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► **To cite this version:**

Catherine Lara, Tamara L Bray. New insights from Ecuador into Inca-style pottery production in the provinces. *Journal of Anthropological Archaeology*, 2025, 77, pp.101636. 10.1016/j.jaa.2024.101636 . hal-04823112

HAL Id: hal-04823112

<https://hal.science/hal-04823112v1>

Submitted on 6 Dec 2024

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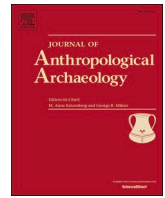
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Journal of Anthropological Archaeology

journal homepage: www.elsevier.com/locate/jaa

New insights from Ecuador into Inca-style pottery production in the provinces

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ARTICLE INFO

Keywords:

Inca *mitmaqkuna*
Communities of practice
Ceramic chaîne opératoire
Imperial Inca pottery
Cañaris
Pottery-making experts
Huactanas

ABSTRACT

Beyond military conquest, the successful consolidation of Tawantinsuyu likely depended on the exercise of soft power and ideological cooptation. The widespread distribution of Inca pottery suggests it played a key role in the imperial agenda. Archaeological evidence from across the Empire indicates that provincial potters were mobilized to generate the distinctive vessels associated with the state, which typically differed significantly from their local repertoires. How did these potters produce the new forms demanded by the Inca? Was any practicing potter capable of adapting their skills? Would new communities of practice have emerged to meet the new morphological and stylistic requirements? We address these questions in a study of Inca and local pottery from southern Ecuador via a focus on the chaînes opératoires involved in production. We incorporate analyses of archaeological materials recovered from survey and excavation work in Olleros in the parish of San Miguel de Porotos in Cañar province, as well as observations from both ethnographic and ethnoarchaeological studies from this region and elsewhere. The study reveals that the Inca-style pottery found at the site was produced locally by expert Cañari potters who combined their usual techniques in a different way to achieve the requisite Inca vessel forms. These specialists were likely *mitmaqkuna* resettled in this region by the Inca due to the abundance of high quality clays in the region.

1. Introduction

Over the course of the fifteenth century, the Inca forged the largest and most well-ordered empire ever created in the Americas. From their home territory in Cusco in the south-central highlands of Peru, they waged unremitting military campaigns aimed at enfolding ever more labor and resources into their dominion. At the height of their power, the Inca controlled approximately 2 million square kilometers of rugged terrain that stretched some 4000 km from northern Ecuador to central Chile and encompassed hundreds of distinct political, ethnic, and linguistic groups. But coercion and the threat of violence has its limits over such a vast territory with respect to ensuring local compliance with state demands. For this reason, it is useful to bring the notion of soft power, broadly speaking, into the discussion of Inca imperialism and political practice.

Thinking along these lines, it is interesting to note that during the late fifteenth and early sixteenth centuries, the ceramic vessels associated with the Inca Empire were second to none in Andean South

America. This highly recognizable style, which originated in Cusco concomitant with the political rise of the Inca, easily surpassed many of its contemporaries in terms of both visual vibrancy and tactile quality. The imperial Inca assemblage was clearly designed to impress in the contexts in which it was deployed: commensal events. Such consumption-oriented occasions, we know from archaeological evidence, could be either grand or intimate in scale, and could involve both the living and the dead, as well as human and other-than-human persons (e.g., Bazán del Campo 2007; Bray et al. 2019; Delgado González 2013; Giovannetti 2021; Morris et al. 2011; Paredes 2003; Pizarro 1921 [1571]).

The widespread distribution of Inca state pottery indicates that it played a key role in advancing the imperial agenda. Beyond military conquest, the successful consolidation of the empire seems to have depended to a large extent on the exercise of soft power and the manipulation of local systems of knowledge, beliefs, and hierarchies. The idea of soft power was originated in the late twentieth century by political scientist Joseph Nye (1990, 2004). The essential point of his

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<https://doi.org/10.1016/j.jaa.2024.101636>

Received 3 July 2024; Received in revised form 12 November 2024;

Available online 22 November 2024

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argument was that expansionary states do not maintain control over subject populations by coercion or force alone. Equally important to the success of imperial states, he argued, is the ability to effect desired outcomes through attraction and persuasion. While not a significant component of his thinking, material culture clearly plays an important role in one's ability to win friends and influence people. In the Inca case, objects, including items of adornment, woven goods, drinking cups, and ceramic wares, as well as architectural spaces, mediated the interactions between newly minted rulers and subjects, helping to enact these new social relations (see, for example, Bray 2017; Correa-Lau et al. 2023; Morris 1995; Rowe 1997; Zori 2022).

Given the needs of the expanding state, it is clear that non-Inca craftspeople would necessarily have been involved in the production of the requisite imperial goods. With respect to imperial Inca pottery, which is the focus of this paper, archaeological evidence from around the Empire indicates that the vast majority of imperial wares recovered outside of Cusco were locally produced (e.g., Alconini 2013; Bray and Minc 2020; Chacaltana-Cortez et al. 2023; Makowski et al. 2011, 2015; Ratto et al. 2002). The implications of the new productive arrangements put in place by the Inca are various. Here we consider several questions that arise at the micro-scalar level of production.

With regard to Inca ceramics, it is important to recognize that the vessel shapes that typified the Inca state assemblage, such as the tall-neck jar, the shallow plate, and the pedestal-base olla (Bray 2003), usually differed significantly from the forms that made up the local vessel repertoires in the conquered territories. We take this as one of the starting points of our discussion. Specifically, we are interested in how non-Inca, or non-Cusco-based, potters went about producing the foreign vessel shapes required by the new lords of the land. Was any practicing potter capable of adapting their skills to the production of new vessel forms? Could good outcomes be achieved by able potters who simply copied examples of the desired new forms? Would new communities of practice have emerged to meet the morphological and stylistic requirements of the authorities? How did populations of relocated pottery-making specialists charged with the large-scale production of Inca ceramics figure into the equation of communities of practice and the social landscapes of the regions to which they were deported?

We address these questions in a study of Inca and local pottery from the Cañar region of southern Ecuador via a focus on ceramic manufacturing techniques. We incorporate analyses of archaeological materials recovered from survey and excavation work in Olleros in the province of Cañar, as well as observations from both ethnographic and ethnoarchaeological studies from this region and elsewhere. The aim of the study is to offer insights into how imperial provisioning requirements were met at the local level, what kinds of social and technical strategies may have come into play, and how state demands did or did not impact local technologies of production.

