2.R1, featuring the technical diagnostic tool traces common in the JOR2 sample.

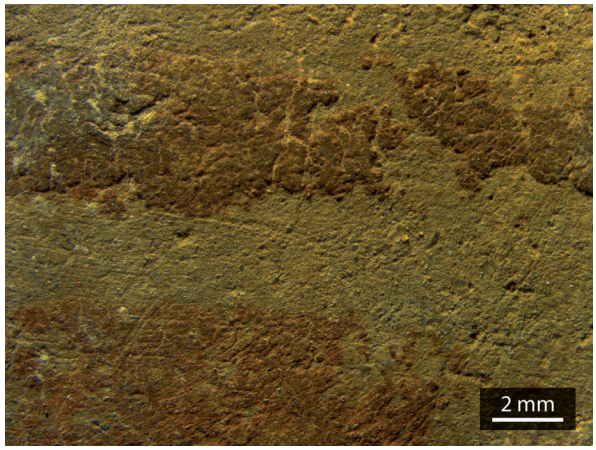

Figure 150: External surface of sample JOR2.25.5, featuring inserted grains and striations typical of leather hard clay work, in combination with a brown slip.

Apart from that, the JOR assemblage is characterized by macroscopic traits related to wet clay preforming, such as the abundance of protuberant and floating grains sensed by simply touching the fragments, combined with visible tool marks that were interpreted as part of the finishing process (**figure 148**). Such marks are usually found, but not exclusively, in the internal walls of the vessels.

Wet clay finishing techniques possibly applied a small tool, as well as hand and finger gestures; the traces related to these practices consist of the combination of protuberant grains with striations and fluid topography (**figure 149**). However, leather hard clay smoothing was also common and is evinced by surfaces with inserted grains and a compact topography that very usually obscures previous steps of the manufacturing sequence (**figure 150**). Coating vessels with slips was a common practice, and some of them were also burnished afterwards.

The 26 samples submitted to petrographic characterization were thoroughly examined for macrotrace identification of manufacturing practices

(see **Appendix 10**). All samples featured fashioning through assembled elements (coils), which measured between 1.0 and 1.5. cm wide in 73.1% of cases (both restricted and unrestricted shapes, wall width between 5.0 and 15.0 mm), while 19.2% ranged between 1.6 and 2.5 cm (mostly unrestricted vessels, wall width 7.0 to 13.0 mm), and the rest had coils measuring below 1.0 cm. Assembled elements were always possible to measure—except for one very small fragment—which, together with very irregular topographies, is a trait that suggests less investment in roughing-out gestures.

Coils were positioned equidistantly and in an oblique fashion (see **figure 147**), either with gestures from the outside to the inside of the vessel (60.0%) or vice versa (40.0%). Bases were possibly assembled positioning the coils as a spiral. Lip coils were always placed with gestures from the outside to inside of the vessels and were generally the same size as body coils, but occasionally bigger or smaller.

Preforming was carried out through pinching and drawing, and all samples except for three featured wet clay finishing, scraping with a tool and/or with the fingers. It is not possible to determine accurately the technique applied or the specific tool since surface treatment practices in leather hard clay erased almost all evidence of finishing gestures. However, identification of prominent grains, combined with striations, suggest wet clay techniques. Striations were frequent, represented in 65.0% of the samples, and were either connected with wet clay finishing gestures or burnishing, leaving distinguishably different traces (see **figures 148, 149,** and **150**). Striations from scraping were usually found in internal surfaces (**see figure 148**), suggesting the use of the tool and possible support with the other hand holding the external surface of the vessel wall. Some samples featured traits that could relate to leather hard clay finishing techniques, but this could not be confirmed due to the erasure of traces caused by surface treatment. Surface treatment consisted of coating with slips and *barbotine*, leather hard clay smoothing, and occasional burnishing. Slips were primarily red, but orange and brown were also identified. Slipped surfaces were very seldomly burnished.

Fragmentation of the sample and absence of full vessels complicates a thorough macrotrace analysis. However, vessels were possibly constructed separating the different sections (base, body, neck/rim), all involving the coiling technique and gestures connected with wet clay roughing out and preforming, followed by leather hard clay surface treatment and firing in oxidized atmospheres without much control.

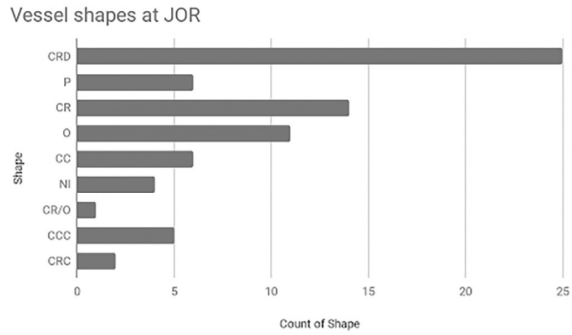

Figure 151: Vessel shapes at JOR2.

7.3.3 MORPHOMETRIC ANALYSIS

Vessel shapes at JOR were homogenous (see **Appendix 10**). Even though the largest group of forms, when analyzing the whole sample, were restricted (**figure 151**), rims overrepresent unrestricted vessels probably due to their higher rim:body ratio. The confirmed unrestricted vessel group was dominated by *ollas*, which measured between 4.0 and 22.0 cm in the diameter of the mouth, with wall thicknesses ranging from 5.0 to 10.0 mm. On average, their diameter was 14.1 cm (63.6% <15.0 cm, and 36.4% >15.0 cm). Within the unrestricted vessel group, the most common shapes are outflaring straight walled jars (CRD), featuring diameters between 8.0 and 45.0 cm (more than 50.0% within the 20.0-25.0 cm diameter rage), with wall thicknesses ranging between 3.5 and 10.5 mm. Straight walled jars (CR) have diameters between 14.0 and 45.0 cm, while their walls range between 5.0 and 10.5 mm in thickness. Curved jars (some convergent) yielded diameters between 20.0 and 35.0 cm, and their walls range between 4.0 and 8.0 mm. Convergent straight walled jars (CRC) measured between 20.0 and 22.0 cm in diameter, and their walls ranged between 5.0 and 6.0 mm. Also, several plates were identified, with diameters between 11.0 and 30.0 cm, and wall thicknesses between 4.0 and 7.5 mm. In summary, 58.1% of the shapes featured diameters between 15.0 and 25.0 cm (mainly CRD, but all shapes represented), 17.5% between 26.0 and 39.0 cm (mainly CR, but also CCC, CRD, and CC),

Figure 152: Circular appliqué decoration, external surface of sample JOR2.62.

Figure 153: Sample JOR1.RR4, featuring incised decoration on the exterior surface, particularly on the shoulder of an *olla*.

9.4% between 10.0 and 14.0 cm (mainly *ollas*, but also CRD, CR, and P), 6.8% had diameters below 9.0 cm (O and CRD), and 5.4% between 40.0 and 45.0 cm (CRD and CR exclusively). In 2.8% of the cases, diameters were not calculated due to the fragmentation of the sample, which consisted exclusively of CRD.

7.3.4 DECORATING TECHNIQUES

Fragments with slipped surfaces—either internal, external, or both—consisted of 44.0%, while other decoration practices were present in only 7.0% of the sample analyzed and consisted mostly of appliqué, paint, incisions impressions, double slip, punctuation,

Figure 154: External surface of sample JOR2. JJJ3, featuring the scar of a support.

Figure 155: Internal surface of sample JOR2. JJJ3 (identified as León punteado), featuring red slip, punctuations, and an *acanaladura* on the

Figure 156: Sample JOR2.68.1, featuring impressions below the rim that are similar to the Carca style rims.

and *acanaladura*. Appliqués were mostly comprised of circular shapes added onto the external walls of unrestricted vessels (diameter between 8 and 11 mm, see **figure 152**), whereas incisions consisted of geometric bands of parallel thin lines (<1 mm) oblique to each other, positioned below the rim, performed with a sharp tool on wet clay (**figure 153**).

Even though incisions were usually performed on the external walls of the vessels, there are some examples of flat vessels that featured the incisions or punctuations on the internal wall of the vessel, suggesting some sort of *molcajete* use, possibly for grinding soft products. Decorating techniques were sometimes applied in combination, such as appliqué with impressions, where coils were added perpendicular to the vessel base and then impressed with the finger or a tool to create circular patterns that resemble a rope. *Acanaladura* was present in two fragments; in the first, it was applied on the lip in combination with punctuation at the center of the internal wall of the vessel (**figures 154** and **155**, identified as the León Punteado type), and in the second example, it was performed to create different surfaces of different wall width.

Figure 157: Sample JOR2.45.5, featuring black paint on a red slip.

Figure 158: Sample JOR2.39, featuring the central coil.

Figure 159: Sample JOR2.39, featuring the two braided coils.

Apart from that, one sample resembled a Carca rim (see left, **figure 156**), but its identification was difficult due to the rough finish of the fragment. Only one sherd featured double slip (red-on-orange), while several fragments showed black paint on red slip (**figure 157**), and one was decorated with parallel bands to the base of brown paint on a white slip. Appendages consisted of a very particular braided handle (**figures 158** and **159**, JOR2.39), manufactured with two coils of 1.4 cm diameter each, which vaguely resembles a diagnostic handle attributed to the Cuapa phase (Gorin 1990, 483, figure VII 91e), as well as another plain cylindrical handle and one cylindrical support.

7.3.5 CERAMIC MANUFACTURING SEQUENCES AT JOR

Based on the data analyzed above, three different manufacturing sequences are proposed for the assemblage excavated at JOR2.

Operational sequence JOR-I

This sequence entails petrographic Group 1, which is characterized by a high frequency of coarse angular quartz and feldspars combined with medium grained intermediate igneous rocks (andesite). The end products of this sequence consist of unrestricted vessels (CC and CRD) with 6.0-7.0 mm walls and 20.0-25.0 cm diameter. Paste preparation apparently involved tempering practices, and then coils of around 1.1 cm wide were positioned equidistantly with gestures both from outside to inside and vice versa. Lip coil was positioned from the outside and was either the same size or smaller than the body. Preforming involved pinching and drawing, followed by wet clay finishing (one sample could have been finished on leather hard clay, but evidence is too fragmentary and surface treatment erased the traces, making it difficult to asses). Surface treatment consisted of leather hard clay smoothing and the application of slips (red and brown). The samples were fired in an incompletely oxidizing atmospheres at temperatures below 750 °C.

Operational sequence JOR-II

This category corresponds to petrographic Group 2 and its subgroup, which are characterized by the combination of both extrusive intermediate volcanic rock and sedimentary rock inclusions, as well as paste preparation practices that might have involved sieving and tempering. After paste preparation, the sequence divides into two subsequences. The first one (JOR-IIa) involves the manufacture of both unrestricted (CR, CC) and restricted (CRC) vessels with a diameter between 20.0 and 28.0 cm and wall thickness between 3.5 and 6.5 mm. The second subsequence (JOR-IIb) focuses on producing both restricted (*ollas*, *tecomates*) and unrestricted (CRD, CR, CC) vessels with diameters between 25.0 and 45.0 cm and wall thicknesses between 7.0 and 13.0 mm. After paste preparation, both subsequences share the same steps, starting with coils between 1.0

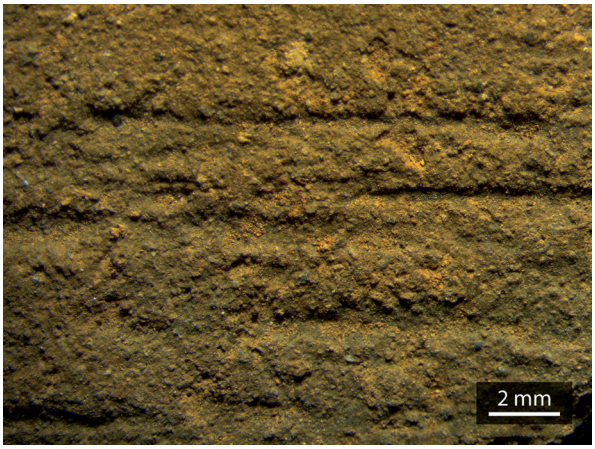

Figure 160: Internal surface of sample JOR2.25.1, featuring traces interpreted as the result of brushing.

and 1.65 cm (only two exceptions, one 0.7 cm and the other one 2.5 cm), which were positioned in an oblique manner, usually from outside to inside gestures, but vice versa in a few cases. Lip coils were placed from outside to inside and were usually the same size as body coils, with some exceptions either larger or smaller. Preforming involved pinching and drawing, done in a manner that left an undulating sherd topography. Finishing was undertaken on wet clay (prominent grains) with an apparent combination of tool and hand/finger use, a technique that usually left striations. Tool marks were exclusive to the internal walls of the vessels, lacking traces on the external surface. This could be related to finishing gestures, such as positioning the tool within the vessel while holding the external surface with the free hand. One sample (**figure 160**) also showed brushing traces, which was observed in a few sherds within the assemblage and were possibly done with straw or a corn cob.

Apart from leather hard clay smoothing, surface treatment also involved the application of a red or brown slip. Bases were apparently fashioned spirally and constructed separately from the vessel body, possibly as a first action. Samples from both subsequences were fired in an incompletely oxidized atmosphere at temperatures ≤750 °C. The most common context in which these samples were excavated were floor surfaces, with a couple of fragments being derived from features (a hearth and a clay deposit).

Operational sequence JOR-III

The JOR-III sequence is associated to petrographic Group 3 and its subgroup, which are characterized by a high frequency of volcanic rock inclusions combined with an absence of single crystals. Paste preparation practices might have involved some tempering, especially within the subgroup. Two different vessel types were built using this paste. The first one included unrestricted vessels (one plate, one non-identified, one possible restricted vessel) with wall thicknesses ranging from 5.5 to 6.0 mm shapes of at least 11.0 cm diameter, and coils between 1.2 and 1.5 cm. The second type of vessel consisted of restricted (*ollas* and NI) and unrestricted vessels (NI) with walls between 9.0 and 15.0 mm, with unknown diameters (one sample was 35.0 cm, but the rest were not large enough fragments to calculate diameters). Coils measured between 1.5 and 2.5 cm. In both vessel types, coils were positioned equidistantly in an oblique manner, usually from inside to outside gestures, but also vice versa in a few cases. Lip coils were placed from outside to inside and were the same size as body coils. Preforming involved pinching and drawing, usually leaving irregular surfaces (with one exception). Finishing was done on wet clay (prominent grains) with the use of a tool, and maybe combined with hand/finger gestures, often leaving striations. Surface treatment involved coating with red slips or *barbotine*, as well as leather hard clay smoothing. One rim was apparently impressed, producing a vague resemblance to the Carca style rims (**see figure 156**). Samples were fired in an incompletely oxidized atmosphere at temperatures ≈750 °C. The dominant context in which these samples were excavated was floor surfaces, with a couple of fragments deriving from features (a hearth and a clay deposit).

The only outlier within the sample analyzed (JOR2.Y3/JOR2.25.5) yielded a completely different operational sequence, with a distinct mineralogical paste composition and roughing-out that involved almost the complete erasure of small coils (0.4 - 0.7 mm)—in contrast to the several sherds featuring extremely irregular surface topographies—followed by unknown fashioning and finishing techniques, the application of parallel bands of brown paint on a white slip, and burnishing of the internal surface.

7.4 OPORTA

The three excavation units placed at the site yielded 1266 ceramic fragments (8130.7 grams). On average, sherds were large, with an average length of 37.8 mm; 53.4% of the sherds were smaller than the average, while 46.6% were larger. Wall thickness averaged between 6.0 and 10.0 mm, with two distinct groups; one ranged between 6.0 and 8.0 mm wide, while a second ranged between 8.0 and 10.0 mm, with extremes exceeding 10.0 mm. Moreover, 34.2% of fragments corresponded to unrestricted vessels, 45.3% to restricted vessels, and the remaining 20.5% to undetermined shapes. The assemblage features several vessel parts, such as rims, rim/necks, shoulders, shoulder/necks, bodies, bases, one handle, and numerous supports. Surface treatment involved coating the vessels with slips, and decorating techniques included incisions, appliqués, punctuation, paint, and impression. Fired clay was also used for making beads as well as clay balls (**figures 161** and **162**). One of the clay balls (**figures 161** and **162**, center) is polished in the outside, features a clean cut in the middle and traces of work in the center, and is similar to the other polished clay ball (**figures 161** and **162**, left) that looks like an unfinished bead due to an orifice. However, this might be due to a flaw in the production process. It is also possible that these two samples were actually employed as tools—polishers, for example. However, the orifice at the center of sample OP1AX5 (**figures 161** and **162**, left) strengthens the bead hypothesis. The distinct finished bead (**figures 161** and **162**, right) is identical to the ones found at La Pachona, both in style and technology, measuring 4.0 mm in diameter and having a 1.0 mm orifice.

Fragmentation was high, and sherds featured subangular and subrounded edges, two characteristics that, when combined, could indicate post-depositional trampling and erosion. Fragments were generally quadrangular, triangular, or trapezoidal in shape, which are typical for assembled elements fashioning, in particular the coiling technique. Also, sherds were relatively well-preserved, with very few eroded surfaces, visible slips (on 77.5% of the sample analyzed) and surface treatment, compact texture, and not breakable by finger pressure. The assemblage featured darker tones than other sites, with generally brown surfaces, and in lower quantities also orange, with light colors (light brown, light orange, yellowish light brown) occurring occasionally. Very rarely, fire marks related to cooking practices were visible on the outside surfaces (less than ten sherds in the whole sample. The assemblage also features several samples with carbonized internal surfaces. Also, some sherds feature a firing atmosphere without oxygen, with very dark cross-sections, as well as differential firing. Additionally, some sherds are so compact that, when hit against each other, they produce a metallic sound. This, together with the lack of fire marks related to production, suggests knowledge of firing conditions, duration, temperature, use of fuel, effects on the end product, and the possible use of some sort of kiln. Therefore, they were possibly fired

Figure 161: Clay balls (left, center) interpreted either as polishers or beads, and a bead identical to the ones recorded at La Pachona (right).

Figure 162: Clay balls (left, center) interpreted either as polishers or beads, and a bead identical to the ones recorded at La Pachona (right).

at low temperatures (approximately 650 to 750 °C) in a controlled environment. A total of 329 sherds (3035.2 grams) were sampled from excavation unit OP1 for further analysis.

7.4.1 PASTE ANALYSIS

Macrofabric groups

The analyzed assemblage was classified into 40 different macrofabric groups that formed several homogeneous ceramic series (see **Appendix 11**). The same clay recipes, which mainly featured feldspars, clay pellets, red and black iron ores, volcanic rock inclusions, quartz, and dark mica, were combined in diverse sizes and textures. The ceramic series span from very coarse to very fine-silt but share similar paste textures, types of inclusions, and voids in the different grain size options. The variability between the clays might be connected to a multiplicity of geologically similar clay sources or to differential paste preparation and firing practices.