1.1. Imperial Inca pottery manufacture

The existing data on the production techniques of provincial Inca imperial pottery refer mainly to the observable actions based on forms and decorative elements, as well as chemical and petrographic analyses. These analyses have provided important comparative information on raw materials, decorative treatments, and firing processes (see, for instance, Alconini 2013; Bray and Minc 2020; Chacaltana-Cortez et al. 2023; De la Fuente and Vera 2016; Costin 2016; Cremonte et al. 2015; Hagstrum 1986; Páez and Sardi 2014; Szilágyi et al. 2012; Williams et al. 2016). But studies of Inca-style pottery to date have tended to focus on only one aspect of the total process involved in the production of these ceramic wares. Here we propose that considering the entirety of the productive process can contribute novel insights into imperial Inca ceramics, potter identities, and the organization of craft production under Inca rule. Such insights, in turn, shed further light on the degree of power and control actually wielded by the lords of Cusco in different regions and under different circumstances.

The process involved in the production of a ceramic vessel –the productive *chaîne opératoire* – corresponds to the “series of operations which transform raw material into finished product” (Cresswell 1996: 43). The first action of this process is the selection and preparation of clay material. Next comes the fashioning of the vessel, which consists of the “operations meant to give a shape to a clay mass” (Balfet et al. 1989: 53). These include (a) roughing out the vessel form, also known as “primary forming,” and (b) shaping operations, which give the receptacle its final geometric characteristics (Roux 2019: 41). Vessel manufacture is usually followed by a finishing process, which involves surface modification of the vessel walls (Rice 2015); distinct treatments, such as rubbing or coating, aimed at further transforming vessel surfaces may subsequently be applied. These may be followed by the application of decoration, and finally, by vessel firing.¹

The relevance of chaînes opératoires lies in their potential to reflect social groupings and the cultural choices they make (Lemonnier 1993: 7). We understand social groups here in the broad sense, as being potentially based on any number of criteria, including gender, religion, ethnicity, family, caste, faction, or class (Roux 2019). For instance, in the north central Andes of Peru, men from the region of southern Conchucos make pots by coiling, while pots from central Conchucos are produced by women using coiling and paddling techniques (Druc 2009: 95). In the Bulandshar district of northwest India, Muslim potters and Hindu potters use completely different kinds of wheels and firing structures (Roux et al. 2017: 330). In the Oromia region of Ethiopia, the Oromo shape rough-outs from a clay mass while the neighboring Woloyta ethnic group rely on coiling (Cauliez et al. 2017: 48). As clear from abundant ethnographic examples worldwide, technological boundaries tend to map onto social boundaries in the sense that each social group has its own chaînes opératoires, with fashioning being the “hard core” of the technical sequence (Roux et al. 2017; also Calvo and García 2014: 10-13; Delneuf, 1991; Mayor 2011: 33; Ramón 2013: 104; Stark 1999: 42).

This phenomenon of overlapping boundaries is explained with respect to the idea of social learning, which necessarily implies learning from a tutor—almost always someone from an individual's close social circle. An apprentice's learning is achieved within a community of practice: a group of people whose collective work creates and constantly reinforces a common identity (Lave and Wenger 1991: 98; Roddick 2016: 138; Wendrich 2012: 5). In this context, chaînes opératoires result in the constitution of recognizable traditions (Dietler and Herbich 1994: 247) and are therefore good markers of social boundaries. This is especially true with respect to fashioning techniques, which are particularly resistant to change (Gosselain 2000: 190; Stark et al. 1995: 217). This is in contrast to stylistic elements of crafted items, which may more readily respond to situational factors and thus often exhibit more rapid transformation (Arnold 1994: 486; Hernández 2012: 208). Recognizing the variable rates of change in the different aspects of crafted goods is key to identifying communities of practice. By focusing on the stable, typically less visible, components of craft production (i.e., manufacturing traces), together with other slightly more flexible elements of production, such as clay preparation and finishing techniques, the chaîne opératoire approach allows for the identification of social groups and hypotheses about the historical factors underlying technical variability. We follow this analytical approach in our study of the archaeological pottery from the Olleros sector of the parish of San Miguel de Porotos, which we describe below.

¹ For contemporary Andean examples of complete ceramic chaîne opératoires, see, Bankes (1988); Brazzera (2011); Camino (1982); Druc (2005); Holm (1961); Ramón (2008); Ravines (1976); Sabogal Wiese (1982); Sjöman (1992).

1.2. Study area and project background

Our study area is centered in the rural parish of San Miguel de Porotos, located in Cañar Province in south-central Ecuador, approximately 20 km northeast of the city of Cuenca (Fig. 1). This territory, originally the homeland of the indigenous Cañari peoples, was conquered by the Inca in the mid-fifteenth century. As imperial forays pushed the boundaries of Tawantinsuyu ever northward, the ruler Topa Inca, and later his son and successor, Huayna Capac, developed this region into their base of operations, making it over into a “new Cusco” (Cabello Balboa 1951 [1586]: 340–345). The Inca accomplished this through the relocation of numerous foreign ethnic groups, known as *mitmaquna*, to the area, and an ambitious program of construction (Bray and Echeverria 2018). The site of Tomebamba, atop which was later built the Spanish city of Cuenca, was the principal Inca settlement in this region and the purportedly lavish estate of the ruler Huayna Capac (Rostworowski de Díez Canseco 1999:17; Idrovo 2000). Another important Inca stronghold in the region, which is visible from San Miguel de Porotos, is Cojitambo. The Cerro Cojitambo (3070 m.a.s.l.) is a highly distinctive, andesitic prominence that visually dominates the northern portion of the Cuenca basin. This striking geologic feature was likely a key element of the sacred landscape of the Cañari people (Idrovo 2000:72).

The area of San Miguel de Porotos, which was within Tomebamba’s orbit, is well known for its exceptional clay deposits and is still today a renowned center of traditional pottery production (Holm 1961; Lara 2017). A report pertaining to this region, written in 1582 by Fray Gaspar de Gallegos, contains an intriguing passage that refers to a “town of potters” (“un pueblo of olleros”) that had been a center of pottery production since “ancient times” (“tiempos muy antiguos”). In his report, Gallegos goes on to state that the contemporary sixteenth century

pottery-makers in this area were not actually “natives” but rather had been relocated here (“traspuestos”) after the Inca conquest. This passage suggests that the Inca likely established a *mitmaquna* colony of potters here.² Interestingly, the surname “Inga” is common in San Miguel de Porotos, and one of the most widely known and respected traditional potters in the area is Don Francisco Inga (Roux and Lara 2016:31).