The groups were dominated by multimodal, very coarse and coarse grain sizes, with minimum amounts of fine sherds (**figure 163**). Frequency of inclusions was equal or higher than 20.0% in more than 85.0% of the macrofabric groups, and very angular to subangular inclusions were common in the assemblage, so it is possible that sieving and sorting practices were not very common. Also, it is possible that tempering was common in the production of ceramics. Apart from that, inclusions tended towards high sphericity, which points to riverine clay sources with various episodes of transport and erosion, combined with more recent episodes, which could be an alternative explanation for the angularity of inclusions. The orientation of the inclusions was usually subparallel, concentric, and oblique, as well as chaotic, which are consistent with the coiling technique for preforming vessels. Voids were generally of a plate-like and oval-sphere shape, and their orientation was highly variable (mainly subparallel, but also chaotic, horizontal, and oblique in relationship to the vessel walls).

Regarding firing technology, the variability in the core-margin relationship as well as cross-sections and surface Munsell colors suggests different temperatures, duration of firing, and position of the vessel (or vessel part) in relation to the fuel source. This positioning would explain a variability ranging from complete oxidizing atmospheres to different varieties of incomplete oxidation, as well as reductive atmospheres. Even though no kiln structures were identified at the site, after careful examination of vessel

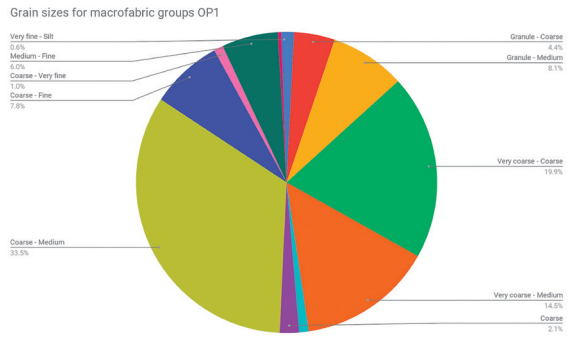

Figure 163: Grain sizes for macrofabric groups OP1.

surfaces and cross-sections, results suggest that firing took place with fuel and fire being separated from the vessels. It could have been in open hearths, but with excellent control of temperature and management of fire, desired temperature and duration to get the expected results. One such example of successful firing technology management is evinced by samples that were perfectly and possibly purposefully smoked exclusively on the inside walls of the vessels, meaning that the pot was fired in an oxidizing atmosphere, but its mouth was either covered or buried upside down for reduction effects. These smoked surfaces were usually burnished, taking advantage of the dark colors achieved. Additionally, other samples appeared to have been covered over after being exposed to an oxidizing atmosphere, reduction of oxygen, and differential firing.

Petrographic Groups

The 23 samples examined through a polarizing light microscope were classified into six petrographic groups, and seven sherds were identified as outliers, since their main characteristics did not match any of the groups. Taking into account the small sample analyzed, variability in paste choices, preparation practices, and firing techniques was relatively high, and it matches the macrofabric assessment, which also pointed to significant variability, with 40 different groups plus outliers identified within a total of only 329 sherds.

In general, the assemblage analyzed was defined by very coarse to coarse inclusions of intermediate igneous rocks (100-4000 µm), both intrusive and extrusive; the former was uncommon not only at this site, but also in comparison to other sites. Accessory minerals consisted of pyroxene (both ortho and

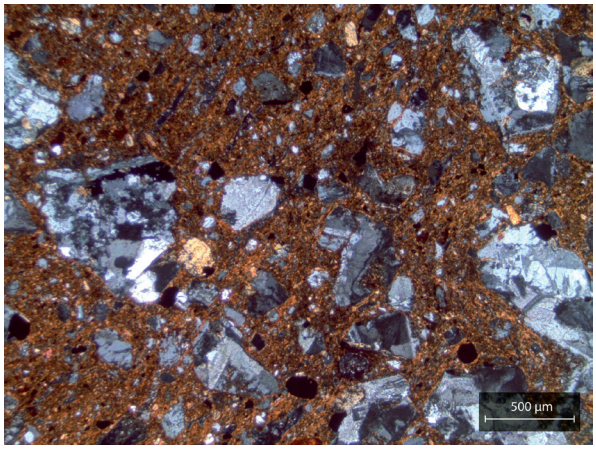

Figure 164: Example of a typical fabric for petrographic Group 1 featuring inclusions with large crystals connected to intrusive igneous rocks. Sample OP1.10.1 was photographed in XP (credit: Simone Casale).

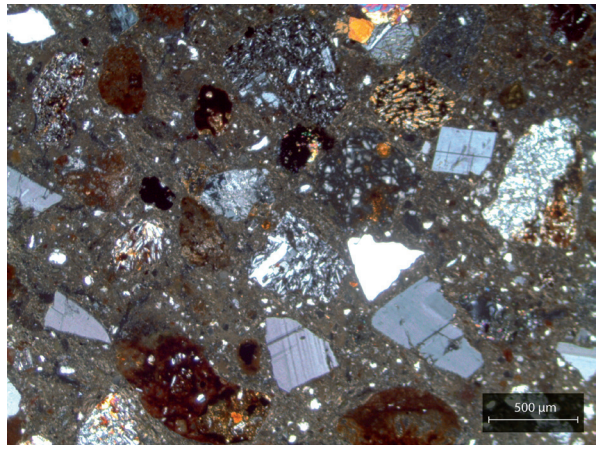

Figure 165: Example of a typical fabric for petrographic Group 2 featuring coarse volcanic rock inclusions, pyroxenes, plagioclase, and quartz. Sample OP1.139.2 was photographed in XP (credit: Simone Casale).

clino, 200-500 µm), quartz (50-1000µm), plagioclase feldspars (100-600 µm), volcanic ash and glass (100-700 µm), and iron-rich inclusions (100-500 µm). Voids tended towards elongated shapes, but vughs and vesicles were also present; orientation was variable, sometimes moderately oriented in relationship to the walls, coils, and coarse inclusions or not oriented.

Group 1 was characterized by a high frequency of very coarse angular and subangular intermediate igneous rock fragments (200-1000 µm, up to 2000 µm), mostly comprised of quartz and feldspars. The combination of the coarse crystals within the inclusions, the yellowish pale olivine, the sericite and the dark minerals—possible spinel—suggest that the inclusions with large crystals are connected to intrusive igneous rocks rather than extrusive, which is a unique characteristic within the sample analyzed (**figure 164**). Within the regional geology, the formations around La Libertad (25 km northeast of Juigalpa) contain intrusive igneous rocks. Apart from that, the fresh fracture of the igneous rocks, together with their high frequency, could suggest tempering practices. In contrast, the fine-grained inclusions seem to be linked to volcanic rocks.

Group 2 is characterized by unsorted intermediate extrusive igneous rocks (100-3000 µm), basalt and andesite, with microphenocrysts of plagioclase and other accessory minerals, such as pyroxene (ortho and clino, 200-500µm), quartz (200-600µm), iron-rich inclusions (100-500 µm), volcanic ash and glass (200-500 µm) (**figure 165**).

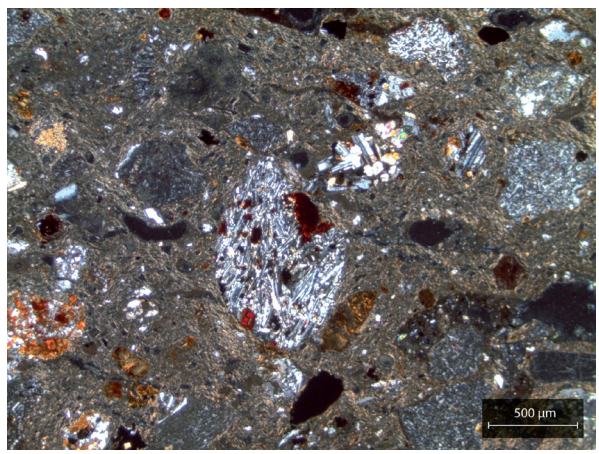

Figure 166: Example of a typical fabric for petrographic Group 3 featuring basalt inclusions with magnetite and titanate, as well as yellow pale olivine. Sample OP1.159 was photographed in XP (credit: Simone Casale).

Group 3 is defined by basalts (300-1400 µm) containing lamellar plagioclase and potassium feldspars, as well as olivine and iron-rich inclusions (200-1000 µm), microphenocrysts of plagioclase and pyroxenes (350-500 µm), coarse quartz, and iron-rich minerals (**figure 166**).

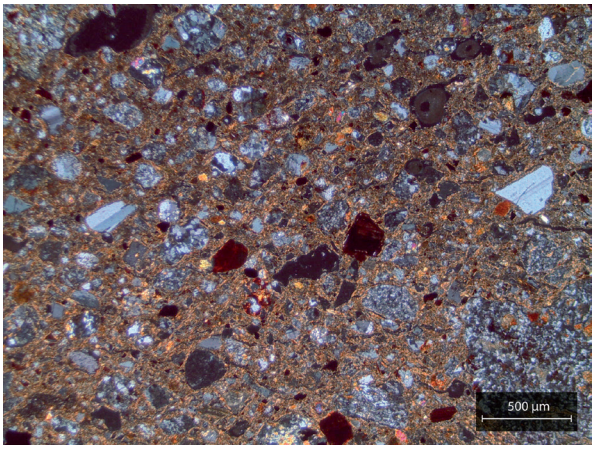

Figure 167: Example of a typical fabric for petrographic Group 4. Sample OP1.169.1 was photographed in XP (credit: Simone Casale).

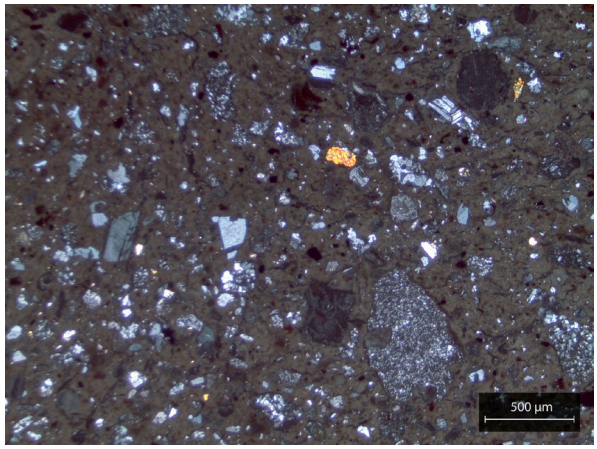

Figure 168: Example of a typical fabric for petrographic Group 5, featuring coarse inclusions with microphenocrysts of quartz, as well as single crystals of quartz, plagioclase, and amphibole. Sample OP1.85.S1 was photographed in XP (credit: Simone Casale).

One of the samples within this group (OP1.65.1) was probably sieved and tempered with coarse basalt fragments. **Group 4** was characterized by basalt inclusions with lamellar plagioclase, pyroxenes and pale yellow olivine (200-1300 µm), microphenocrysts of plagioclase, pyroxenes and globular quartz minerals (300-600 µm). The volcanic inclusions present intergrowth iron-rich minerals (magnetite or spinel). Accessory minerals consisted of olivine (100-200 µm), augite (150-200 µm), pyroxenes (ortho 400-600 µm, clino 150-200 µm), quartz (150-1000 µm), plagioclase euhedral crystals (200-500 µm), and iron-rich inclusions (90-350 µm) (**figure 167**). This petrographic group is connected to the Güegüestepe ethnoarchaeological sample.

Group 5 is characterized by smaller inclusions than the rest of the groups, ranging from medium to coarse sizes (200-800 µm). Samples contained intermediate extrusive igneous rocks, including microphenocrysts of plagioclase and orthopyroxenes (200-4000 µm), quartz (500-800 µm), rare basalt with lamellar plagioclase, olivine, and pyroxenes (600 µm) (**figure 168**). Quartz, potassium, and plagioclase feldspar inclusions—not within volcanic rock ones—featured fresh subangular edges and measured between 200 and 500 µm. Iron-rich inclusions were also present.

Group 6 was characterized by intermediate extrusive igneous rocks associated with inclusions between 200 and 1000 µm, such as polycrystalline quartz with intergrowth dark minerals, olivine, microphenocrysts of plagioclase, pyroxenes, and iron-rich alkali-based olivine rich basalts (200-1500 µm). Inclusions usually showed sericite alteration on their surfaces (**figure 167**). Accessory minerals consisted of iron-rich inclusions (100-500 µm), olivine (100-200 µm), and volcanic ash and glass (200-700 µm) (**figure 169**).

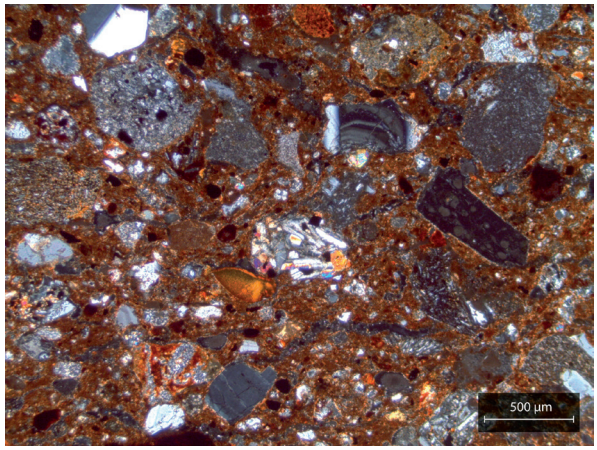

Figure 169: Example of a typical fabric for petrographic Group 6, featuring an alkali-based olivine-rich basalt inclusion, together with volcanic inclusions with microphenocrysts of feldspars. Sample OP1.169.2 was photographed in XP (credit: Simone Casale).

Outliers featured a high variability in their mineral composition (Casale *et al.* 2019), as well as in paste preparation practices. In particular, sieving and tempering practices were observed (i.e. sample OP1.62.1 features grog), as along with traces of hydrothermal alterations in the clay outcrops. Additionally, some samples (OP1.85 and OP1.139.1), with their high contents of volcanic glass and ash respectively, may indicate divergent provenances.

Firing technology was highly variable in the sample. Even though all the petrographic groups featured non-calcareous matrices of different colors, Groups 1, 2, 4, 5, and 6 were optically active, while Group 3 was optically inactive. In addition, outlier OP1.85.1 was slightly active.

7.4.2 MACROTRACES OF MANUFACTURING PRACTICES

An overview of the analyzed assemblage suggests preforming through assembled elements based on several lines of evidence. First, the shape of the fragments and orientation of inclusions supports coiling as the main fashioning technique, as argued above. Second, the topography of the sherds is irregular, thinning and thickening at regular intervals—possibly following the coil's thicker parts. Third, coils are usually visible in cross-sections of the sherds (**figure 170**).

The general first impression of the assemblage suggests a preference for a leather hard clay environment for preforming and surface treatment—evinced by the occurrence of inserted grains, for example. However, it is possible that traces of the earliest steps of the manufacturing sequence were erased by later gestures. After macroscopic inspection of the different macrofabric groups, data pointed to wet clay preforming followed by leather hard clay surface treatment. In particular, the wet clay preforming implied the use of a tool that left wide marks (between 7 and 10 mm wide, gestures parallel to the vessel rim—possibly circular—maybe done with a small scraper) (**figures 171** and **172**). Fine parallel striations (maybe a pumpkin shell or something similar) were also common (**figure 173**). Finally, surface treatment involved, apart from smoothing on leather hard clay as previously stated, coating with clayish slips (**figure 174**) and burnishing.

The 23 samples submitted for petrographic characterization were also thoroughly examined for macrotrace identification of manufacturing practices (see **Appendix 11**). All samples featured fashioning through assembled elements (coils), which measured between 1.0 and 1.5 cm wide in 60.9% of the cases (both restricted and unrestricted shapes, wall width between 4.0 and 9.0 mm), while 26.1% ranged between 1.6 and 2.0 cm (restricted and unrestricted vessels, wall width 7.0-11.0 mm), and 8.7% measured 2.5 cm (restricted vessel, wall thickness 10.0 mm). Coils smaller than 1.0 cm were only identified in 4.3% of the sample (a base with 4.5 mm wall width). Assembled elements could, in all cases, be measured, suggesting less intensity in roughing-out gestures than at other sites, where they are very complex to identify.

Figure 170: Example of visible oblique coil junctures on sample OP1.152.2.

Coils were positioned equidistantly and in an oblique fashion, either with gestures from the outside to the inside of the vessel (52.2%) or vice versa (34.8%), while in 13.0% of cases it was not possible to assess this gesture. Apart from that, lip coils were positioned either from the outside or inside and were generally the same size as body coils but were occasionally smaller. Preforming was carried out through pinching and drawing, and all samples, with the exception of three, featured wet clay finishing, either scraping with a soft tool or with fingers, providing the sherds with a very irregular topography. It is not possible to determine accurately the technique applied or the specific tool used since surface treatment practices in leather hard clay erase almost all evidence of finishing gestures. However, identification of prominent grains combined with striations suggests wet clay techniques. Striations were frequent, represented in 60.9% of the samples, and were either connected with

Figure 171: External surface of sample OP1. C1(1), featuring leather hard clay surface treatment.

Figure 172: Internal surface of sample OP1. C1(1), featuring clear tool marks characteristic of the OP1 sample.

wet clay finishing gestures or burnishing, leaving distinguishably different traces. Striations from scraping were usually—yet not exclusively—found in internal surfaces, suggesting the use of the tool and possible support with the other hand holding the external surface of the vessel wall. Surface treatment consisted of coating with slips or *barbotine*, leather

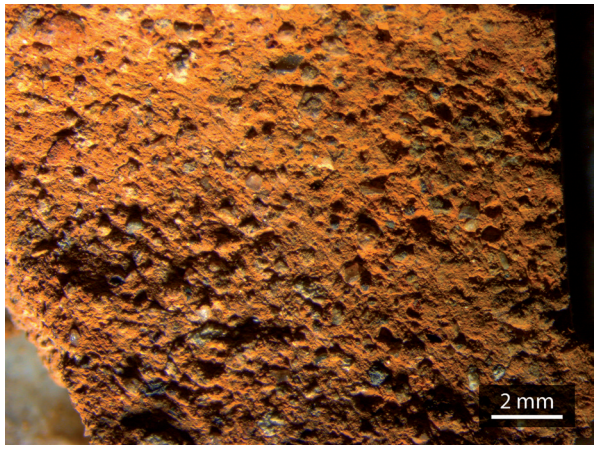

Figure 173: External surface of sample OP1.169.3, featuring prominent grains in combination with threaded striations.

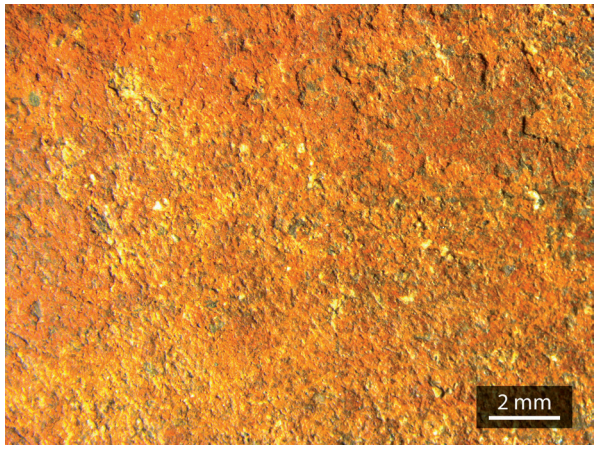

Figure 174: External surface of sample OP1.152.2, featuring inserted grains, compact topography, and red slip.

hard clay smoothing, and burnishing. Slips were usually red, orange, and brown. Slipped surfaces were very seldomly burnished, and there are also sherds that feature burnishing of smoked surfaces.