Our research in the region, which dates from 2019 to the present, began with an initial reconnaissance and subsequent pedestrian surface surveys in several communities of San Miguel de Porotos, including Chico Ingapirca, Pacchapamba, Olleros (upper and lower), and Capizhún (Fig. 2). The areas investigated primarily comprise agricultural fields that were either in fallow or planted in maize during our field seasons. Plowing, as well as road construction that occurred in the 1940s, are the main impacts registered in this area. High densities of imperial Inca pottery were recorded on the surface in the Olleros district, as well as to a lesser extent in the adjacent area of Capizhún. We subsequently conducted systematic shovel test pit surveys in these two sectors, with probes placed every 5 m. The quantity of Inca pottery present subsurface in Olleros led us to focus our excavations there.

The general area of Olleros consists of small, individually owned agricultural plots and scattered houses. Because of this, our field investigations were segmented according to property owner with each individual area of study receiving its own designation (i.e., Olleros I – VIII). During 2022 and 2023, we excavated 11 test units to depths ranging from 0.5 to 2.0 m below surface (11.4 cubic meters total excavated fill) in two sectors (II and IV) of Olleros (Bray and Lara 2023). In the relatively small area of Olleros that we sampled (1.8 ha), we recovered 21,300 ceramic sherds, amongst which was an amazing amount of Inca-style polychrome pottery ($n = 3027$, or approximately 14 % of the total assemblage). To put this in perspective, very little Inca-style pottery outside of the immediate vicinity of Tomebamba has been found in the basin of Cuenca (see, for example, archaeological reports by Heffernan 1995; Gomis 2012; Vargas, n.d.). Even at the architecturally impressive site of Ingapirca located approximately 50 km north of Olleros, only 13 percent of the pottery recovered in excavations at the site was identified as Inca (Rivera 1975).

In our excavations, Inca-style and local-style pottery was found mixed in the upper levels of the test units, from approximately 0–60 cm below surface, though in two units, Inca pottery was recovered to a depth of 120 cmbs. In the remaining nine test units, only local style pottery was found below approximately 60–70 cm. Thus, we have no “exclusively” Inca levels at the site, and we know that the area was occupied prior to the Inca incursion into this region. There is, however, a notable difference in the amount of Inca-style pottery recovered in Olleros II versus IV, which are separated by only 50 m. In the former area, Inca-style pottery made up only 7.6 % of the total ceramic assemblage, while in Olleros IV, it constituted 19.5 % of the total.

Importantly, we encountered neither structures nor any definitive workshop areas, though we did document a burned area, a handful of potentially ceramic production-related tools, and a small deposit of red and yellow minerals. Radiocarbon dating of charcoal recovered in the excavation units in Olleros II and IV yielded dates pertaining to the first half of the fourteenth century for the lower levels and approximately cal CE 1450–1550 for the upper levels (Bray and Lara 2023). The



Fig. 1. Map indicating location of the parish of San Miguel de Porotos in relation to Cuenca and Cusco, and the general territory associated with the Cañari ethnic population.

² “Hay en este pueblo muy buen barro para loza, y hácese respecto desto mucha loza, así de tinajas, jarras, ollas, cántaros y otras vasijas para el servicio de los españoles y naturales. Es una loza muy colorada que se tiene en mucho; y así están los olleros aquí de muy antiguos tiempos, que desde el tiempo del Inga hay muy buenos oficiales deste oficio aquí en este pueblo, aunque no son naturales, sino traspuestos aquí por respecto del buen aparejo que hay para la dicha loza; y hácese tan buena y tan pulida, que de muchas partes envían aquí por loza. Y hay mucho bolarménico con que estos indios hacen la loza muy colorada con un matiz que casi como de vidrio, que le dan con el dicho bolarménico” (Gallegos 1965 [1582]:277).

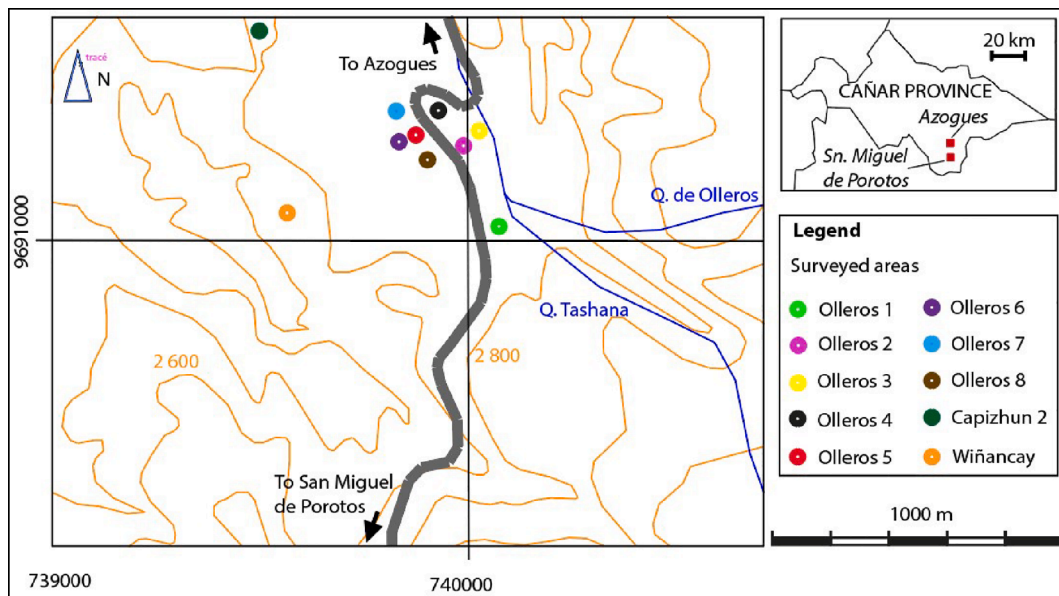


Fig. 2. Map indicating locations of the areas investigated within the communities of Olleros and Capizhun in the Parish of San Miguel de Porotos, Cañar province, Ecuador.

technological analysis we present in this article is based primarily on the materials recovered in excavations in the Olleros sector of San Miguel de Porotos and the area of Capizhun 2.

1.3. Technological analysis of ceramics from Olleros

The study presented utilizes a chaîne opératoire approach, which aim is to quantitatively characterize technical traditions. This type of analysis involves a highly detailed examination of each sherd. Given the impossibility of subjecting the entire assemblage to such detailed technological study, we decided upon a sample size of 20 percent and used a judgmental sampling strategy aimed at exploring potential spatial differences across the area. To avoid biasing the analysis, the entire lot of ceramics from each spatial unit selected was included in the preliminary sort. The criteria for further, microscopic analysis of a sherd was based on fragment size ($>2\text{cm}^2$), state of conservation, and the presence of some visible trace of manufacturing method. Sherds traditionally described as “non-diagnostic” were equally as likely to be included in the next phase of analysis as diagnostics. The spatial lots selected for the technological analysis included (1) all the ceramics from Test Units 10 and 11 in Olleros II; (2) all the ceramics from Test Units 2 and 6 in Olleros IV; and (3) all ceramic material from shovel test probes and the single 1x1 meter test unit (#1) in the area designated Capizhun 2 ($n = 4,154$ sherds in total). In addition to providing good spatial coverage across the area, this selection of units also insured adequate representation of both Inca-style and local-style ceramics, with Olleros IV exhibiting the highest density of Inca material in the study area, and Olleros II and Capizhun producing more local, Cañari wares. The remainder of the ceramics recovered during the two field seasons were quantified and described in terms of morphology, surface treatment, and likely cultural affiliation. Any sherd exhibiting an unusual fabrication-related attribute not already registered in the 20 percent sample was subject to more detailed study and incorporated into the technological analysis.

Each of the steps of a chaîne opératoire is completed through the application of specific techniques, that is, the physical modalities through which raw material is transformed into finished product (Roux 2019: 42). Each of these techniques leaves specific traces in the clay in specific combinations that can be identified thanks to ethnographic and experimental studies (see for example García Rosselló and Calvo Trías

2013; Lara 2017). Thus, the identification of these combinations of traces in archaeological assemblages makes it possible to identify technical traditions and chaînes opératoires. These combinations can be identified through a series of three steps (see Roux 2019: 218 for a complete description of the methodology), which we followed in our study of the Olleros materials. In the first step, the ceramic sherds are examined with both the naked eye and a digital microscope, in this case, a Dino-lite, to identify macroscopically and microscopically visible marks related to fashioning, finishing, surface treatment, decoration, and firing operations.

These observations are complemented by the petrographic and chemical analysis of the ceramics (step 2). From our sample, a total of 74 archaeological sherds were submitted to the Oregon State University Radiation Center for instrumental neutron activation analysis: 29 Inca pottery fragments (identified on the basis of decorative treatment) and 43 Cañari sherds (identified on the basis of rim form and surface treatment) (Minc 2024). For comparative purposes, four clay samples from Olleros area sources used by local potters, as well as two modern sherds from broken vessels produced in two different workshops in San Miguel de Porotos parish were included in the study.

In the third step of the chaîne opératoire analysis, the vessel shapes and decorative treatments are recorded.

In Olleros, the consistent and patterned appearance of specific diagnostic attributes in combination allowed us to establish two principal chaînes opératoires. The first operational sequence, which characterizes 60 percent of the sample, involved the use of both coiling and beating (pounding) as the core manufacturing techniques used in vessel construction. The second, which is represented in 28 percent of the sherds in the sample, involved three fashioning techniques: modeling, beating, and coiling. For the remaining 12 percent of the sample, the chaîne opératoire could not be reliably determined. We describe the two principal production sequences identified and their respective diagnostic attributes in detail below.

The first step in the chaîne opératoire of pottery production involves the selection and preparation of the clay. As determined through neutron activation analysis, the majority of the ceramic samples of both chaînes opératoires form a single, distinct composition group (referred to as the “SMP” group), which is relatively high in cesium and low in REE content. This compositional group is easily distinguished from others previously defined for archaeologically-recovered Inca-style and

local wares from other parts of Ecuador (see Bray and Minc 2020).

The results of the petrographic analysis are still preliminary, but in general, the chemical differences between the clays involved in both chaînes opératoires appear to be minimal. It is, however, worth noting that the paste recipes used for Chaîne Opératoire 1 vessels were slightly more standardized in terms of their elemental composition, rarely exceeding a coefficient of variation (CV) of 30 %. This suggests a somewhat higher degree of consistency and control in the preparation of the pastes that were used to produce the vessels included in this group. In comparison, the pastes of chaîne opératoire 2 were somewhat more variable, especially with respect to certain elements, such as cesium and antimony, which yielded CVs of 60 % and 90 %, respectively (Minc 2024).

1.4. Olleros Chaîne Opératoire 1

The primary forming procedure in Chaîne Opératoire 1 involves coil construction. This technique is revealed by a combination of macro- and microscopically observable features, including surface undulations (Fig. 3a), preferential/horizontal fractures (Fig. 3b), and thickened or raised ridges (Fig. 3c), as well as randomly-oriented voids and fissures that are especially visible in cross-sections of bases and necks (Fig. 3d). Microscopic observation of body sherds evidences a subparallel orientation of voids, which suggests the use of a percussion technique following initial coil construction (see Fig. 4a and 4b – note the difference with Fig. 3d). This interpretation is confirmed by the presence of microscopically visible “micro-pull-outs” (Fig. 4b), which occur as a result of particles adhering to the percussive instruments involved. In one example, macroscopic cupule marks were not erased and can still be clearly seen (Fig. 4c). With regard to the base and neck fragments, the presence of macroscopic depressions indicate that they were shaped through the application of discontinuous pressure rather than the use of percussive techniques. Coil made handles and modeled appliques, which would have been subsequently added, are also present in this group.