Fragmentation of the sample and a complete absence of bases large enough to conduct full macrotrace analysis prevents a full reconstruction of the operational sequences of whole vessels. The only base thoroughly analyzed was highly fragmented, but coils were positively identified despite an inconclusive positioning technique, which may have been spiral.

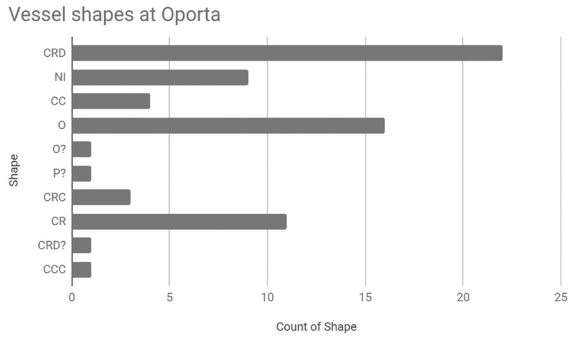

Figure 175: Vessel shapes at Oporta.

7.4.3 MORPHOMETRIC ANALYSIS

Vessel shapes at Oporta were overall homogenous (**figure 175**). The largest group of forms (based on the whole sample, not only the rims), restricted vessels, was dominated by *ollas*, which measured between 6.0 and 34.0 cm in mouth diameter, with wall thicknesses ranging from 3.0 to 9.0 mm. On average, vessel diameter was 19.8 cm (52.9% <20.0 cm and 47.0% >20.0 cm). Within the unrestricted vessel group, the most common shape consisted of outflaring straight walled jars (CRD), which featured diameters between 12.0 and 36.0 cm, while their wall thickness ranged between 3.0 and 11.0 mm. Straight walled jars (CR) had diameters between 4.5 and 31.0 cm, while their walls ranged between 2.0 and 11.5 mm in thickness. Curved jars (one convergent) yielded diameters between 10.0 and 25.0 cm, and their walls ranged 4.0-6.0 mm. Convergent straight walled jars (CRC) measured between 9.0 and 35.0 cm in diameter, and their walls ranged between 5.0 and 8.0 mm. Also, one plate was identified, with a 30.0 cm diameter.

In summary, all shapes—except for the curved jars—featured samples that exceeded 25.0 cm in diameter. At the same time, only the unrestricted jars (CR, CRD, CRC, CC) and *ollas* featured samples with diameters below 15.0 cm. Samples belonging to *molcajetes* were also analyzed (i.e. OP1B.140.S1).

7.4.4 DECORATING TECHNIQUES

Practices related to coating were present in 90.4% of the sample, either on the internal or external walls or both, while other decoration practices were recorded in only 11.9% of the sample analyzed and consisted mostly of incisions, appliqué and appendages, paint, punctuation, impression, and *acanaladura*.

Figure 176: Example of typical incisions found at external surfaces on OP1 sherds, featuring subparallel lines <1mm wide (sample OP1.O4).

Figure 177: Example of sherd incised in the internal wall, suggesting a possible *molcajete* (sample OP1.Q4).

In the case of incisions, they consisted of geometric bands of parallel thin lines (<1 mm) oblique to each other, positioned below the rim and executed with a sharp tool (**figure 176**). Even though incisions were usually performed on the external walls of the vessels, there are some examples of flat vessels that featured incisions on the internal wall of the vessel (**figure 177**), suggesting a *molcajete* use, possibly for grinding soft products.

Figure 178: Carca rim style sherd, sample OP1.31.1.

Decorating techniques were sometimes applied in combination, such as appliqué with punctuation or appliqué with incision. Aesthetic choices for color involved bichrome effects through the combination of paints and slips, such as orange paint on red slip or black paint on red slip. Two sherds also featured very rare bright orange tones, only present as well in the AB2 assemblage. Finally, samples characterized as Carca style rims were present, featuring vertical impressions—possibly digital—right below the rim (**figure 178**).

Appendages consisted of an annular base of small dimensions (6.0 mm diameter for the extra coiled attached to the base), which was the only sample of a base like this at the site; supports featuring circular and conical shapes; and one handle, which was manufactured with one coil.

7.4.5 CERAMIC MANUFACTURING SEQUENCES AT OPORTA

High heterogeneity in clay procurement practices resulted in groups with a very small number of samples, which could in fact belong to the same vessel, so the strength of the groupings should be tested with further sampling. All the samples analyzed involved clays extracted from igneous settings of coarse grain size, but within these mineralogical profiles, clay procurement and preparation practices, finishing, and decorating techniques were variable. OP1 is the excavation unit with the highest petrographic variability within the sample examined for this book. This could be indicative of a special function of the excavated mound or higher technical variability (higher number of producers), either local or exogenous. In spite of the limitations due to the heterogeneity, an attempt to systematize the data was undertaken, in order to reconstruct the manufacturing sequences and find possible relationships between different technical choices and the end products. The result are six different production sequences, as well as an outline of the techniques observed in the outliers.

Operational sequence OP-I

This category corresponds to petrographic Group 1, which is characterized by inclusions of intrusive igneous rocks and paste preparation practices that might have involved tempering. After paste preparation, coils between 1.0 and 1.3 cm were positioned in an oblique manner, either from outside to inside or vice versa. Lip coils were placed from inside to outside and were of the same size as the coils forming the vessel body. Preforming involved pinching and drawing, done in a manner that left the topography of the sherds regular; finishing was undertaken on wet clay (prominent grains) with a technique that left very fine striations, most likely with a soft tool or finger. The internal walls of the vessel featured these traces, while they were absent on the external walls. This could imply a gesture of applying the tool only on one side of the vessel, while the other side is supported by the free hand; however, it is also possible that the tool was applied on both walls, but later leather hard clay finishing techniques on the external surface obscured the traces related to finishing. Apart from this leather hard clay smoothing, surface treatment also involved the application of a red slip. The samples were fired in an incompletely oxidized atmosphere at temperatures around 750 °C. The end product associated to this sequence consisted of curved bowls (CC, Ø 25.0 cm). Wall thickness ranged from 5.0 to 6.0 mm, and the sample was found in an off-mound context.

Operational sequence OP-II

This category corresponds with petrographic Group 2, which is characterized by inclusions related to volcanic igneous rocks, particularly the combination of basalt and andesite. No paste preparation practices were identified. Fashioning involved the assembling of coils between 1.0 and 1.6 cm, which were positioned in an oblique manner, either from outside to inside or vice versa. Preforming involved pinching and drawing; finishing was undertaken on

wet clay (prominent grains) with a technique that did not leave striations, or left very mild ones, so it was possibly performed with the fingers or with a soft tool. However, leather hard clay surface treatment might have erased previous steps of the operational sequence, especially those related to wet clay finishing. Apart from this leather hard clay smoothing, surface treatment also involved the application of a brown slip only on sample OP1.139.2. Additionally, samples OP1.139.2 and OP1.32.1 showed similar "Carca style" decoration, which is comprised of impressions done immediately below the lip with a vertical gesture, measuring 5.0-7.0 by 4.0 mm and with a depth of less than 2.0 mm. Sample OP1.140. S1 featured incised, long, subparallel lines on its internal surface, and as it is a flat sherd, it could be either a *comal* or *molcajete*. Samples were fired in an incompletely oxidized atmosphere at temperatures <750 °C. The end products associated to this sequence consisted of vessels classified with mainly cooking uses, such as O (Ø between 20.0 and 17.0 cm) and MLC. Wall thicknesses ranged from 6.0 to 8.0 mm, and all samples were found in an off-mound context.

Operational sequence OP-III

This operational sequence corresponds to petrographic Group 3, which is characterized by basalt inclusions. Paste preparation practices were heterogeneous; sample OP1.159 featured the mixing of different clays, while OP1.65.1 showed evidence of tempering. Fashioning involved the assembling of coils between 1.0 and 2.5 cm, which were positioned in an oblique manner, either from outside to inside or vice versa. Preforming involved pinching and drawing; sample OP1.159 showed voids following the pinching and drawing gestures on its cross-section, while sample OP1.165.1 yielded an irregular topography. Therefore, preforming traces are clearly visible on the sherds. Finishing was undertaken on wet clay (prominent grains) with a technique that left very mild striations, so it was possibly performed with the fingers or with a small soft tool. However, leather hard clay surface treatment might have erased previous steps of the operational sequence, especially the ones related to wet clay finishing. Apart from this leather hard clay smoothing, surface treatment also involved the application of a brown slip (only on sample OP1.159 on its outside surface, while its interior featured smoking). The samples were fired in an oxidizing atmosphere at temperatures below 750 °C. The end products associated to this sequence consisted of vessels such as a CRD (Ø 22.0 cm) and a restricted vessel, with wall thickness varying between 9.0 and 10.0 mm; all samples were found in off-mound contexts.

Operational sequence OP-IV

This sequence entails petrographic Group 4, which is characterized by inclusions related to volcanic igneous rocks, particularly basalt. No paste preparation practices were identified. Fashioning involved the assembling of coils between 1.5 and 2.4 cm, which were positioned in an oblique manner, either from outside to inside or vice versa. Preforming involved pinching and drawing; finishing is unclear due to leather hard clay surface treatment, which apparently erased previous manufacturing traces. However, it is possible that samples were shaved in leather hard clay, but evidence is insufficient to state this, and sample OP1A.169.S1 might actually prove scraping (wet clay finishing) instead. Therefore, it is possible that finishing gestures in the other samples also implied wet clay techniques but surface treatment obscured them. Apart from this leather hard clay smoothing, surface treatment also involved the application of both brown (external) and red (internal) slips on sample OP1.85.3.2, while sample OP1.169.S1 featured brown slip only. The samples were fired in an incompletely oxidizing atmosphere at temperatures <750 °C. The end products associated to this sequence consisted of vessel shapes divided into two groups: restricted (wall thickness 7.0 mm) and unrestricted vessels (Ø between 16.0 and 35.0 cm, wall thickness between 4.5 and 8.0 mm). This second category allowed for precise shape identification and included a CRD and a CRC. Fragments were both excavated in an off-mound context.

Operational sequence OP-V

This category corresponds to petrographic Group 5, which is characterized by inclusions related to coarse volcanic igneous rocks with the particularity of rare basalt frequency, in combination with finer inclusions and freshly fragmented K-feldspars and plagioclase, which could imply tempering practices. Fashioning involved the assembling of coils between 1.3 and 2.0 cm, which were positioned in an oblique manner, either from outside to inside or vice versa. Preforming involved pinching and drawing; finishing was undertaken on wet clay (prominent grains), with a technique that did not leave striations on sample

OP1B.172 (internal wall) but did leave calabash-like striations on sample OP1.85.S1, Sample OP1B.172 showed the particularity of possibly combining wet clay finishing in its interior with leather hard clay finishing on its exterior wall, most probably shaving. The irregularity of the surface, combined with inserted grains and *festonné* traces, supports that hypothesis. However, leather hard clay surface treatment might have erased previous steps of the operational sequence, especially the ones related to wet clay finishing. Sample OP1.85. S1 consisted of a base, preformed through spiral coiling and with clear pinching marks in its interior. Apart from the leather hard clay smoothing, surface treatment also involved the application of a brown slip only on the exterior surface of sample OP1B.172. The samples were fired in a completely oxidized atmosphere at temperatures <750 °C. Also, sample OP1.85.S1 within this group featured a highly optically active matrix, what could suggest firing temperatures exceeding 700 °C, therefore narrowing the firing temperature to between 700 and 750 °C. The end products associated to this sequence consisted of restricted vessels mainly related to cooking and storage uses, with wall thicknesses ranging from 7.0 to 11.0 mm. Samples were found in both on- and off-mound contexts (OP1B.172 and OP1.85.S1 respectively).

Operational sequence OP-VI

This cluster corresponds to petrographic Group 6, which is characterized by inclusions related to volcanic igneous rocks, particularly olivine-rich basalt. No paste preparation practices were identified. Fashioning involved the assembling of coils between 1.5 and 1.6 cm, which were positioned in an oblique manner with gestures from the outer towards the inner walls of the rough-out. Preforming involved pinching and drawing; finishing was performed on wet clay, involving a scraper applied using curved movements that left clear tool marks parallel to the vessels base with protuberant grains. Sample OP1A.48 shows clear finishing traces of a tool approximately 15.0 mm high. Surface treatment involved leather hard clay smoothing and the application of a brown slip; sample OP1.169.2 featured burnishing as well. The samples were fired in an incompletely oxidizing atmosphere at temperatures <750 °C. Sample OP1.169.2 shows fire marks on its external wall, and some digital pressure on the rim is reminiscent of a Carca rim. The end products associated to this sequence consisted of vessels with wall thicknesses ranging between 9.0 and 15.0 mm, and only one shape was positively identified as an *olla* (Ø 16.0 cm). Vessels were found in both on- and off-mound contexts.

Outliers OP

The samples that could not be grouped within the petrographic clusters were examined separately. In general, they all shared preforming through assembled elements, coils measuring between 0.8 and 1.6 cm, positioned in an oblique manner, either from outside to inside or vice versa, then pinched and drawn. Finishing was possibly performed on wet clay, with one case possibly featuring shaving (leather hard clay). Surface treatments involved leather hard clay smoothing and the application of slips (orange, red, and brown, as well as combinations). Five out of the eight outliers featured decorative techniques. Sample OP1.85 featured the highest quantity of volcanic glass inclusions in the entire analyzed dataset (possibly derived from tempering practices) and was ornamented with the application of clay balls of 6.0-9.0 mm, followed by a punctuation on their surfaces (**figure 179**). One important characteristic of this sample is the presence of protuberant grains underneath the brown slip coating, meaning that leather hard clay smoothing gestures were not performed before the application of the slip, but afterwards.

Sample OP1.62.1, with its paste lacking in basalt and andesite, as well as the addition of grog as temper, featured bands of incised lines (width <1 mm) oblique to the rim and positioned below it and was macroscopically identified as part of the Santa Barbara tradition, from the Ulúa Valley in Honduras (R. Joyce, pers. comm. 2018) (**figure 180**).

Fragment OP1.169.3 is characterized by medium and coarse round volcanic inclusions connected to basalt in combination with angular quartz and plagioclase fragments (temper) and was classified as Cocal phase (R. Joyce, pers. comm. 2018). Sample OP1.85.1 involved paste preparation practices of sieving and tempering, was decorated with black paint on red slip, and is connected to the Sulaco valley in Honduras (R. Joyce, pers. comm. 2018). This relationship between the outliers and ceramics produced in Honduras will be further explored in Chapter 8.

Figure 179: Sample OP1.85, featuring appliqué decoration combined with punctuation, applied on top of a slip that in turn was placed on a wet clay finished external wall.

Figure 180: Sample OP1.62.3, incised *olla* neck identified as part of the Santa Barbara tradition from the Ulúa valley, Honduras.

7.5 BARILLAS

The three excavation units placed at the Barillas site yielded 4249 ceramic fragments (21579.7 grams). In general, fragments were formally homogenous, of large size with an average length of 31.1 mm; 54.0% of the sherds were smaller than the average, while 46.0% were larger. Wall thickness averaged 6.0 mm. Moreover, 74.4% corresponded to unrestricted vessels, 7.3% to restricted vessels, and the remaining 18.3% to undetermined shapes. The assemblage features several vessel parts, such as rims, rim/necks, shoulders, shoulder/necks, bodies, bases, handles, lugs, and supports. Surface treatment involved the coating of the vessels with slips, while decorating techniques included incisions and appliqués in very low quantities, which tended to be zoomorphic.

Fragmentation was high, possibly due to trampling; sherds featured subangular edges, and surfaces were well conserved. Fragments featured triangular, trapezoidal, and quadrangular shapes, which are typical for assembled elements fashioning, in particular the coiling technique. Also, sherds were generally of brown, reddish brown, and orange brown tones, suggesting a well-controlled oxidizing atmosphere, with very few fragments featuring carbonization marks (in both external and internal surfaces). Therefore, they were possibly fired at very low temperatures (<750 °C), perhaps in a hearth. A total of 507 sherds (3460.6 grams) was sampled from excavation UBI1 for further analysis.

7.5.1 PASTE ANALYSIS

Macrofabric groups

In total, 32 different macrofabric groups were identified in the sample analyzed (see **Appendix 12**). Even though this variability might seem high for such a relatively small sample, the different groups were quite homogenous. The same clay recipes, mainly including feldspars, rock fragments, iron ores (both black and reddish-brown), and quartz were repeated in the different grain sizes and textures. This created ceramic series that could span from coarse, coarse/medium, medium/fine, and fine while sharing similar paste textures, types of inclusions, and voids. Apart from a hypothesis related to various clay and or/tempering sources, differences in paste texture among the macrofabric groups could be the result of differential sorting and/or firing practices. For example, the presence and absence of coarse iron ores— also known as *pistolettes* (P. Quinn, pers. comm. 2016)—

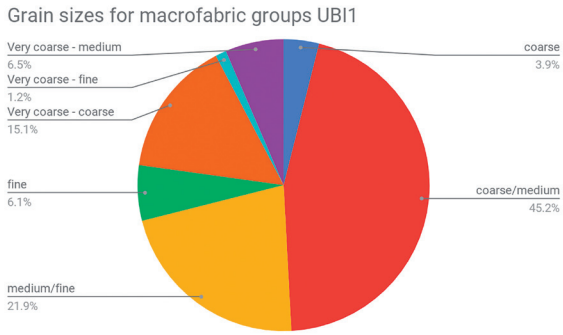

Figure 181: Grain sizes for macrofabric groups UBI1.

seem to be related to sorting or sieving rather than clay sourcing. Also, differential temperature, length of firing, and/or atmosphere can chemically affect the clays and might have caused a single source to result in a more or less porous, granular, or compact texture depending on firing technology. Alternatively, differences could be related to the exploitation of several clay outcrops along the Mayales river, which could explain the microvariability among the paste recipes identified.

Groups featuring mainly coarse grains comprised 49.2% of the sample, while those containing very coarse grains were 22.8%, medium sized 21.9%, and fine 6.1% (**figure 181**). Therefore, the samples were characterized as mainly coarse, with minimum amounts of fine sherds. Frequency of inclusions was lower than 20.0% in more than 90.0% of the macrofabric groups, so sieving and sorting practices were apparently more common than tempering. Apart from that, inclusions tended towards high sphericity, or a combination of both high and low sphericity, which points to riverine clay sources with various episodes of transport, both recent and old. The orientation of the inclusions was usually concentric and oblique, with subparallel, horizontal, and chaotic orientations also occurring. This is consistent with the coiling technique for preforming vessels. Voids were generally of a plate-like and oval-sphere shape, and their orientation was highly variable (mainly oblique, but also subparallel to the walls, concentric, chaotic, and horizontal).

Regarding firing technology, variability in the core-margin relationship as well as cross-section and surface Munsell colors suggest different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source. These variables

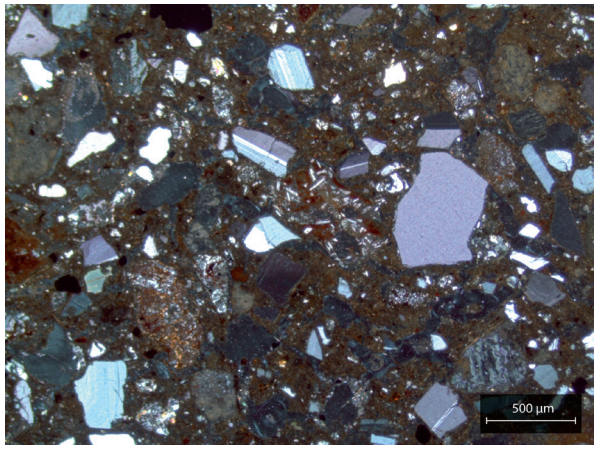

Figure 182: Example of a typical fabric for petrographic Group 1. Sample UBI1.B4.3 was photographed in XP (credit: Simone Casale).

explain the range from complete oxidation to different varieties of incomplete oxidation. The sample lacks reduced fragments, and kilns were not identified during survey nor excavation, so the working hypothesis regarding firing technology at Barillas suggests the use of the domestic hearth in combination with opportunistic outdoor fires for ceramic production.

Petrographic Groups

The 20 samples examined with a polarizing light microscope were classified into six different petrographic groups, as well as two subgroups (Casale *et al.* 2019). It is important to point out that there were no outliers within the sample analyzed, which has implications for later interpretations regarding ceramic production at the site. In general, the composition of the samples—characterized by intermediate extrusive igneous rock (200-1500 µm), featuring accessory minerals such as biotite (100-600 µm), orthopyroxene (100-600 µm) and amphibole (200-400 µm)—was homogeneous and related to the local geology. The main distinguishing characteristic of the assemblage was that all groups (except for Group 5, which was already interpreted as a possible import during its macrofabric characterization as macrofabric Group A) contain lamellar plagioclase with orthopyroxenes and olivine, which corresponds with basalt fragments. The main differences among petrographic groups —except for Group 5—consisted in the frequency of inclusions, which is related not only to clay procurement but also to clay preparation practices, such as tempering, sorting, and sieving. **Groups 1** (**figure 182**) and **4**

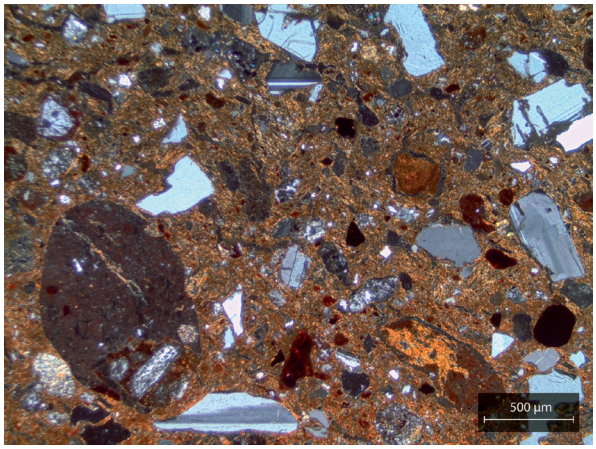

Figure 183: Example of a typical fabric for petrographic Group 4. Sample UBI1.BB1 was photographed in XP (credit: Simone Casale).

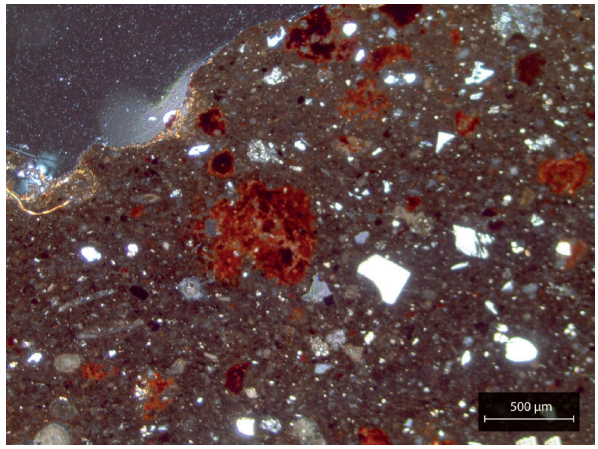

Figure 185: Example of a typical fabric for petrographic Group 5. Sample UBI1.A2 was photographed in XP (credit: Simone Casale).

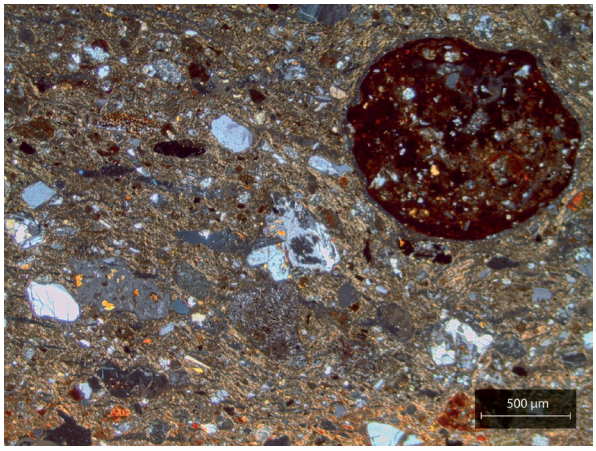

Figure 184: Example of a typical fabric for petrographic Group 3. Sample UBI1.H3 was photographed in XP (credit: Simone Casale).

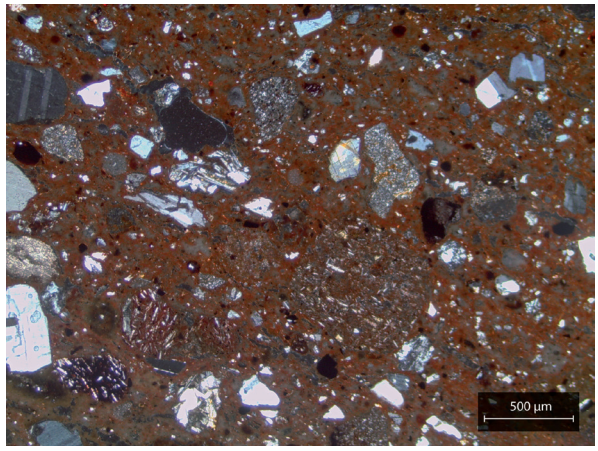

Figure 186: Example of a typical fabric for petrographic Group 2. Sample UBI3.W2 was photographed in XP (credit: Simone Casale).

(**figure 183**), for instance, feature high percentages of quartz (100-1000 µm) and plagioclase feldspar (100-1000 µm) with angular edges, suggesting a fresh fracture in contrast to the rest of the inclusions, which are rounded. Therefore, these dominant inclusions can be interpreted as intentionally added to a more weathered clay matrix.

Moreover, **Group 3** (**figure 184**) yielded compositional similarities to a thin section made as a reference sample from a modern *comal* manufactured at the Güegüestepe community of potters, which procures its clays a few meters away from the village (located less than 2 km south of Barillas), from the banks of the Mayales river, and does not perform any clay preparation besides hydration before production.

In contrast to the rest, **Group 5** (**figure 185**) is composed of a very fine matrix with dominant inclusions of quartz crystals (100-200 µm), clay pellets (100-600 µm), volcanic inclusions (100-300 µm), and powdered olivine, which is spread throughout the matrix. Additionally, volcanic ash (100-1800 µm) is common in all groups except for Group 5, which strengthens the import hypothesis for the latter.

Group 2 (**figure 186**) is characterized by a poorly-sorted matrix with volcanic rock inclusions of

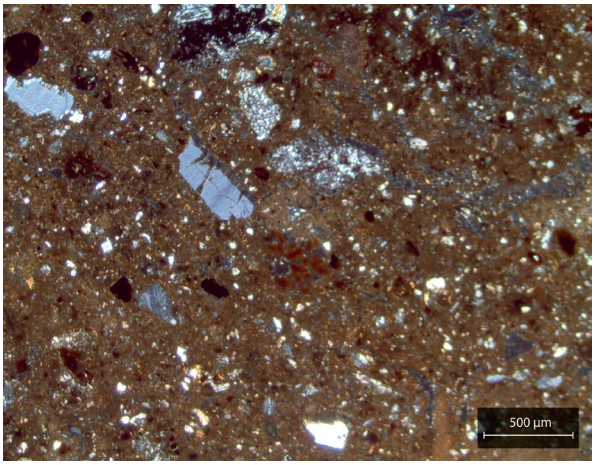

Figure 187: Example of a typical fabric for petrographic Group 6. Sample UBI1.FF1 was photographed in XP (credit: Simone Casale).

angular to rounded intermediate igneous rock (200-3000 µm). These inclusions are varied, featuring microphenocrysts of plagioclase and orthopyroxene with iron-rich inclusions and large crystals of plagioclase, basalt inclusions with lamellar plagioclase, orthopyroxene, pale yellow olivine, and iron-rich inclusions. Apart from that, isolated euhedral to anhedral plagioclase and sanidine (100-600 µm), as well as angular to subrounded, often zoned quartz (50-550 µm) are frequent. Iron-rich inclusions, from rounded to irregular shapes (100-600 µm), are common.

Group 6 (**figure 187**) is characterized by a fine matrix with coarse inclusions, mainly comprising subangular to rounded volcanic intermediate igneous rocks (200-700 µm), with microphencrysts of plagioclase, orthopyroxene and iron-rich minerals (magnetite or titanite). Isolated angular to subrounded quartz and plagioclase (50-100 µm) inclusions are frequent. The fine grain of the matrix suggests possible sieving practices. A subgroup of Group 6 was created for samples lacking sieving traces.

7.5.2 MACROTRACES OF MANUFACTURING PRACTICES

A general overview of the assemblage suggested preforming through assembled elements based on several lines of evidence. First, the shape of the fragments and orientation of inclusions support coiling as the main fashioning technique, as stated in sections above. Second, many sherds show in their cross-sections undulating voids and cracks, sometimes leaving coils visible even in old fractures. This can also be indicative of clay mixing, as well as poor clay preparation techniques, in which, for example, natural organic inclusions were not cleaned before manufacture, or temper is not sufficiently integrated into the clay through kneading. Surface topography of sherds was generally regular, suggesting that the roughing out was followed by careful preforming. Even though the general first impression of the assemblage suggests a preference for a leather hard clay environment for working from preforming through surface treatment—evinced by the occurrence of inserted grains, for example—it is possible that traces of earlier steps were erased by later gestures. However, after macroscopic inspection of the different macrofabric groups, data pointed to wet clay preforming followed by leather hard clay surface treatment. Finally, apart from smoothing on leather hard clay as previously stated, surface treatment involved coating with clayish slips. Post-depositional calcite was found on surfaces, similar to the AB Mound 1 assemblage.

The 20 samples submitted for petrographic characterization were also thoroughly examined for macrotrace identification of manufacturing practices. All samples featured fashioning through assembled elements (coils), which measured between 10.0 and 15.0 mm wide in 75.0% of the cases (all unrestricted shapes, wall width <7.0 mm), while 20.0% ranged between 15 and 20.0 mm (exclusively *comales* shape, wall width 7.0-12.0 mm), 10.0% between 20.0 and 25.0 mm (exclusively *comales* shape, wall width 5.0-10.0 mm) and in 5.0% of cases coils could not be measured. Therefore, it is possible that coil size and wall thickness were related to specific desired characteristics expected from *comales*—heat transfer, for instance—rather than production contexts (Donner *et al.* 2019). Sample UBI1. BIB5.42, an *olla*, evinces that this necessity was not generalized for all cooking vessels, but only for the griddles. The types of foods cooked in the different kinds of containers could explain this discrepancy: for example boiling versus toasting on a griddle.

Coils were positioned equidistantly and either alternatively (45.0%) or obliquely (**figure 188**) (25.0% from inside to outside and 20.0% from outside to inside), while in 5.0% of the cases it was not possible to assess this gesture. Apart from that,

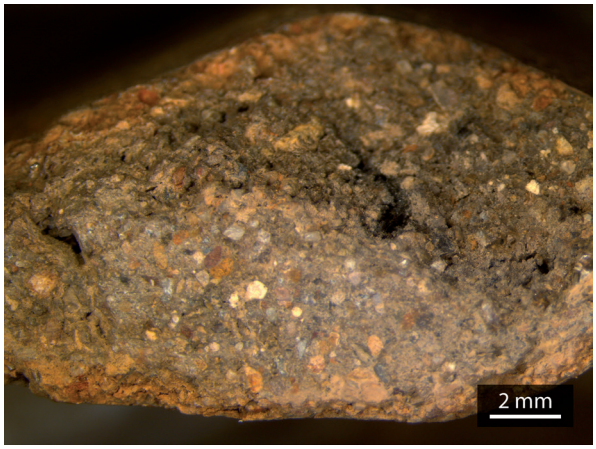

Figure 188: Sample UBI1C.27.4, featuring oblique coil junctures.

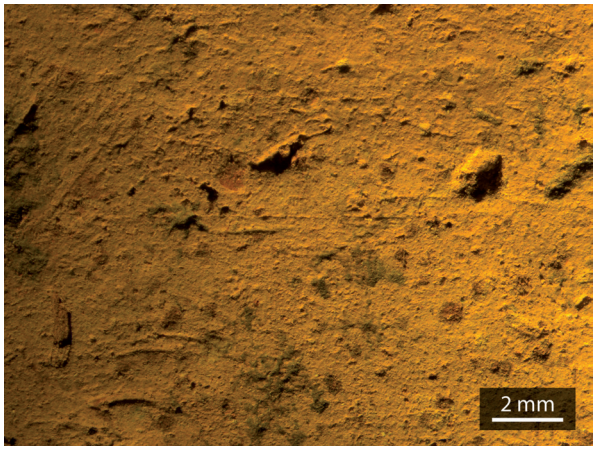

Figure 189: Sample UBI1B.9, featuring prominent grains covered by coating.

lip coils were positioned either from the inside or outside and were generally smaller than the coils of the vessel body. However, there were some cases in which they were either the same size or bigger. Preforming was carried out through pinching and drawing, and all samples featured wet clay finishing, either scraping or with the fingers. It is not possible to determine accurately the technique applied or the specific tool, since surface treatment practices in leather hard clay erased almost all evidence of finishing gestures. However, identification of prominent grains underneath slipped or *barbotine* surfaces suggests wet clay techniques (**figure 189**).

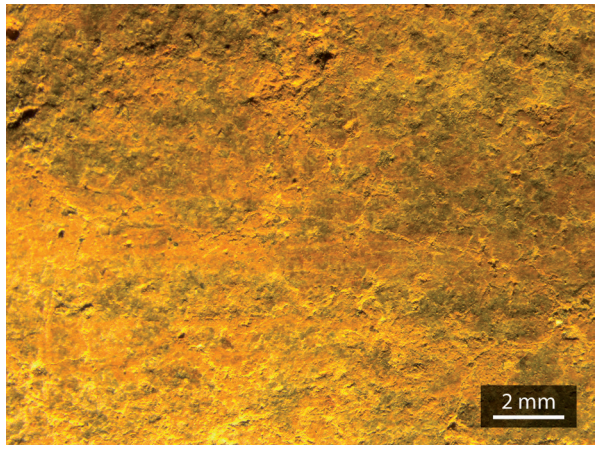

Figure 190: Sample UBI1CXIII5, featuring inserted grains, slip, and a burnished internal surface.

Striations were present in 35.0% of the analyzed samples—mostly associated to leather hard clay surface treatment but some to wet clay finishing—and surface treatment consisted of coating, leather hard clay smoothing, and burnishing (**figure 190**). Slips were usually red, white, reddish brown, and orange, featuring combinations such as red-on-white (the most ubiquitous), black-on-red, black-on-white (UBI1.K3), black-on-white combined with red-on-white (UBI1.N3), white-on-orange (UBI1.N2), and red-on-orange. Slipped surfaces were seldomly burnished, and there are also sherds that feature burnishing of smoked surfaces.

Fragmentation of the sample analyzed does not allow for a full reconstruction of the operational sequences of whole vessels. However, the only base within the sample that was large enough to analyze suggested fashioning technique through coils positioned spirally (UBI1C.27.S1), which coincides with the alternate position of coils on plates and *comales*, which could actually imply spiral coiling and discontinuous finger, nail, and hand pressure combined with drawing gestures. The case of sample UBI1C.27.S1, together with the other base that features differential paste preferences for different vessel parts (UBI1C.27.S2), suggests that bases were manufactured separate from the vessel body, most likely as a first step after slight drying, followed by the fashioning of the body. For cooking pots, necks were possibly applied last after at least minimal drying of the body.

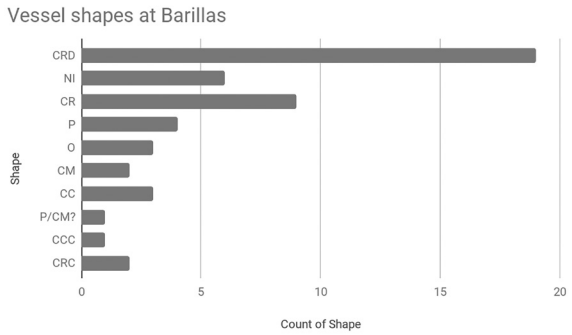

Figure 191: Vessel shapes at Barillas.

Figure 192: Anthropomorphic appliqué, sample UBI1C.25.

7.5.3 MORPHOMETRIC ANALYSIS

Vessel shapes at Barillas were quite homogenous (**figure 191**). The largest group of forms, the unrestricted ones, was dominated by outflaring straight walled jars (CRD), which measured between 11.0 and 40.0 cm diameter, with wall thicknesses ranging from 4.0 to 8.0 mm. On average, their diameter was 27.8 cm (52.7% <20.0 cm and 47.3% >25.0 cm). The second most common shape, straight walled jars (CR), featured diameters between 9.0 and 25.0 cm, while their wall thicknesses ranged between 3.0 and 9.0 mm. Curved jars (CC) had diameters between 13.0 and 25.0 cm, while their walls ranged between 4.0 and 5.5 mm. Convergent straight walled jars (CRD) yielded diameters between 10.0 and 20.0 cm and wall thicknesses ranging from 8.0 to 12.0 mm. The only convergent curved jar (CCC) measured 20.0 cm in diameter, and its walls were 4.5 mm thick. Plates featured a wider range, between 15.0 and 32.0 cm diameter, but their walls were thin (3.5-5.0 mm). The griddles evinced the largest diameters, between 25.0 and 42.0 cm, as well as the thickest walls (9.0-12.0 mm). Regarding restricted vessels, the only ones identified (*ollas*) had mouths between 6.0 and 15.0 cm in diameter, while wall thickness varied from 5.5 to 11.0 mm. In summary, the only shapes that exceeded 25.0 cm in diameter—which is the standard maximum for an individual plate in Western culture, for example—were plates, griddles, and CRD. At the same time, only the unrestricted jars (CR, CRD, CRC, CC) featured samples with diameters below 15.0 cm.