Most of the fragments in Group 1 indicate that vessels were subject to two sequential finishing operations. The first one was carried out on leather-hard paste that was re-wet due to the tools employed being continuously dipped in water. Diagnostic attributes of this finishing procedure include the following: macroscopically visible crests caused by an accumulation of the clay slurry (Roux 2019: 145), a compact surface micro-topography, microscopically visible “floating grains” or “coarse fraction grains that protrude on the surface” (Roux, 2019: 149), and thin striations with threaded edges “characterized by a trickle of clay slurry” (Roux, 2019: 153; Fig. 5a). This unique combination of attributes corresponds exactly to the macro- and microscopically observed features on vessels made by modern potters from San Miguel de Porotos (Lara 2017: 141; Fig. 5b). It results from the simultaneous rubbing of the inner and outer leather-hard walls of the vessel with a specific type of tool called a *huactana* or *golpeador*—a mushroom-shaped ceramic object also used as a percussive tool—that the potter continuously re-wets during the vessel finishing process (Fig. 4d).

The second finishing operation was carried out on a leather-hard paste with a dry tool rubbed on the inner and outer surfaces of the vessel, resulting in a compacted micro-topography (Roux 2019: 152; Fig. 6a). On the inner surface, however, in the majority of specimens in the sample, this rubbing was incomplete, leaving some of the striations produced in the first finishing operation visible (Fig. 6b).

Regarding surface treatment, most fragments in the Chaîne Opératoire 1 group exhibit the use of red, white, black/brown, orange, or buff-colored slip. Following the slipping procedure, vessels were often burnished or polished, as indicated by the presence of shiny surface facets (Fig. 7a). The slip is usually fairly thick, dense, and uniformly applied, and it evidences moderate cracking (Fig. 7b).

The use of predominately black, red and white painted decoration is also recorded for this group (Fig. 8). The design formats and motifs registered are those associated with imperial Inca ceramic wares. With

respect to design formats, predominant in the Olleros assemblage is the pattern referred to as Polychrome B (Rowe 1944), which consists of a central panel containing a column of concentric rhombuses flanked by lateral panels filled with rows of pendant black triangles. There are a variety of other design patterns and elements present as well, including the use of red, black, and white checkerboard fill, the use of white dots, the ramified stalk motif, the X-&-bars motif, and a few radial elements.

Firing clouds are rare in this group, while the cores and margins of most fragments evidence light colors that vary between beige and orange (see Fig. 4a). This indicates that the vessels remained in the firing structure through completion of the oxidation process.

As seen in Table 1, the categories of vessel forms in this group include the tall-neck Inca jar (Fig. 9a), the shallow plate (Fig. 9b), the pedestal base pot (Fig. 9d), and the two-handled deep dish (Fig. 9c), as well as a handful of examples of small, face-neck jars (Fig. 9e) and flat-bottom, short neck jars. Based on rim diameter, the tall-neck jars range in size from miniature to very large, with rims measuring between 5 and 42 cm in diameter. There are two dominate size modes in this vessel category: jars with rims 10–15 cm in diameter and jars with rims 25–30 cm in diameter (Fig. 10). The rim diameters of the shallow plates in the sample (n = 38) range from 5 to 50 cm. The majority are 5 to 30 cm in size, with seven specimens exceeding 30 cm in diameter.

1.5. Olleros Chaîne Opératoire 2

As noted above, the chemical differences between the clays used in this technological group and those associated with the former are minimal. Both utilized raw materials that are relatively high in cesium and low in REE content. There is, however, comparatively more variability in the constituent elements of the pastes included in the present group as indicated by the coefficient of variation, which ranges from 10 %–87 %, with differences particularly noted in the elements arsenic, antimony, and cesium (Minc 2024).

Both the bases and the bodies of the vessels in Group 2 were first modeled and then subject to pounding or beating. This is indicated by the combined presence of an irregular microtopography characterized by depressions (Fig. 11a) and cupule marks visible macroscopically (Fig. 11b), as well as micro pull-outs (Fig. 11c), sub-parallel voids, and fissures visible at the microscopic scale (Fig. 11d).

Necks were coil built using either segments or rings as revealed by a combination of macroscopic features that include fissures, horizontal fractures, undulations (Fig. 12a) and ridges (Fig. 12b) together with oblique voids and fissures visible microscopically in cross-section (Fig. 12d). The presence of depressions indicate that final shaping involved the use of discontinuous pressure.

As seen in the previous chaîne opératoire, finishing was carried out on re-wetted, leather-hard paste with a wet ceramic tool (probably a huactana), creating the characteristic surface attributes mentioned in the earlier discussion, i.e., the floating grains and striations with threaded edges observed on a compact microtopography on the interior and exterior vessel walls (Fig. 13a, compare with Fig. 5). In contrast to what we observe for Chaîne Opératoire 1, however, only the interiors of the open vessel forms (bowls) were subject to an additional finishing step, which was carried out with a dry tool on a leather-hard surface and resulted in a compacted micro-topography (Fig. 13b).

The surface treatment operations identified on the sherds belonging to Group 2 are slipping (generally red, sometimes black) and burnishing. Unlike the case for the previous group, in Chaîne Opératoire 2, the slip used is heterogeneous and exhibits considerable cracking (Fig. 14), and the burnishing facets are irregular.

With respect to firing, the cross-sections of most sherds in Group 2 evidence dark-colored cores and light-colored margins. Firing clouds are also visible. In contrast to the first chaîne opératoire, these characteristics indicate that pots were removed from the firing structure before the end of the oxidation phase (Martineau and Pétrequin 2000: 346).

The main decoration technique for vessels manufactured following

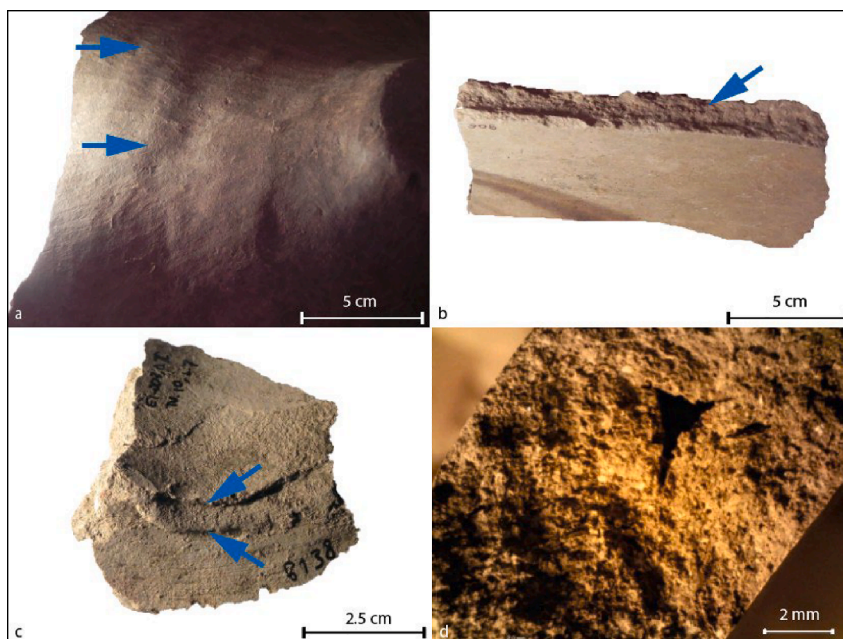


Fig. 3. Diagnostic features of coiling: (a) undulations; (b) horizontal fracture; (c) raised ridges; (d) randomly-oriented voids visible in cross section (magnification: x 31).