As stated above, most of the sherds lacked fire marks caused by exposure to fire after the manufacturing process, which indicates directly exposing vessels to a cooking fire. However, the griddle fragments were clearly exposed to fire or to heat for longer periods of time, which suggests differential cooking practices. Therefore, use-alteration analysis can shed light on cooking practices; absence of soot on the outer walls of the vessels and of carbonized encrustations within the vessels suggest a preference for cooking practices involving water. However, the underrepresentation of bases in the sample analyzed makes this hypothesis hard to sustain. The sizes of the vessels imply both communal and individual servings, though the sample is too fragmentary to infer specific eating habits.

7.5.4 DECORATING TECHNIQUES

Slipped fragments comprised 66.3% of the samples (either external or internal walls, or both). Other decoration practices were very rare in the assemblage analyzed—representing less than 2.0%—and consisted mostly of appliqué decoration and one case of paint. Sample UBI1C.25 featured an anthropomorphic human face applied to the outside surface of an unrestricted vessel (**figure 192**), while sample UBI1CXIII5 was decorated with a coil featuring incisions possibly performed with human fingernails, creating a rope-like band across the outer surface of the vessel.

Figure 193: Zoomorphic support, sample UBI1B.10.S1 (macrofabric group A, petrographic Group 5).

The other five fragments with appliqué consisted of supports, two zoomorphic UBI1B.10.S1 (**figure 193**) and UBI1C.24 (bird), one cylindrical support (UBI1C.36), two round ones (UBI1B.46.S1 and UBI1C.27.S1), and a modelled one (UBI1C.30). Finally, the only painted and incised fragment (UBI1C.27.4) featured a black band of paint applied parallel to the lip on the rim surface of the unrestricted vessel over a red slip, specifically at the angle of bevelling. Also, this sherd had two wide (1.5 mm) parallel incisions, perpendicular to and right below the lip.

7.5.5 CERAMIC MANUFACTURING SEQUENCES AT BARILLAS

The mineralogy of all clays studied suggests provenance connected to a volcanic environment, which coincides with the geology of the research area. In spite of this, intermediate igneous rocks of volcanic origin are common beyond the local geological unit, so variability in techniques and gestures might elucidate questions regarding production loci. Also, the lack of outliers in the sample analyzed supports homogeneity both in local production and in networks of practices. When taking into account the whole production process, from raw material procurement practices through the end product and its uses—with the limitations that this study has regarding function—it is possible to distinguish four different technological groups, of which two contain a subsequence.

Operational sequence Barillas-I

This category corresponds with petrographic Group 1 and is characterized by a non-calcareous clay matrix with very coarse to coarse grain size

inclusions, which was subjected to the addition in high percentage (>30.0%) of angular fragments of quartz, plagioclase and alkali (sanidine) feldspars of different dimensions. In a lower frequency, coarse and medium sized inclusions of intermediate igneous rock fragments are present, especially featuring quartz crystals, microphenocrysts of plagioclase, orthopyroxenes and iron minerals—such as magnetite or titanite. Additionally, samples contain lamellar quartz. Paste preparation varied, possibly depending on the expected end product; for example, sample UBI1.B1 (an *olla*) contained the same type of temper but in a slightly lower frequency, which could be connected to functional choices.

After paste preparation, roughing out was very homogeneous, featuring wet clay techniques such as pinching, drawing, and finishing—most likely with hands, fingers, and nails. No clear tool marks were identified, which could be a consequence of the erasure of traces caused by later steps involving leather hard clay smoothing. Coils between 1.5 and 2.5 cm were positioned in an alternate manner; in the case of the *comales,* it is probable that they were formed through spiral coiling. Lip coils were always smaller than the coils forming the vessel body, and all samples were fired in an oxidized atmosphere—ranging from complete to partially oxidized—at temperatures below 750 °C. The end products associated with this sequence consisted of vessels with mainly cooking uses, such as *comales* (Ø between 25.0-42.0 cm) and *ollas*; the latter could also serve other purposes. Wall thicknesses ranged from 5.0 to 11.0 mm, and the *olla* yielded thinner walls than the *comales*. All samples were found in off-mound contexts.

Operational sequence Barillas-II

Samples classified within sequence Barillas-II correspond to petrographic Group 3, which consists of a fabric strongly related to the Güegüestepe ethnographic sample (see 7.8). This is not surprising, since Barillas is located only 2 km northwest of the clay outcrop used nowadays. Therefore, these fabrics were characterized by intermediate volcanic igneous rock inclusions of medium to coarse grain sizes of subangular to subrounded shapes, which suggests they were the product of natural weathering processes. This hypothesis is strengthened by the extensive presence of sericitic alteration on the surface of inclusions, which is caused by hydrothermal alteration. However, clay preparation might have involved sieving practices in the case of samples UBI1.S2 (unrestricted vessel) and UBI1.E4 (restricted vessel).

As with the previous group, roughing out was very homogeneous and featured wet clay techniques such as pinching, drawing, and finishing—most likely with hands, fingers, and nails. No clear tool marks were identified, but this could have resulted from the erasure of traces caused by later steps involving leather hard clay smoothing. Coils between 1.0 and 1.5 cm—considerably smaller than in the Barillas-I sequence—were positioned in either an alternate or oblique (outside to inside or inside to outside) manner. Lip coils were both larger or smaller than the coils forming the vessel body. Surface treatment consisted of leather hard clay smoothing, as well as slips (red, brown, and orange), and sample UBI1. H3 was also burnished. Regarding firing technique, all samples were fired in an incompletely oxidized atmosphere—ranging from completely to partially oxidized—at temperatures below 750 °C. The end products in this sequence consisted of vessels associated with serving and storage practices, such as jars with outflaring straight walls (Ø 18.0 cm), straight walls (Ø 10.0 cm), or curved-convergent walls (Ø 20.0 cm). Wall thickness ranged from 4.5 to 7.0 mm. Apart from that, all samples were found in mound contexts.

Within this sequence, there is a subgroup that deviates after clay procurement because it shows very coarse to medium angular inclusions of quartz and plagioclase feldspars that imply tempering practices. The fabric is also characterized by inclusions of volcanic origin, mainly comprised of intermediate igneous rocks with microphenocrysts of plagioclase. Tempering materials in sample UBI1.U2 (CRD) were coarser than within the rest of the group. Fashioning and firing techniques, as well as surface treatments, coincided with the rest of the sequence. The two end products positively identified within this sequence were an outflaring straight walled jar (Ø 20.0 cm) and an *olla* (Ø 7.5 cm); a third shape, possibly unrestricted, consisted of a base with an appliqué round support. Wall thickness ranged between 5.5 and 7.0 mm. These shapes were associated with serving—especially in the case of the unrestricted vessels—and to cooking and storing practices. The first sample was excavated from a mound context, while the *olla* was retrieved off-mound.

Operational sequence Barillas-III

The Barillas-III sequence is associated with petrographic Group 5 and macrofabric Group A, which are characterized by a very fine non-calcareous matrix, featuring only quartz crystals, clay pellets, and powdered olivine. Fabric indicated either a fine clay outcrop or sieving practices followed by possible tempering. Absence of intermediate volcanic igneous rocks could be connected to sieving or provenance.

As with the previous two groups, roughing out was homogeneous, featuring wet clay techniques such as pinching, drawing, and finishing, most likely with hands, fingers, and nails. No clear tool marks were identified, but this could have resulted from the erasure of traces caused by the high erosion suffered by the sherds, which is related to their "powdery" texture, possibly connected to fabric texture. Coils, including lip, of 1.0 cm were positioned in either an alternate or oblique (inside to outside) manner. Surface treatment consisted of leather hard clay smoothing, as well as slips (orange and brown). Regarding firing technique, the two samples studied under the polarizing microscope showed divergent practices. Sample UBI1BIB5.9 was fired in a completely oxidizing atmosphere, and since its matrix is not optically active, it is possible that it was fired for a longer period of time at a higher temperature, or the vessel was gradually heated and fired for a longer period than the rest of the sherds (Degryse & Braekmans 2017, 259). In contrast, sample UBI1B.46.S1 was fired in a partially oxidizing atmosphere, and its matrix is optically inactive, suggesting firing conditions more similar to the rest of the samples analyzed. Both samples consisted of vessels associated with serving, cooking, and storage practices, such as jars with outflaring straight walls (Ø 20.0 cm). Wall thickness ranged from 5.0 to 5.5 mm. Apart from that, all samples were found in off-mound contexts. Decoration within this group consisted of applied supports, both zoomorphic and geometric.

Operational sequence Barillas-IV

Regarding clay procurement practices, the Barillas-IV sequence includes both petrographic Groups 6 and its subgroup. However, the operational sequence of manufacturing vessels with clay from this origin diverged at the paste preparation step. Samples classified within petrographic subgroup 6 are characterized by very coarse-grained inclusions of volcanic intermediate igneous origin combined with quartz and plagioclase, which, due to their shapes, were interpreted as a natural product of weathering processes. As in the previous groups, roughing out was very homogeneous and featured wet clay techniques such as pinching, drawing, and finishing—most likely with hands, fingers, and nails. No clear tool marks were identified, but this could have resulted from the erasure of traces caused by later steps involving leather hard clay smoothing. Coils between 1.0 and 1.1 cm were positioned in either an alternate or oblique (outside to inside) manner. Lip coils were of the same size as the coils forming the vessel body. Surface treatment consisted of leather hard clay smoothing, as well as slips (red, brown), and sample UBI1C.27.4 featured two decorative techniques: paint (black) and incisions. Regarding firing techniques, samples were fired in an incompletely oxidized atmosphere—ranging from complete to partially oxidized—at temperatures below 750 °C. The end products in this sequence consisted of unrestricted vessels associated with serving and storage practices, and wall thicknesses ranged from 4.5 to 6.0 mm. Apart from that, all samples were found in mound contexts.

Petrographic Group 6, on the other hand, diverges from the previous subgroup within the same manufacturing sequence due to its differential paste preparation practices, which consisted of sieving or sorting. The fabric is also characterized by volcanic intermediate igneous rock combined with quartz and plagioclase feldspars. Sample UBI1C.27.S2 features clay mixing, with one coarser clay—possibly not sieved—used for the vessel wall and a finer one used for the base.

Roughing out, surface treatment, and firing technique coincide with the rest of this sequence, but they also involved burnishing external surfaces of vessels. Coils measured between 1.2 and 1.8 cm and were positioned in either alternate or oblique (outside to inside) manners. Lip coils were of the same size or smaller than the coils forming the vessel body. The end products in this subsequence consisted of unrestricted vessels such as plates, straight walled jars, and outflaring straight walled jars. Only one vessel diameter was measurable—25.0 cm for a straight walled jar—and wall thickness ranged from 5.0 to 7.0 mm. Apart from that, as in the rest of Barillas-IV sequence, all samples were found in mound contexts.

Figure 194: Sample RDO2.F1, featuring deposition of soot on the external wall of the vessel.

7.6 ROSA DOLORES OPORTA

Ceramics collected at RDO will be described per excavation unit, since the two contexts within the site yielded very dissimilar radiocarbon dates. To begin with, 100 ceramic fragments (833.5 grams) were retrieved from excavation unit **RDO1**. In general, fragments were of medium size, with an average length of 33.5 mm; 39.0% of the sherds were smaller than the average, while 61.0% were larger. Wall thickness averaged between 6.0 and 8.0 mm, with isolated thin (4.0 mm) and wider (10.0 mm) samples. Moreover, 34.0% corresponded to unrestricted vessels, 38.0% to restricted vessels, and the remaining 28.0% to undetermined shapes. The assemblage features several vessel parts, such as rims, rim/necks, shoulders, bodies, and bases. Surface treatment involved coating with red slips, while decorating techniques included incisions, appliqués, and punctuation on appliqué bands.

Fragmentation was moderate, and sherds featured subangular edges, which could indicate trampling. Fragments were of quadrangular and triangular shapes, which are typical of assembled elements fashioning, in particular the coiling technique. Also, sherds were usually brown in color, with some occurences of orange and lighter colors, featuring no fire marks visible on outer surfaces but some smoking and charred residues on the internal walls. Therefore, they were possibly fired in oxidizing atmospheres at low temperatures (approximately 750 °C).

Excavation unit **RDO2** yielded 172 ceramic fragments (1194.9 grams). In general, fragments were of medium size, with an average length of 37.5 mm; 52.0% of the sherds were smaller than the average, while 48.0% were larger. Wall thickness should be divided into two groups. The first one averaged 5.0 mm and consisted mostly of unrestricted vessels, while the second one averaged 8.0 mm and was comprised of restricted vessels. In general, 45.0% of the fragments corresponded to unrestricted vessels, 25.0% to restricted vessels, and the remaining 30.0% to undetermined shapes. The assemblage features several vessel parts, such as rims, rim/necks, necks, bodies, bases, and supports. Decorating techniques included incisions, appliqués, and red slips.

Fragmentation was moderate, with sherds featuring subangular to angular edges and eroded surfaces, which could indicate trampling. Fragments were of quadrangular, trapezoidal, and triangular shapes, which are typical of assembled elements fashioning, in particular the coiling technique. Also, sherds were

of brown tones with some occurence of orange and lighter colors. Therefore, they were possibly fired at low temperatures (approximately 750 °C) in an oxidizing atmosphere. Also, some sherds feature carbonization in the internal surface, as well as soot deposition outside (**figure 194**), which is consistent with cooking practices. However, sherds with use-alteration are less frequent than in excavation unit RDO1. Besides, no post-depositional fire was identified, except for one sherd. A total of 109 sherds (1419.5 grams) were sampled from both excavation units for further analysis.

7.6.1 PASTE ANALYSIS

Macrofabric groups

Excavation unit RDO1

In total, nine different macrofabric groups were identified in the sample analyzed, as well as several outliers (see **Appendix 13**). Even though this could be interpreted as a high variability rate in comparison with the number of sherds examined, the groups can actually be clustered in two main ceramic series, in which certain clay recipes—mainly containing feldspars, rock fragments and quartz as inclusions—were repeated in the different textures, types of inclusions and voids, resulting in a homogenous assemblage.

Groups featuring mainly coarse grains consisted of 64.8% of the sample, while the ones containing medium grains comprised 35.2% (**figure 195**). It is important to mention that no fine or very coarse groups were identified. Frequency of inclusions was low in comparison to other sites, with most of the sherds (55.0%) featuring frequencies of inclusions between 5.0 and 10.0%, and no group exceeded 25.0%. Therefore, either clay procurement involved a preference for naturally finer clays, or sieving and sorting practices were more common than tempering practices. Apart from that, inclusions tended towards low sphericity, with one group as an exception (RDO1.G), which yielded a combination of both high and low sphericity, which points to either riverine clay sources with various episodes of transport, both recent and old, or tempering practices. The orientation of the inclusions was usually oblique and chaotic, which is consistent with the coiling technique for preforming vessels. Voids were generally of a plate-like and irregular shape, with few oval-sphere examples, and their orientation was highly variable, mainly subparallel, chaotic and oblique.

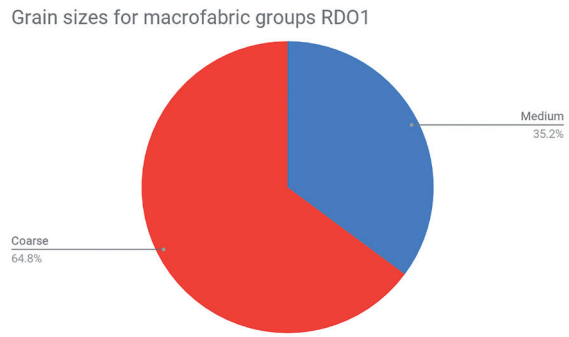

Figure 195: Grain sizes for macrofabric groups RDO1.

Regarding firing technology, variability in the core-margin relationship as well as cross-section and surface Munsell colors suggest different temperatures, duration of firing, and position of the vessel (or vessel part) in relationship to the fuel source. These variables explain the range found in the sample from complete oxidation to different varieties of incomplete oxidation.

In relationship to vessel use, the assemblage contained fire traces that seem to be connected to use-alteration analysis, particularly carbonization processes such as carbonization in the inside of the vessels, with no soot on the outside wall, and in some cases with transfer of charred remains into the walls. These traces connect the pots with intensive cooking activities.

Apart from the above, several sherds feature post-depositional fire traces, evinced by carbonization deposited on old fractures. This trait is consistent with the stratigraphy of RDO1, which featured at least three stratigraphy units (SXIV, SXV, and SXVI) that were related to a hearth, as well as two layers (SXI and SX) that were intentionally burnt for construction purposes.

Excavation unit RDO2

In total, eleven different macrofabric groups were identified in the sample analyzed, as well as two outliers (see **Appendix 13)**. As in excavation unit RDO1, this variability is relative, since the groups can actually be clustered into three main ceramic series, in which certain clay recipes—mainly containing feldspars, rock fragments and quartz as inclusions—were repeated in the different

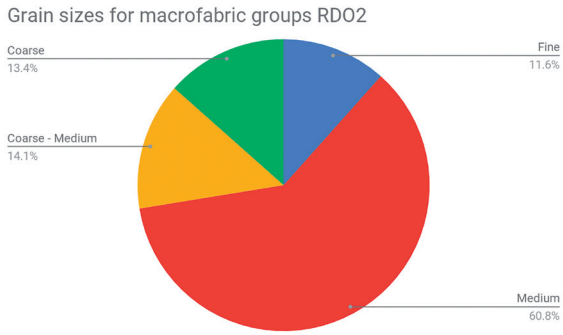

Figure 196: Grain sizes for macrofabric groups RDO2.

textures, types of inclusions and voids, resulting in a homogenous assemblage.

Groups featuring mainly coarse grains consisted of 13.4% of the sample, the ones containing medium grains were 60.8%, coarse-medium sherds represented 14.1% of the total, while fine groups comprised 11.6% (**figure 196**). In contrast to excavation unit RDO1, groups featuring fine grained ceramics were present in RDO2, and the majority of samples were medium instead of coarse. Frequency of inclusions was equal to or below 20.0% in most cases (80.0% of the total), and no group exceeded 25.0%. When compared to RDO1, with most of its groups featuring 10.0% or less, frequency of inclusions was higher in RDO2 (15.0%). Therefore, either clay procurement involved a preference for clays naturally containing higher amounts of inclusions, sieving was more prevalent in RDO1, or tempering practices in RDO2 were more common. Apart from that, inclusions tended towards a combination of both high and low sphericity, which could partially support the tempering hypothesis. However, some groups also featured either low or high sphericity—the latter being consistent with tempering practices. The orientation of the inclusions was usually oblique and chaotic, which are characteristic of the coiling technique for preforming vessels. Voids were generally of irregular, oval-sphere, or plate-like shape, and their orientations were usually chaotic and oblique.