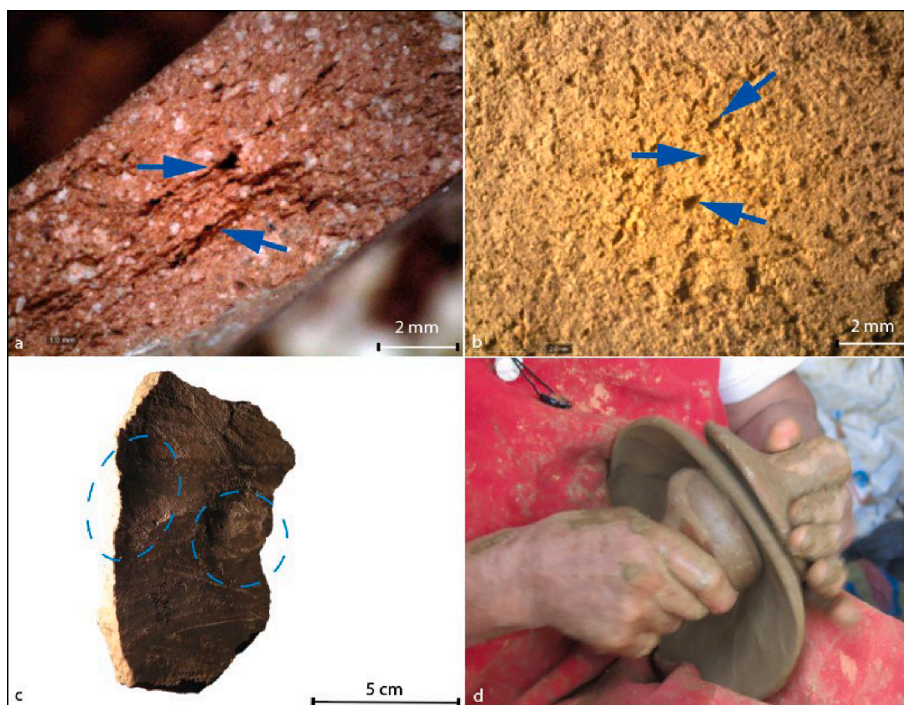


Fig. 4. Diagnostic features of percussion: (a) subparallel orientation of voids (magnification: x 37); (b) micro pull-outs on inner surface (magnification: x31); (c) macroscopic cupule marks; (d) modern use of *huactanas* in Taquil (Loja province, Ecuador).

Chaîne Opératoire 2 is painting. For the unrestricted forms, red painted rims are a common type of embellishment (Fig. 15a). Many open forms, or bowls, also exhibit crossed red bands painted on the bottom interior of the vessel (Fig. 13d). On restricted forms, white bands on red or black slip are sometimes painted on either the vessel neck or body (Fig. 15b and 15c).

The vessel forms produced as described in Chaîne Opératoire 2 include tall and short neck ollas, shallow plates, tripod plates, very small bowls, and shallow bowls (Fig. 16). The diameter of the ollas varies

between 8 and 20 cms, the diameters of shallow bowls between 8 and 16 cms, and the diameters of very small bowls between 2 and 5 cms.

1.6. Summary of Archaeological Chaînes Opératoires Identified in Olleros

The results of the chaîne opératoire analysis performed on a sample of archaeological ceramics from the Olleros sector of San Miguel de Porotos is summarized in Table 2. According to the preliminary results of the compositional and petrographic analyses, the clays used in both of

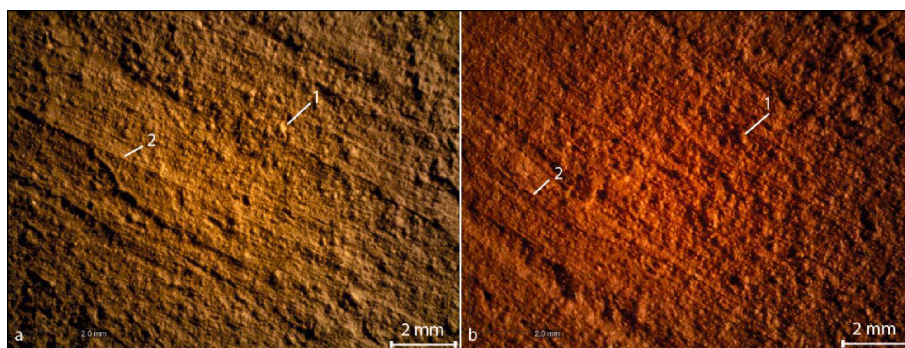


Fig. 5. Microscopic diagnostic features of finishing by rubbing with ceramic huactanas on a re-wetted, leather hard surface (magnification: x 28): (a) archaeological sample from San Miguel (Olleros); (b) ethnographic sample from San Miguel (Pacchapamba); 1: floating grains, 2: thin striation with threaded edges.

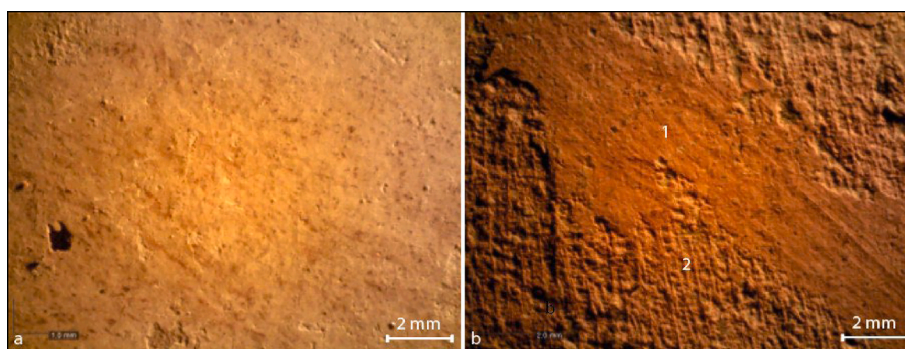


Fig. 6. Microscopic diagnostic features of finishing on a leather-hard paste with a dry tool: (a) external compacted surface (magnification: x 30); (b) inner surface (magnification: x 27); 1: compacted surface, 2: striated surface corresponding to previous finishing operation.