Regarding firing technology, variability in the core-margin relationship as well as cross-section and surface Munsell colors suggest different temperatures, duration of firing, and position of the vessel (or vessel part) in relation to the fuel source. These variables explain the range from complete oxidation to different varieties of incomplete oxidation found in the sample. Regarding vessel use, the assemblage featured fire traces that seem to be connected to use-alteration analysis, but in much lower frequency than excavation unit RDO1. For example, sample RDO2.G shows soot on its external wall combined with internal carbonization. However, samples with cooking traces within the assemblage are minimal. Additionally, and in contrast to excavation unit RDO1, no post-depositional fire traces were identified.

Petrographic Groups

Since the differences found in the macrofabric analysis of the assemblages excavated from units RDO1 and RDO2 were interpreted mostly as contextual and/or functional, but not temporal, samples were mixed for petrographic characterization, and the results were assessed taking into account the rest of the analytical tools.

The 15 samples examined using a polarizing light microscope were classified into three petrographic groups, two subgroups, as well as one outlier (Casale *et al.* 2019). Even though all the groups are connected to volcanic geological settings, their mineralogical content was very distinctive regarding frequencies of certain inclusions and texture. Also, it seems that paste preparation practices were not common, since only one sample (RDO2.I2, **figure 197**) evinced possible sieving practices. Tempering was apparently not present, and clays might have been used without the addition or extraction of materials from the natural outcrop. However, certain characteristics present in Group 2 (see below) might also indicate sieving practices. In general, the assemblage analyzed was defined by very coarse, coarse, medium, and fine inclusions of intermediate igneous rocks (200-1000 µm). The most common inclusions consisted of quartz (100-550 µm), plagioclase feldspars (100-1000 µm), and volcanic ash (100-2000 µm). Accessory minerals were considerably less frequent than these three main inclusions but were present in all groups, comprised of clino and orthopyroxene (150-600 µm), muscovite (50-300 µm), iron-rich inclusions (100-300 µm, which are common in Group 2), and olivine (50-400 µm). Volcanic ash (200-600 µm) was minimally present in Groups 2 and 3 but absent in Group 1. Voids (100-250 µm) tended towards meso-elongated and meso-vugh shapes and were not usually oriented to vessel walls.

Group 1 was characterized by a reddish-brown matrix dominated by a high frequency of angular to rounded quartz (100-800 µm) and plagioclase feldspars (100-

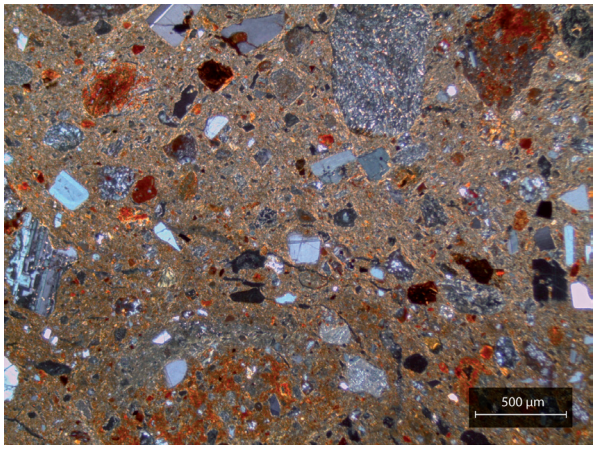

Figure 197: Sample RDO2.I2, featuring a matrix that was possibly sieved.

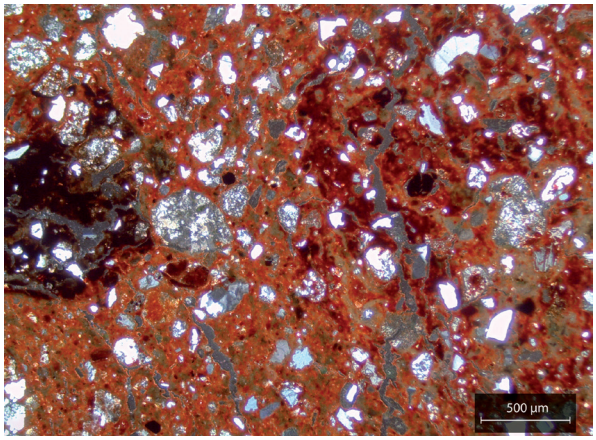

Figure 198: Example of a typical fabric for petrographic Group 1. Sample RDO1.X4 was photographed in XP (credit: Simone Casale).

1000 µm). Volcanic rock inclusions were present in lower frequencies and consisted of subrounded and rounded extrusive intermediate igneous rocks, connected with andesite (**figure 198**). One of the main characteristics of this group is the presence of volcanic ash with a distribution spread throughout the matrix (100-2000 µm). Accessory minerals were present but not common (Casale *et al.* 2019). Even though this group is only comprised of two samples, which vary in texture, they were still clustered together because they are connected with groups such as JOR2.B and UBI1.A, which are possibly linked to Honduras. Even though clay preparation practices are obscure, the

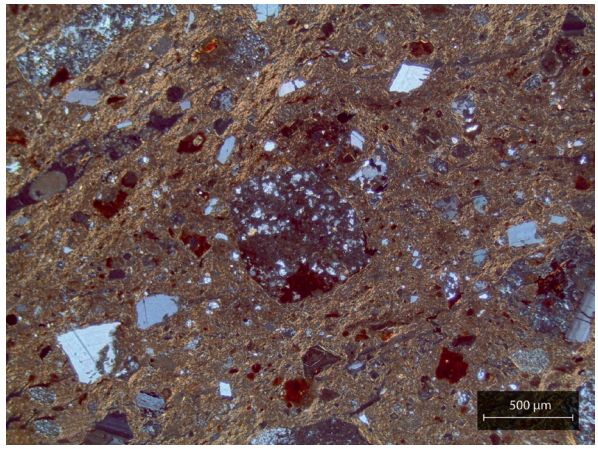

Figure 199: Example of a typical fabric for petrographic Group 2. Sample RDO1.E3 was photographed in XP (credit: Simone Casale).

contrast between the angularity of quartz and feldspars with the more rounded shapes present in volcanic rock inclusions could be interpreted as evidence of temper or exploitation of a clay outcrop with an eroded substrate mixed with more contemporaneous transport episodes. Voids were of meso-elongated shapes; meso-vughs were also present (150-500 µm) and did not show orientation to the walls. Firing temperature was estimated between 650 and 750 °C.

The majority of the samples analyzed (n=8) were classified within **Group 2** and its subgroup, which share mineralogical characteristics but differ in the characteristics of their matrices. In particular, this subgroup is characterized by the presence of coarse inclusions spread throughout a fine matrix, while the main cluster features variable inclusion sizes (300-1000 µm) without a finer substrate (**figure 199**). Also, one of the samples within the subgroup, RDO1.I4, contained basalt, in contrast to the rest of the samples within the main group and subgroup, which were more connected with andesite. Both groupings mainly featured angular to subrounded quartz (50-550 µm) and angular to subangular plagioclase feldspars (200-600 µm), combined with fragments of extrusive intermediate igneous rocks (200-1000 µm), as well as subrounded to irregular iron-rich inclusions (100-300 µm) and volcanic ash (100-500 µm). It is important to mention their similarities with one of the identified petrographic groups at Barillas, which is linked to the Güegüestepe ethnographic sample (see 7.8). Voids were of meso-elongated shapes; meso-vughs were rare (100-250 µm) and did

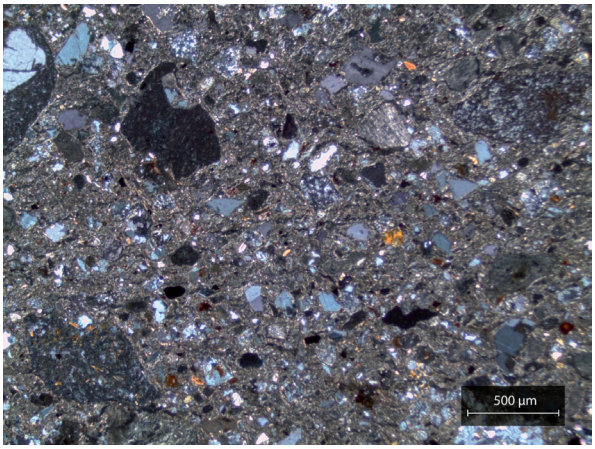

Figure 200: Example of a typical fabric for petrographic Group 3. Sample RDO1.E1 was photographed in XP.

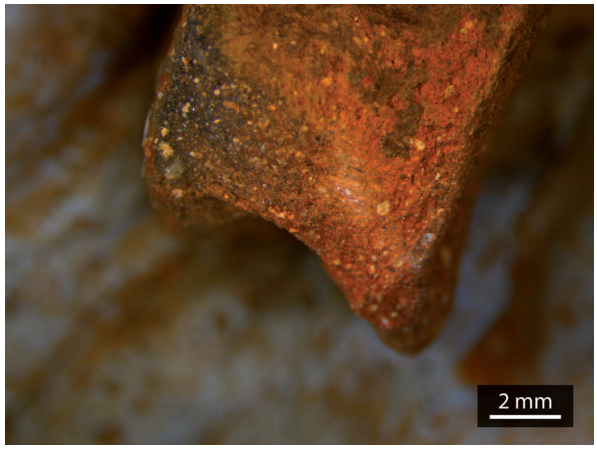

Figure 201: Sample RDO1.X4, featuring a U-shaped coil junction.

sometimes show orientation to the walls, depending on the vessel part analyzed. Firing temperature was estimated between 650 and 750 °C.

Group 3 is defined by a high frequency of coarse extrusive intermediate volcanic rock inclusions connected to andesite (100-600 µm), angular to subrounded quartz (100-500 µm), angular and subangular plagioclase (100-500 µm), and olivine (100-400 µm) (**figure 200**). The only **outlier**, sample RDO2.E4, is characterized by the dominance of one single type of volcanic inclusion, globular quartz inclusions with iron-rich minerals (100-3000 µm), which could connect it to Group 3, but the absence of other volcanic inclusions is distinctive. Voids were of macro/meso-elongated shapes; meso/macroelongated vughs were also present (150-250 µm) and sometimes did show orientation to the walls. Firing temperature was estimated between 650 and 750 °C.

7.6.2 MACROTRACES OF MANUFACTURING PRACTICES

In general, the assemblage is characterized by an undulating cross-section, where coils are clearly visible, combined with an irregular topography, which—together with the shape of the sherds and the orientation of both inclusions and voids—point to preforming through assembled elements (coils). Apart from that, the RDO assemblage shows traits related to wet clay preforming, such as the combination of abundant protuberant and floating grains combined with visible threaded striations possibly connected to smoothing on wet clay with dry fingers, found on both internal and external walls of the fragments analyzed. However, leather hard clay smoothing was also common and is evinced by surfaces with inserted grains and a compact topography that very usually obscures previous steps of the manufacturing sequence. Coating vessels with slips was a common practice, and some of them were also burnished afterwards.

The 15 samples submitted for petrographic characterization were examined for macrotrace identification of manufacturing practices. All samples featured fashioning through assembled elements (coils, see **figure 201**), which generally measured between 1.0 and 1.6 cm wide in 86.0% of the cases (both restricted and unrestricted shapes, wall width usually between 4.0 and 9.0 mm, with one exception of 12.0 mm). Only one sample, corresponding to an unrestricted vessel, featured small coils (0.7 cm) combined with thin walls (4.0-5.0 mm), while a single sherd, possibly part of a restricted vessel, yielded large coils (2.5 cm) with wide walls (up to 14.0 mm). Assembled elements were always possible to measure with no exceptions, showing a lack of intensity in roughing-out gestures.

Preforming of vessels was carried out through pinching and drawing, and all samples featured traces related to wet clay finishing (protuberant grains in combination with threaded striations, **figures 202** and **203**), which are interpreted as finishing and smoothing on wet clay with dry fingers. Tool marks were identified in a few cases and were

Figure 202: Sample RDO2.B4, featuring prominent grains characteristic of wet clay finishing.

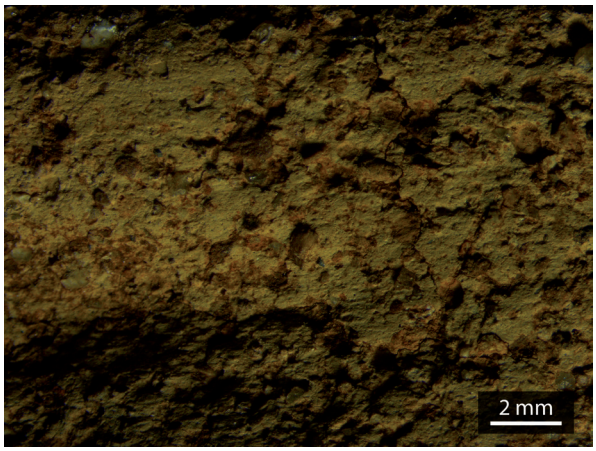

Figure 203: Sample RDO1.G4, featuring a combination of prominent grains with threaded striations, characteristic of wet clay finishing.

usually found on the internal walls of the vessels—but not exclusively. This suggests the use of a tool and possible support with the other hand holding the external surface of the vessel wall, followed by the repetition of the gesture inverting the position. The RDO sample, unlike other sites, did not pose doubts regarding the possibility of leather hard clay finishing; evidence supporting a wet clay hygronomic state was very solid. However, smoothing both on wet and leather hard clay (**figure 204**) was present (exclusively on samples within petrographic Group 3). Surface treatment occasionally involved coating with a reddish-brown slip and occasional burnishing.

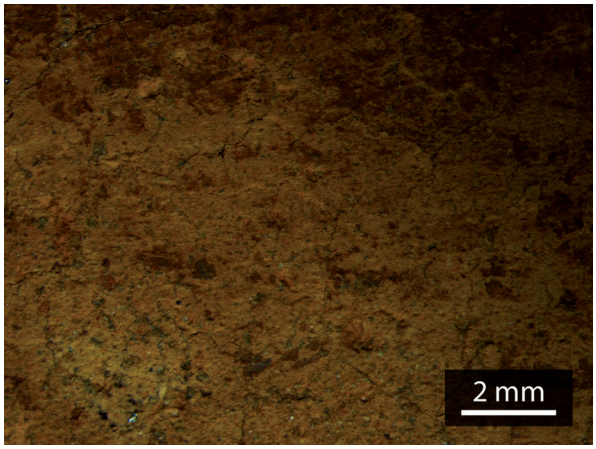

Figure 204: Sample RDO1.E1, featuring inserted grains and compact microtopography, characteristic of leather hard clay smoothing.

Fragmentation of the analyzed sample and absence of full vessels complicated a full macrotrace analysis. However, vessels were possibly constructed separating the different sections (base, body, neck/rim), all involving the coiling technique and gestures connected with wet clay roughing out and preforming, sometimes but not often followed by leather hard clay surface treatment and firing in oxidized atmospheres without much control.

7.6.3 MORPHOMETRIC ANALYSIS

Since only ten recovered rim fragments were large enough to draw and make morphological inferences, it is impossible to attempt any quantitative analysis regarding vessel shapes at RDO (**figure 205**).
However, some insights can be drawn; for example, *olla* rims with diameters between 10 and 25 cm and wall thicknesses between 6.0 and 12.0 mm were identified. Two of these samples were classified as "Carca" style rims (**figure 206**). *Olla* rims were exclusively recovered from excavation unit RDO1. Also, outflaring straight walled jars (CRD) of diameters between 23 and 30 cm, with wall thicknesses between 6.0 and 9.0 mm, were retrieved from both excavated contexts. One curved jar (CC), from excavation unit RDO2, measured 25 cm in diameter and 9.0 mm in wall thickness. Even though the largest diameter measured within the sample was 30.0 cm—corresponding to a CRD—the detailed analysis of vessel bodies points to the presence of large vessels as well.

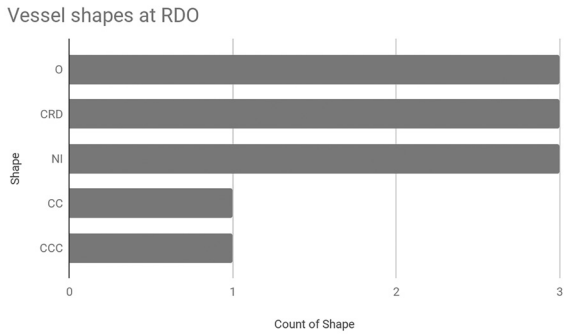

Figure 205: Vessel shapes at RDO.

Figure 206: Sample RDO2.K4, a Carca style rim sherd.

Figure 207: Sample RDO1.I4, featuring incisions of bands of subparallel lines oblique to each other, done in leather hard clay.

7.6.4 DECORATING TECHNIQUES

Sherds with slipped surfaces—either internal, external, or both—comprised 33.0% of the total sample analyzed, while other decoration practices were present in 21.0% of the sherds and consisted mostly of incisions, followed by appendages, appliqué, and impressions.

The most ubiquitous decoration technique was incising, and it was divided into two different types. The first group represents the main trend within the assemblage, which consisted of bands of subparallel lines (<1.0 mm) positioned oblique to each other at irregular intervals. These incisions were done on leather hard clay and always on the external surface of vessels (**figure 207**). Within this type, two samples featured thinner lines of less than 0.5 mm.

The second cluster includes incisions done on wet clay and is divided in two categories. The first one features two samples with incisions on their external surfaces: one with three perfectly parallel lines (1.0 mm) spaced at regular 4.0 mm intervals and with subparallel lines (<1.5 mm). The second subgroup only includes one sample, incised on the internal surface with wide (>2.0 mm) lines, which suggest the possibility of a *molcajete* shaped vessel. However, the sample is too fragmentary to make any further assessments.

Appendages mainly featured conical supports with variable measurements (12.0-14.0 mm diameter at the part attached to the vessel base, 4.0 mm diameter on their tip, 17.0-18.0 mm height), as well as a "button" support with 14.0-18.0 mm diameter and 8.0 mm height. Moreover, only one sample featured appliqué decoration exclusively, which comprised an oval shape measuring 10.0 by 7.0 mm, positioned right below the vessel's lip (**figure 208**).

Two samples yielded combined decorative techniques on their external surfaces. One sample was incised with two bands of parallel lines (<1.0 mm), one placed parallel to the rim and the other oblique to it, creating a geometric pattern and, right above the incised area, a coil measuring 7.0 mm wide was applied with an orientation parallel to the vessel mouth, and then impressions were made with a tool tip approximately 2.0 mm wide. Another sample featured a coil 10.0 mm wide that was applied parallel to the vessel mouth and

Figure 208: Sample RDO2.5, featuring an oval appliqué decoration.

punctuated (Ø 4.5 mm); then below and perpendicular as well as parallel to this, thin subparallel lines (<1.0 mm) were incised to form a geometric pattern. Finally, impressions were present in three samples—all Carca style rims—with variable measurements (2.0-5.0 mm wide, see **figure 206**).