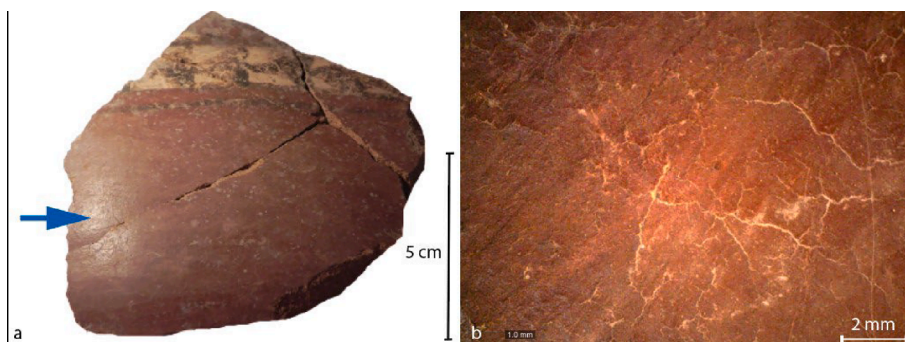


Fig. 7. Diagnostic features of surface treatment of vessels included in the Chaîne Opératoire 1: (a) shiny surface caused by burnishing; (b) homogeneous layer of slip with presence of cracks (magnification: x 26).

the operational sequences identified in the Olleros assemblage are from the same sources. Based on a close chemical match with two modern sherds from vessels produced by potters in local workshops who use locally available clays, we are confident that the raw materials for the archaeological ceramics derive from the general area of San Miguel de Porotos, which, as noted earlier, has been recognized as an important source of high-quality clays since at least the time of the Inca.

Looking first at the less common production sequence identified in the Olleros assemblage, that is, Chaîne Opératoire 2, we note that the technological features of production observed match precisely with the

operational sequence of production identified for Cañari pottery from elsewhere in the region based on previous studies (Lara 2017).³ This local style ware, which dates from approximately 1000–1500 CE, has been documented throughout the greater Cañari territory of southern Ecuador (Lara 2017). The main operational chain associated with the production of Cañari pottery has been previously defined by Lara (2019) based on technological studies of both archaeologically excavated and museum pieces. The primary forming technique associated with the production of Cañari wares involved both percussive beating and the use of the unique mushroom-shaped objects known as huactanas, which

³ Prior to the Spanish invasion, Cañari territory encompassed the region that now comprises the modern provinces in southeastern Ecuador of Cañar, Azuay, southern Chimborazo, eastern El Oro and Guayas, western Morona Santiago, and northern Loja.

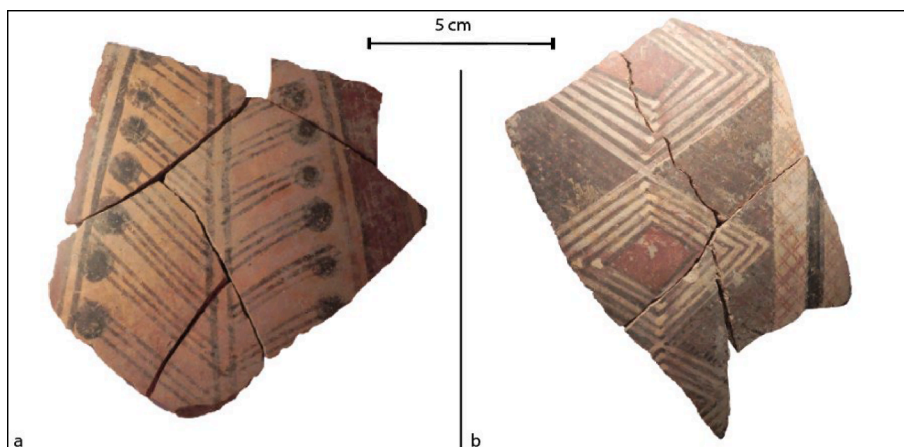








Fig. 8. Examples of black, white and red paintings of vessel fragments included in Chaîne Opératoire 1: (a) ramified stalk motif; (b) concentric rhombuses in center panel. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 1

Vessel forms associated with Chaîne Opératoire 1, which corresponds to Inca-style imperial pottery. Total counts of each vessel type recovered in the study area are given below icon.

Tall-neck jar	Shallow plate	Pedestal-base pot	Deep dish	Face-neck Jar	Flat-bottom jar
					
N = 852	N = 121	N = 22	N = 10	N = 2	N = 1

have been found in archaeological contexts (Almeida et al. 2014: 272; Idrovo 1989: 6; Sjöman 1991: 71; Valdez 1984: 169).⁴ The potters in the San Miguel de Porotos region, both past and present, utilize huactanas (which they also make from clay) to fashion ceramic vessels via a hammer-and-anvil technique that relies on two such objects, one slightly convex, held on the inside of the vessel, and the other slightly concave held on the outside. This percussive technique employing this unique set of objects has been documented in only a few other settings ethnographically (see Lara et al. 2023). We are thus confident in linking the Olleros Chaîne Opératoire 2 to the Cañari culture.

With respect to Chaîne Opératoire 1, it is clear from both a formal and stylistic standpoint that this operational sequence is associated with the production of imperial Inca pottery, which, given our sample, pertains primarily to the tall-neck Inca jar form, commonly known as the *aribalo*.⁵ But the combination of microscopic traces of the forming and finishing methods identified indicate the use of huactana-type percussive tools in the manufacture of these Inca-style vessels. As noted, these tools, and this particular method of shaping a vessel through a unique hammer-and-anvil process, is proper to the native Cañari people of the region and their descendants. Such shaping and finishing methods are specifically local and contrast with the few reports on manufacturing techniques employed in the production of imperial pottery in the Cusco area, which, based on present data, appear to have involved primarily coil construction (Lunt 1987; Quave 2012:214, 222). We therefore hypothesize that our sample of Inca ceramics from Olleros in the parish of

⁴ See Lara and Iliopoulos (2020) on the corresponding techniques used and combinations of diagnostic attributes observed on Cañari wares.