7.6.5 CERAMIC MANUFACTURING SEQUENCES AT RDO

The sample analyzed at RDO yielded homogenous results through macrofabric, petrographic, macrotrace analysis, vessel shape, and decorating techniques, so differences in the steps of the operational sequence are minimal. In spite of this, three different production sequences were identified.

Operational sequence RDO-I

This category corresponds with petrographic Group 1, characterized by volcanic ash inclusions and connections with other samples identified as exogenous. Even though clay preparation practices could not be confirmed, the mineralogical characteristics of the samples suggest either differential clay procurement practices or tempering during paste preparation. Regarding fashioning, coils between 1.3 and 1.8 cm were positioned in an oblique manner, from inside to outside. Lip coils were positioned from the outside, with a U-shaped cross-section juncture for one sample (see **figure 201**). Preforming involved pinching and drawing, and finishing was undertaken on wet clay (prominent grains); the specific technique applied, as well as surface treatment, could not be assessed due to fragmentation and erosion. Decoration was present on one fragment and was done with impressions in the Carca style. The samples were fired in an incompletely oxidized atmosphere at temperatures around 750 °C. The end products associated with this sequence consisted of a CRD (Ø 25.0 cm, 4.0 mm wall width) and a possible *olla* (Ø 10.0 cm, wall width 9.0 mm), which featured the Carca style decoration. This sequence was found in both excavation units, in connection to a hearth related to mound construction (excavation unit RDO1) and within the core cultural layer of RDO2.

Operational sequence RDO-II

This category corresponds with petrographic Group 2 and its subgroup, which is considered the main sequence related to local clay procurement practices. Mineralogically, the paste is characterized by volcanic rock inclusions generally connected to andesite, mainly in combination with plagioclase feldspars and quartz. Following the similarities with the Güegüestepe ethnographic sample, it seems that paste preparation was absent. An exception to this is the subgroup within this cluster, which appears to have been sieved. Fashioning involved the assembling of coils between 1.0 and 1.4 cm, with two exceptions: the only base in the sample analyzed was roughed-out with coils measuring 0.7 cm, while a large vessel featured 2.5 cm coils combined with the thickest wall found in the sample (11.0-14.0 mm).[82] Therefore, coil size had very specific ranges but was adaptable depending on vessel section and function. Assembled elements were positioned equidistantly and in an oblique manner, with gestures either from the inside to the outside or vice versa; the base analyzed was fashioned through spiral coiling. Finishing was undertaken on wet clay (prominent grains) with a technique that left no striations, while smoothing was evinced by threaded striations connected to dry finger gestures. Surface treatment involved a reddish-brown slip on one sample, as well as leather hard clay smoothing in only two samples. Decorating techniques involved impressions on the Carca style rim and appliqué; combined decorative techniques consisted of appliqué and incisions as well as incised zones with punctuated appliqué.

82 It is relevant to mention that the base from OP1 also yielded smaller coils than the vessel body.

Samples were fired in an incompletely oxidized atmosphere at temperatures below 750 °C. The end products associated with this sequence consisted of CC (Ø 25.0 cm), plates (Ø N/A), and *ollas* (Ø 25.0 cm). Wall thickness ranged from 4.5 mm to 14.0 mm, with restricted vessels being the thickest. Samples were retrieved from both excavation units; the RDO1 ones corresponded with mound filling and off-mound floor contexts, while the RDO2 ones were retrieved either from the core cultural layer or the one immediately underneath it.

Operational sequence RDO-III

The RDO-III sequence is associated to petrographic Group 3 and its subgroup, which are characterized by the predominance of coarse volcanic rock inclusions related to andesite, combined with more quartz and feldspars that tend to be more angular. Paste preparation practices might have involved some sieving, especially within the subgroup. Fashioning involved coils that measured between 1.1 and 2.6 cm, which were positioned equidistantly in an oblique manner with either inside to outside gestures or vice versa. In the only rim sample within the group, the lip coil was positioned from outside to inside and was of the same size as body coils. Preforming involved pinching and drawing, leaving clear wet clay evidence (prominent grains) as well as irregular threaded striations possibly connected to dry finger or dry tool smoothing. Sample RDO2.D4/RDO2I1.4(4) showed unique traces on its external wall, possibly connected to brushing with a straw or a corn cob. Surface treatment involved leather hard clay smoothing in all of the samples except for one, which yielded none. Additionally, one sample was coated with a reddish-brown slip on its external wall and then burnished, while another sample was burnished inside and featured fine subparallel incisions (<1.0 mm wide) performed on leather hard clay. Samples were fired in an incompletely oxidized atmosphere at temperatures more or less 750 °C. Due to fragmentation issues, defined end products were scarce, with only a confirmed CRD (Ø 30.0 cm); the other samples are both restricted and unrestricted, and wall thickness ranged between 4.0 and 9.5 mm. Contextually, samples were excavated from both excavation units, corresponding with the core cultural layer and the stratigraphic unit below it in unit RDO2, as well as with the mound's foundation in unit RDO1.

The only outlier within the sample analyzed (RDO2. E4/RDO2I1) yielded significant mineralogical differences, which could entail differential clay procurement and preparation practices, but the rest of the steps in the manufacturing process are consistent with the sequences described above. Differences, therefore, should be interpreted in relationship to clay procurement and preparation practices.

7.7 LA AVENTURA

The three excavation units placed at the site yielded 2020 ceramic fragments (12598.7 grams). In general, fragments were small, with an average length of 26.0 mm; 65.0% of the sherds were smaller than the average, while 35.0% were larger. Wall thickness can be divided in two different groups. The majority of the sherds (85.0%) featured vessel walls that averaged 6.0-8.0 mm in thickness, while a minor group (15.0%) yielded thicker walls, usually measuring between 10.0 and 14.0 mm. No vessel walls thinner than 5.0 mm were found in the sample, and none were chicker than 14.0 mm. Moreover, 77.0% corresponded to unrestricted vessels, 9.0% to restricted vessels, and the remaining 12.0% to undetermined shapes (see **Appendix 6**). The assemblage features several vessel parts, such as rims, rim/necks, shoulders, necks, bodies, bases, and handles. Decoration techniques included incisions, slips (white, red), and glaze. No incisions were found. One particular characteristic of this collection consisted of a reinforcement applied on the vessel's rim/neck (**figures 209** and **210**).

Fragmentation was medium, and sherds featured subangular edges, two characteristics that, when combined, could indicate trampling and erosion. Fragments were of quadrangular, trapezoidal, and triangular forms, which are typical for assembled elements fashioning, in particular the coiling technique. Sherds featured good conservation and metallic sounds. Surface colors tended towards brown tones, with minimal occurrence of lighter colors such as orange and yellowish brown. An abundance of fire marks associated with production and variability of cross-section colors suggest firing in contact with flames or smoke and different positioning of the vessel in relation to fuel source. Therefore, firing probably took place on an open hearth without much control. A total of sherds 592 (8917.3 grams) were sampled from excavation units for further analysis.

Figure 209: External surface of sample LA1. E4, featuring a reinforcement on the short neck with digital impressions.

Figure 210: Internal surface of sample LA1. E4, featuring a reinforcement visible next to the preferential fracture of the vessel neck.

7.7.1 PASTE ANALYSIS

Macrofabric groups

In total, only five different macrofabric groups were identified in the sample analyzed, as well as few outliers (**Appendix 14**). The assemblage was highly homogeneous, with 76.0% of the samples classified within one single macrofabric group (LA1.A), and the remaining four groups were similar in composition—

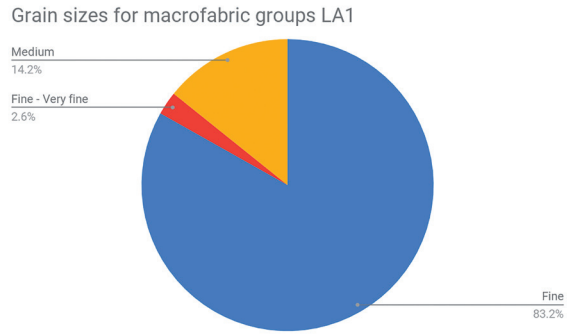

Figure 211: Grain sizes for macrofabric groups LA1.

the main inclusions were feldspars, rock fragments and quartz—and differences were only found in texture and frequency, suggesting the use of a single clay source for most of the sherds. Outliers featured white paint and glazing. Also, construction materials such as roof and floor tiles were observed.

Groups featuring fine grains comprised 83.2% of the sample, while those containing medium grains were 14.2%, and those featuring a combination of fine and very fine inclusions were 2.6% (**figure 211**). No coarse groups were identified within the sample analyzed. Frequency of inclusions was low in comparison to other sites, with the vast majority of the sherds featuring frequencies of inclusions between 5.0 and 10.0%, while the rest ranged between 10.0 and 15.0%. Therefore, either clay procurement involved a preference for naturally finer clays, or sieving and sorting practices were more common than tempering practices. Apart from that, inclusions tended towards a combination between low and high sphericity, with one group as an exception (LA1.E), which yielded high sphericity only. The dominant orientation of the inclusions was subparallel and oblique to the walls of the vessels, but also chaotic and sometimes concentric. Voids were generally of plate-like and irregular shapes, and their orientation was mainly subparallel, chaotic and oblique. Several fragments featured undulating forms.

With regard to firing technology, variability in the core-margin relationship, as well as cross-section and surface Munsell colors, suggest different temperatures, duration of firing, and position of the vessel (or vessel part) regarding the fuel source, which would explain the variability ranging from complete oxidizing atmospheres (very few samples)

to different varieties of incomplete oxidation, as well as reductive atmospheres (in minimal examples). Smoke clouds are present on external surfaces, as well as smoking (both internal and external). Apart from that, carbonization from use-alteration, soot deposits on external walls, and encrustations of charred remains on internal vessel walls were observed. The sample at LA1 was characteristic for its abundance of fire marks related to production and also showed traces of carbonization related to use.

Petrographic Groups

The 15 samples examined through a polarizing light microscope were classified into one major group including a subgroup, as well as one outlier, whose main characteristics did not match any of the groups (Casale *et al.* 2019). Observations under the petrographic microscope matched the ones undertaken during macrofabric analysis; the pastes analyzed at excavation unit LA1 are extremely homogeneous in their intermediate volcanic composition, size, shape, and frequency of inclusions, as well as the composition and characteristics of the matrix. In particular, the clays examined show extreme similarities with the Güegüestepe ethnographic sample (see 7.8), which was manufactured with clays procured a few hundred meters off the archaeological site.

The main cluster, **Group 1** (**figure 212**), is characterized by a non-calcareous iron-rich matrix featuring medium to coarse clay pellets and intermediate volcanic rock inclusions connected to granite and andesite (200-600 µm), with some isolated inclusions (between 1000 and 2000 µm) with rare basalt (200 - 1200 µm), as well as volcanic ash (200-600 µm). Igneous inclusions also include highly weathered volcanic rock fragments. Generally, three types of volcanic inclusions are present: lamellar plagioclase with orthopyroxenes and olivine (basalt), globular quartz inclusions with iron-rich minerals, and microphenocrists of plagioclase. The inclusions include sericite and micritic calcite, which could indicate hydrothermal alteration. The shapes of the inclusions range from subangular to subrounded, suggesting that they are a product of weathering processes rather than an intentional addition to the fabric. Subrounded as well as angular plagioclase and quartz are frequent as isolated minerals (100-500 µm), while olivine (100-400 µm) and orthopyroxene (200-300 µm) are mostly present both within the volcanic inclusions and in isolated positions. Also,

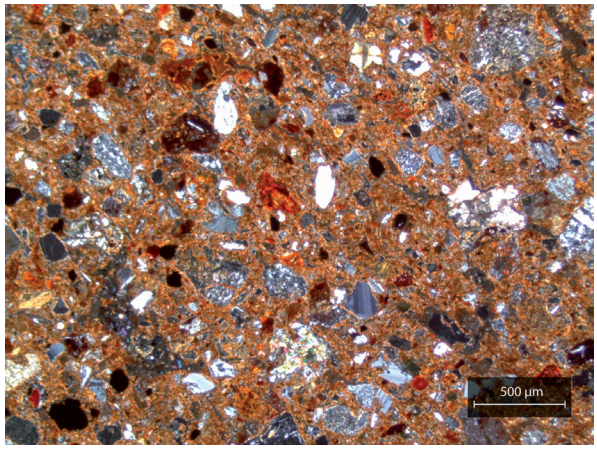

Figure 212: Example of a typical fabric for petrographic Group 1. Sample LA1.A4(8) was photographed in XP.

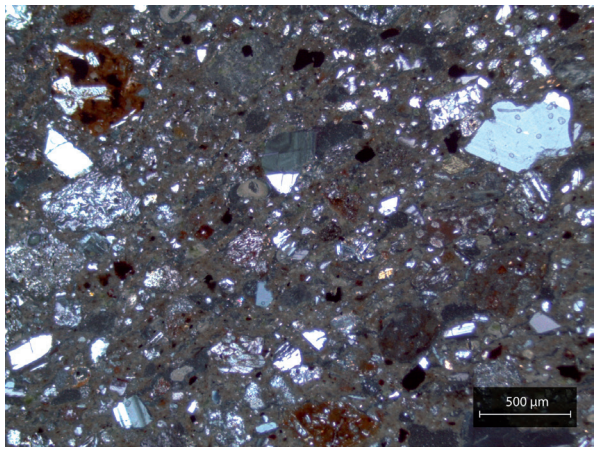

Figure 213: Example of a typical fabric for petrographic subgroup Group 1, featuring quartz and feldspar tempering. Sample LA1.B4 was photographed in XP.

clay pellets are common. As the matrix is optically active, firing temperature was estimated below 750 °C.

The subgroup within this cluster (**figure 213**), represented by the samples classified on macrofabric group LA1.B, yielded strong similarities with petrographic Group 1 at UBI, characterized by quartz and feldspar tempering. However, the presence of quartz at LA1.B is lower than at UBI1. The outlier LA1.D4.1 featured a high percentage of quartz and feldspar inclusions (both sanidine and plagioclase), in combination with volcanic rock fragments that

are more related to andesite than basalt. Accessory minerals included few orthopyroxenes and clinopyroxenes, as well as biotite; while iron-rich dark inclusions (100-400 µm) were frequent.

7.7.2 MACROTRACES OF MANUFACTURING PRACTICES

A general overview of the assemblage suggested preforming through assembled elements based on several lines of evidence. First, the shape of the fragments and orientation of inclusions and voids supports coiling as the main fashioning technique, as stated in sections above. Second, the topography of the sherds is mostly irregular. However, the presence of fabric imprints in some samples (less than 20 in the whole assemblage) suggests that roughing-out was also conducted with the aid of a passive support covered by a piece of cloth where coils were placed and worked (**figures 214** and **215**). It is unclear whether all fragments were fashioned in that manner, since heavy leather hard clay gestures, both for finishing and surface treatment, possibly obliterated fashioning traces. Therefore, pinching and drawing might have been applied for vessels preformed without a mold, while discontinuous pressure (palmar beating) might have been used in combination with the support. However, cross-section of fragments with fabric imprint do not feature the orientation of inclusions and voids parallel to the vessel walls, so this interpretation is problematic. The presence of fabric imprints is a strong line of evidence for molding, so this hypothesis is considered as a possible alternative operational sequence, maybe linked to specific end products.

Even though wet clay finishing is present, as is evinced by surfaces with protuberant grains, the majority of the samples seem to have been finished on leather hard clay with a variety of hydrated tools or fingers. Surface treatment also involved leather hard clay techniques, but with dry hard tools that left shiny surfaces and tool marks. The intensity of the surface treatment is evinced by compact surfaces, stress marks, inserted grains, and regular microtopography and is a distinctive characteristic of the LA1 assemblage (**figure 216**).

The 15 samples submitted to petrographic characterization were also thoroughly examined for macrotrace identification of manufacturing practices. All samples featured fashioning through assembled elements (coils), which measured between 0.8 and 2.0 cm wide. Sizes of coils varied within this

Figure 214: Fabric imprint on the internal wall of a sherd from LA1 (credit: Sebastien Manem).

Figure 215: Fabric imprint on the internal wall of sample LA1.4, also featuring clear sections with leather hard clay surface finish (credit: Sébastien Manem).

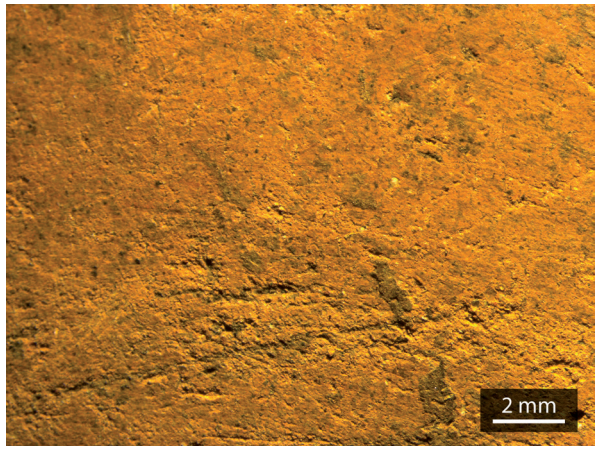

Figure 216: Sample LA1.A4(4), featuring compact microtopography and inserted grains, characteristic of leather hard clay work.

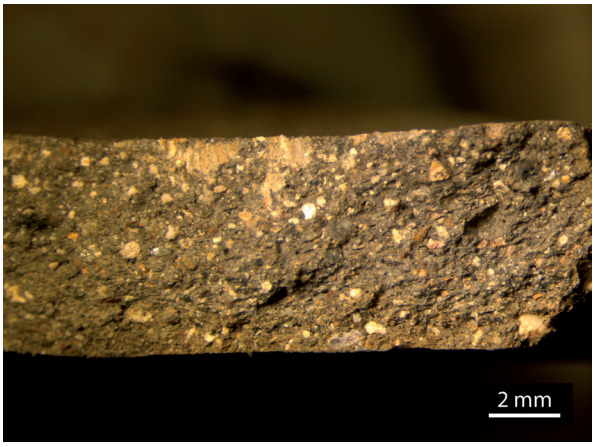

Figure 217: Cross-section of sample LA1.31, featuring an oblique coil juncture.

range, in both restricted and unrestricted shapes, with walls between 5.0 and 14.0 mm wide and with no apparent connection between coil size and wall width. For example, the samples fashioned with the thickest coils (LA1.B4/LA1.31 and LA1.A4(1)/ LA1.31.2) featured thin walls (5.5 - 7.5 mm). Apart from that, assembled elements (with one exception) were always able to be measured, suggesting less intensity in roughing-out gestures than at other sites, where they are very complex to identify. Coils were positioned in an oblique fashion (**figure 217**) and possibly equidistantly, either with alternate or oblique gestures, from the outside to the inside of the vessel or vice versa.

Apart from that, lip coils were positioned either from the outside or inside and were generally the same size as body coils but occasionally smaller. Preforming was mostly carried out through pinching and drawing, but, as mentioned above, some percussion also took place. The most predominant finishing involved leather hard clay smoothing with a rehydrated tool (possibly corn cob, straw, ceramic tool, or fingers), evinced by ribbed striations combined with inserted grains. Some samples (n=4) featured wet clay finishing, demonstrated by the presence of protuberant grains, but the absence of striations makes interpretation of the technique difficult. Striations were common but mostly connected to surface treatment, which consisted of leather hard clay smoothing and burnishing, either isolated or combined. Coating was almost entirely absent, with minimal representation within the sample analyzed, and mostly featured red and black, but also brown colors, which were always burnished.

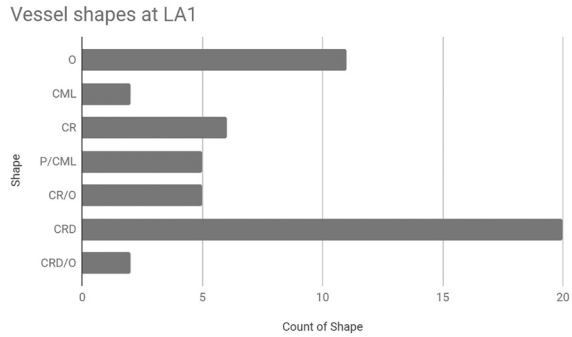

Figure 218: Vessel shapes at LA1.

The fragmentation of the sample analyzed, combined with an absence of bases large enough to conduct full macrotrace analysis, did not allow for a full reconstruction of the operational sequences of whole vessels. However, two main processes were identified: one involving the use of a mold and one related to modelling gestures. Reinforcement coils, applied on necks and junctures between neck and shoulder on *ollas*, as well as on griddle/plate rims, are a technical marker for this manufacturing tradition.

7.7.3 MORPHOMETRIC ANALYSIS

Vessel shapes at La Aventura were varied (**figure 218**) but repeated within certain standards related to size and morphology. The largest group of forms, the unrestricted ones, was dominated by CRD, which measured between 5.0 and 30.0 cm in mouth diameter, with a wall thickness ranging from 5.0 to 11.5 mm. On average, diameter was 18.6 cm (45.0% <20.0 cm and 55.0% > 20.0 cm). Straight walled jars (CR) featured diameters between 15.0 and 25.0 cm, while wall thickness ranged between 6.0 and 13.0 mm. Shapes that could be either a *comal* (CML) or a plate (P) had diameters between 25.0 and 40.0 cm,[83] while their walls ranged between 7.5 and 9.0 mm in thickness. Two confirmed *comales* measured 40.0 and 45.0 cm in diameter, with walls 7.0-8.0 mm wide. Samples classified as CRD/O or CR/O could either be restricted or unrestricted vessels, with diameters ranging from 10.0 to 25.0 cm and wall thicknesses between 6.5 and 12.0 mm. Restricted vessels consisted exclusively of *ollas*, with diameters between 5.0 and 30.0 cm and walls between 6.5 and

83 Different traditions of food presentation could imply the use of large communal serving plates (Vroom 2000; Roddick & Hastorf 2010).

12.0 mm. The diameter of *ollas* averaged 14.5 cm (45.0% <15.0 cm and 55.0% >15.0 cm).

In summary, and coinciding with the preliminary assemblage assessment, unrestricted vessel shapes dominated kitchenware at LA1; outflaring straight walled jars, straight walled jars, and plates (either cooking or serving) were ubiquitous and featured different sizes, both for individual and communal portions. Restricted vessel shapes were limited to *ollas*, with various—yet repeated—sizes.

7.7.4 DECORATING TECHNIQUES

Fragments with slipped surfaces—either internal, external, or both—consisted of 2.0% (red, black, and brown), while other decoration practices were present in only 6.0% of the sample and consisted almost exclusively (88.0%) of impressions done with the fingers on the external surface of *ollas*, most often right below the vessel lip, but sometimes also at the base of the neck, on the juncture with the vessel body. These impressions were either applied directly on the vessel neck or on a reinforcement coil or set of coils added to the vessel (see **figures 209** and **210**). Reinforcement coils were also present on unrestricted vessels, and in the case of *comales,* they could consist of folded lips (**figure 219**). The digital impressions combined with reinforcement coil(s) could be interpreted as part of pinching gestures; however, the horizontality of the impressions, together with their exclusive presence on certain parts of the vessel, suggests a combination of decorative and probably functional intentions (i.e. grip). This is supported by the fact that even samples without reinforcement coils present this trace, meaning that pinching gestures on those sections of the vessel were not necessarily connected in a direct manner to the assemblage of elements (coils). It is important to mention that this decorative feature is somewhat reminiscent of the Carca style rims.

Other decorations consisted of a glazed white sherd, a painted fragment—also white, but not glazed (see **figure 220**)—and a rim featuring black slip only on its lip. The only appendage found in the assemblage consisted of a cylindrical handle fashioned with a 1.5 cm coil.

Figure 219: Example of a griddle featuring digital pressure gestures on reinforcement coils (sample LA1.31.2).

Figure 220: Sample LA1.X1, featuring paint decoration.

7.7.5 CERAMIC MANUFACTURING SEQUENCES AT LA

The sample analyzed at LA yielded a unique combination of highly homogenous clay procurement and preparation practices, with one sole raw material outcrop exploited and use of its clay without modifications—even for construction materials, such as roof tiles. Minimal exceptions might involve sieving (LA1A4.4) or tempering (LA1.D4(1) and especially LA1.B4). Then, roughing-out was always conducted on assembled elements (coils) but featured high variability in the gestures and tools involved; on the one hand, pinching and drawing was identified for the bulk of the sample, but percussion and the use of a passive support was also observed. Finishing was predominantly on leather hard clay with a rehydrated tool, but wet clay techniques were also present. Surface treatment was also homogeneous,

with minimal coating and widespread leather hard clay smoothing and burnishing traces. Firing was done in an open hearth that reached temperatures below <750 °C, with mostly partially oxidized atmospheres and a few oxidized and reduced samples. These minimal differences were interpreted as divergent positions of vessels in relationship to fuel and flames rather than technical differences. As a result, one primary operational sequence was identified, with various subsequences related to paste preparation, roughing-out, and finishing.

Operational sequence LA-I

This sequence entails petrographic Group 1, a clay very similar to the Güegüestepe ethnographic sample, which is characterized by a high frequency of medium to coarse clay pellets and intermediate volcanic rock inclusions—connected to granite and andesite, volcanic ash, and rare basalt—as well as plagioclase feldspars and quartz inclusions. The end products of this sequence consist of both restricted (O, Ø 10.0-30.0 cm, 11.0-14.0 mm wall width) and unrestricted vessels (CML, CR, 20.0 cm Ø, 5.0-13.0 mm wall thickness). Addition or subtraction of materials during paste preparation seems absent (except for sample LA1.A4(4), see below), so the next step in the operational sequence, involving the placement of coils (0.8-1.5 cm), was done equidistantly with gestures both from outside to inside and vice versa, as well as alternate (identified on *comales* and possibly related to spiral coiling). Lip coil was positioned from the outside, the inside, or parallel to the vessel wall, and was usually the same size as the body, although two samples featured a smaller lip coil. Roughing-out subdivides this sequence in two subsequences: LA-IA and LA-IB. LA-IA is characterized by preforming through pinching and drawing, while LA-IB involved percussion and the use of a passive support dividing the clay from the mold with a fragment of fabric. LA-IA is subdivided in two regardless of vessel shape, with LA-IAa featuring wet clay finishing and LA-IAB leather hard clay finishing with the use of a hydrated tool, as well as the only decorative technique present on the sample analyzed: digital pressure either below the rim or at the juncture between neck and body, applied directly on the vessel wall or as a reinforcement appliqué. In both cases, surface treatment consisted of leather hard clay burnishing, with a single exception featuring leather hard clay smoothing (LA1.A4(1)/LA1.31.2).

Sample LA1.A4(4) could be classified as sequence LA-IC, featuring possible sieving connected to paste preparation practices, followed by coiling (1.3 cm) in an alternate manner, pinching and drawing, leather hard clay finishing and burnishing. The rest of the samples within this subsequence coincide with the petrographic subgroup that belonged to macrofabric group B and are characterized by possible tempering paste preparation practices. Roughing-out involved coils (0.8-2.0 cm) positioned either obliquely (from outside to inside) or in a parallel manner (LA1.B4/LA1.31.5), followed by wet clay finishing. Surface treatment consisted of leather hard clay smoothing and burnishing. Sample LA1.B4/LA1.31.5 featured decoration of digital impressions on a reinforcement below the lip. End products within this subsequence consisted of restricted and unrestricted vessels. Finally, outlier LA1.D4(1)/LA1II3, classified as sequence LA-ID, was possibly tempered with quartz, involved coiling (1.7 cm) in an oblique fashion (inside to outside), pinching and drawing, as well as leather hard clay burnishing, but the sample was too fragmentary to assess the finishing technique.

As mentioned above, coating was minimal, but was possibly present in all subsequences. Glazed and painted fragments were classified as outliers during the macrofabric assessment, so they were not sampled for petrography and were too fragmentary to examine macrotraces of manufacturing practices. Also, firing techniques were homogenous in all subsequences, and all samples, regardless of their sequence classification, were fired in a partially oxidizing atmosphere at temperatures below 750 °C. Finally, consumption practices were also homogenous, with extensive exposure of cooking vessels to fire, evinced by soot deposits on external surfaces as well as encrustations of charred materials on the internal walls. Ubiquity of *comales* and the possible use of corn cobs for fashioning might be related to transformations on foodways when compared to the pre-Hispanic culinary traditions.

7.8 CONTEMPORARY CERAMIC MANUFACTURING PRACTICES

Even though a systematic ethnographic study of traditional potters within the research area was not conducted due to time restrictions, meeting Doña Antonia Villegas Ruíz, an elderly woman who resides

Figure 221: A member of Espora Producciones filming firing techniques at the Güegüestepe community of potters (credit: Espora Producciones).

in the San Isidro community, inspired an opportunistic survey of local potters who still manufacture their ceramics using traditional techniques. In particular, the visit to Doña Antonia for the first time in February 2015 allowed me to start exploring certain aspects of clay procurement practices, as well as the properties of local raw materials (from clays to fuel), climatic conditions that affect pottery manufacture, and firing technologies.

This ethnographic study departs from a view that neglects the historicity of the communities under examination (Fabian 2014), or other Western-biased views regarding ethnoarchaeological endeavours (Gosselain 2016). On the contrary, this section intends to challenge the idea of a divide between communities before and after the arrival of Europeans in the region. Without denying the devastating effects in human populations, as well as the diverse histories of violence embodied in the invasion, colonial, and contemporary sociopolitical dynamics, the microhistories of ceramic manufacturing practices can actually serve as evidence of the palimpsestic ontology of present materialities.

In spite of this, time restrictions connected to the main goals of this manuscript did not allow intensive ethnographic campaigns. As a result, an ethnographic documentary film was jointly produced by Espora Producciones and PACEN (**figure 221**).

This audiovisual memory, titled "Barro Somos" (Espora Producciones 2016), recorded experiences in two different communities. The first is San Isidro, located immediately east of the Aguas Buenas archaeological site and home to Antonia Villegas Ruíz (**figure 222**), the last resident who remembers how to manufacture pots.

The second community is Güegüestepe (part of the San Diego community), which is a village located 400 meters north of a Mayales river meander northwest of Juigalpa, where families—as of 2015—were fully dedicated to pottery and brick production

Figure 222: Antonia Villegas Ruiz, the potter-healer who inspired the audiovisual documentation of contemporary ceramic manufacturing practices (credit: Espora Producciones).

(**figure 223**). There, we interviewed Angélica Bermúdez, Francisca Bermúdez Sequeira, Blanca Bermúdez Sequeira, and José Florencio Bermúdez, who produce vessels to sell to intermediaries, who, in turn, re-sell them at local markets throughout the region, but mainly in Juigalpa.

Therefore, this research involved both non-specialized and specialized potters. Additionally, a non-systematic interview was also undertaken at the Aguas Buenas II community, located north of Aguas Buenas, with María de la Cruz Pérez Silva. Casale (2017) included an ethnographic component in his clay procurement-oriented survey, so some of his results will also be included in this short section.

San Isidro

Clay procurement practices involved a raw material outcrop located 300 meters west of the potter's household, at the shore of La Garnacha stream. Clay was collected with a single blade posthole digger. Paste preparation did not entail the addition or extraction of materials other than water, as well as kneading and percussion gestures to obtain the desired plasticity. Fashioning was done with a clay mass, preformed in a "*tortilla*" shape, which was then placed over a convex mold with a piece of cloth for separation, preventing the wet clay from adhering to the surface of the mold. Percussion by palmar beating continued to be applied on the mold until the desired shape was achieved, and then immediately after—on wet clay—a corn cob was hydrated and applied with a double purpose: drawing and evening the surfaces. Then, the preform was dried for a few hours and then positioned on a concave support, after placing ash, followed by newspaper, between the vessel in the making and the plate acting as a support. Later, pinching using hydrated fingers to exert pressure and the palms as support, as well as palmar beating, were used to homogenize the walls. After drying for

Figure 223: Some members of the Bermúdez family, pottery and brick specialists (credit: Espora Producciones).

two (dry season) or five days (rainy season), surface treatment was executed with a *zapoyol* seed (from the Sapotaceae family). Finally, ash was placed in the pots before firing them in an open hearth. This hearth was on ground level, where a bed of fuel—wood, cut according to the sizes of the pots—was positioned; then the ceramics were added, and finally another layer of fuel covered them. When the fuel was consumed, the pots were left outdoors to cool down, while being handled with wooden Y-shaped forked stick. Vessels fired in this manner show fire marks derived from manufacture.

Doña Antonia's mother in law was a *locera*, a potter, and she learnt the craft from her through observation. However, Antonia never became a *locera* herself, and she hadn't produced a pot in more than 20 years by the time she was interviewed. However, she still remembered the procedure in detail. Also, it is important to mention that even though all meetings with Antonia were agreed upon in advance, she specifically dressed up with good clothes for firing, explaining that it is a decisive moment when pots can break. In summary, non-specialized potters produce their vessels within the household upon necessity; procure their clay, fuel, and water from nearby; and fire them either in their kitchen oven or on an open hearth. Tools and materials employed—apart from the raw materials—include a forked stick, a mold, a passive support, newspaper, corn cob (that is pre-prepared by rolling it on the floor with the feet), ash, and a piece of fabric.

Güegüestepe

Clay procurement practices involved exploitation of a clay outcrop located 400 meters south of the village, at the Mayales river. Clay was collected using a *machete,* and paste preparation practices only involved hydration, kneading, and pounding, without the addition or substraction of materials rather than water (**figure 224**).

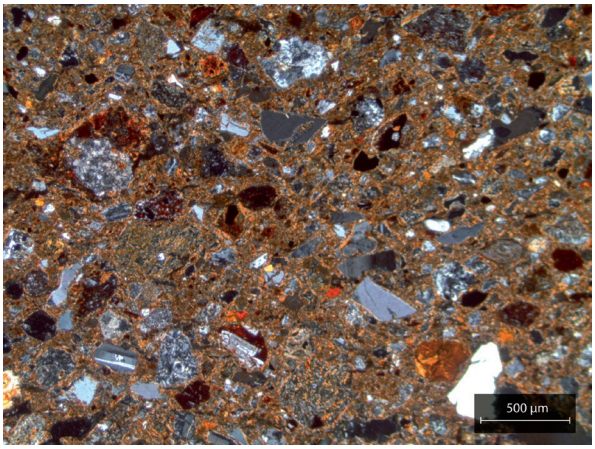

Figure 224: Thin section of a modern griddle, produced by the Güegüestepe community of potters. Sample was photographed in XP (credit: Simone Casale).

Fashioning was done with a clay mass, first preshaped as a *tortilla* and then applied to a mold with a piece of fabric in between. Percussion was performed through palmar beating, combined with drawing gestures that applied pressure with the fingers. In the case of *comales*, Doña Francisca used a concave mold that also served as a rotational support for finishing purposes, which were done on wet clay. For jars, Angélica placed the clay mass on top of a convex mold and then reinforced the upper part of the vessel by applying a large coil (5.0-10.0 cm) that is then crushed. Impressions caused by pinching were left on the upper parts of the vessel, reminiscent of the decoration identified from the archaeological samples excavated at LA. Finishing was also undertaken on wet clay, in this case with a hydrated corn cob and then with a thin but sturdy plastic tool (also rehydrated), manufactured from a shampoo bottle. According to the potters, the same tools and procedures are applied on different molds, depending on the desired end product. After drying—which can be outdoors or indoors—surface treatment involved burnishing with a *zapoyol* seed. Pots were fired in a kiln with one or two openings, until they were red; if a reddish tone was not achieved, more fuel was added until complete oxidation without fire marks was achieved. Finally, pots were removed with a Y-shaped forked stick and cooled down.

Specialized potters are either men or women; a gender preference was not a factor within the community of potters at Güegüestepe. Family relations are extremely important in the production process, and manufacture is completely separated from distribution, which is done by someone who does not belong to the family group.

Manufacture is organized at the family and household level, and it takes place at a house-workshop, which has designated areas for storing raw clay (generally kept dry), a table for fashioning, racks for drying, space for tools, finished vessels waiting to be fired, and fired vessels. Backyards always include kilns, constructed with a circular base of stones (very similar to pre-European mounds) and a semi-oval structure made of flexible tree trunks covered by a mix of tierra *lanilla* with *zacate*, occasionally reinforced with a bit of cement to avoid erosion by rain. For firing, Angélica also dressed up specially for the occasion, as Antonia did.

Other potters throughout the research area reported clay preparation practices, such as mixing of clays (Aguas Buenas II). In particular, Casale interviewed Guadalupe, a potter living just south of Güegüestepe by the Cuapa road, who also used to mix clays, and one of the outcrops she used represents the longest distance between a potter's household and a raw material source for the research area (Casale 2017, 60). In spite of this, the majority of the potters retrieved their clays near their households, and manufacturing practices are strongly connected to those identified at LA. The main difference is the disappearance of the coiling technique in favor of working on a clay mass, which was not identified at LA. Also, the generalization of percussion in relationship to molding resulted in the minimization of pinching and drawing gestures, which were directly connected to coiling. Finishing was always conducted on wet clay, which is not the case at LA, but surface treatment is very similar. Firing techniques are also different because modern samples are extremely fragile; *comales* can be broken with minimal hand pressure.

In the valley of Juigalpa, clays have been consistently transformed into ceramics for at least the last 1600 years. As discussed in Chapter 5, argillaceous materials have had many itineraries, which bundled with various types of materialities in differential temporal rhythms. In Chapter 7, ceramic technologies were discussed in depth, addressing both continuities and variability in the different steps of the manufacturing process. It is time now to integrate all this data into a chronological narrative that accounts for the unfolding of human experience within the research area.