⁵ Due to the fact that most of the shallow plate fragments we recovered were quite small, it was generally not possible to ascertain the primary forming technique involved, i.e., whether they were coil built, modeled, or shaped with the use of percussion.

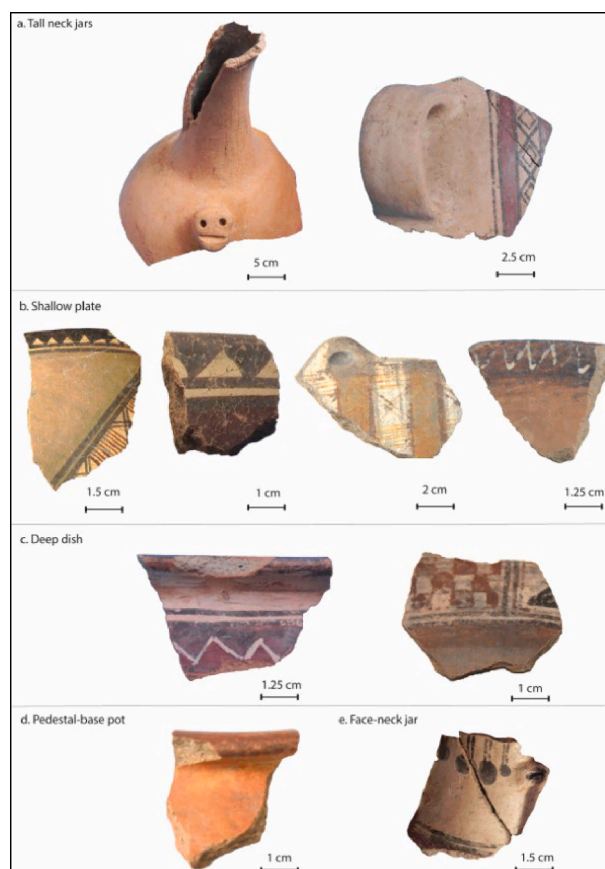


Fig. 9. Fragments of main vessel types represented in the sample: (a) tall-neck Inca jar; (b) shallow plate rim sherd; (c) deep dish; (d) Pedestal-base pot; (e) Face-neck jar.

San Miguel de Porotos was either produced by foreigners who adopted local methods of manufacture, or by Cañari potters who were either resident in this area or resettled here from more distant sectors of Cañari territory. Given the sum of the evidence, we lean toward the latter option, as we discuss further below.

2. Discussion

If indeed it was Cañari potters involved in both of the chaînes

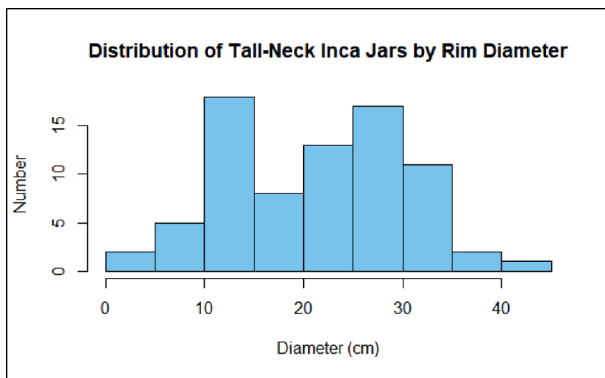


Fig. 10. Histogram illustrating the distribution of the rim diameters of the tall-neck Inca jars in Olleros sample and the two dominant size modes ($n = 78$).

opérateiros identified, the differences highlighted between the two ceramic production sequences bring forward issues relating to our initial questions about the adaptation of local techniques to the manufacture of foreign forms and the way in which the Inca affected the organization of production in different sectors of the empire. The technological data assembled in this study suggest that local pottery-making skills were converted to meet the requirements of the imperial state, with a potentially added mandate imposed by the authorities to ensure that differences between wares were materially marked.

As seen above, based on the preliminary results of the compositional analysis, it appears that although the clays used were essentially the same for both operational chains present in the Olleros assemblage, the preparation differed slightly for Inca-style ceramics compared to the Cañari wares, with the Inca pottery exhibiting more uniform paste composition. This is similar to what other scholars who have conducted comparative studies on Inca and local ceramics elsewhere in the Andes

have reported (e.g., Bray and Minc 2020:10; Chacaltana-Cortez et al. 2023:3; Hayashida et al. 2002:579; Páez and Sardi 2014:73).

The data also reveal differences in the finishing techniques utilized. As seen above, the first, wet-smoothing operation on leather-hard clay is the same in both chaînes opératoires. But the application of a second, dry-finishing step depended on the vessel form in question. In the Cañari assemblage, the interior surfaces of unrestricted forms (i.e., bowls) received the secondary finishing treatment, while the restricted vessel forms (i.e., ollas) did not. This contrasts with the restricted vessel forms in the Inca assemblage, which in our sample consist primarily of the tall-neck Inca jars. For these vessels, the second finishing operation was performed on both the interior and exterior surfaces, resulting in the full or partial erasure of the striations created by the initial smoothing operation. That this secondary finishing step was applied to the difficult to access interior walls of tall-neck jars not visible to consumers and not serving any obvious functional purpose indicates an intention to elevate the quality of these vessels or mark their superiority in some fashion.

This type of differentiation is seen again in the surface treatments that characterize the Cañari and Inca pottery from Olleros. As noted, the slips applied to the Inca-style ceramics in the local assemblage are much denser and more uniform in comparison to those used for the Cañari wares. Likewise, the high degree and more thorough coverage of the burnishing noted on the Inca ceramics contrasts markedly with the Cañari materials. Along these same lines, it also appears that the imperial style wares in our assemblage were generally better fired. Similar observations have been made by various other researchers in studies of Inca ceramics around Tawantinsuyu (e.g., Chacaltana-Cortez et al. 2023; Ratto et al. 2002; Szilagyi et al. 2012; Vera et al. 2019). Taken together, the evidence suggests a concerted effort to materially mark difference and elaborate a higher quality ceramic assemblage to represent the imperial state.

The differences in production quality evidenced in the two technological traditions is noteworthy and calls attention to the skill levels and

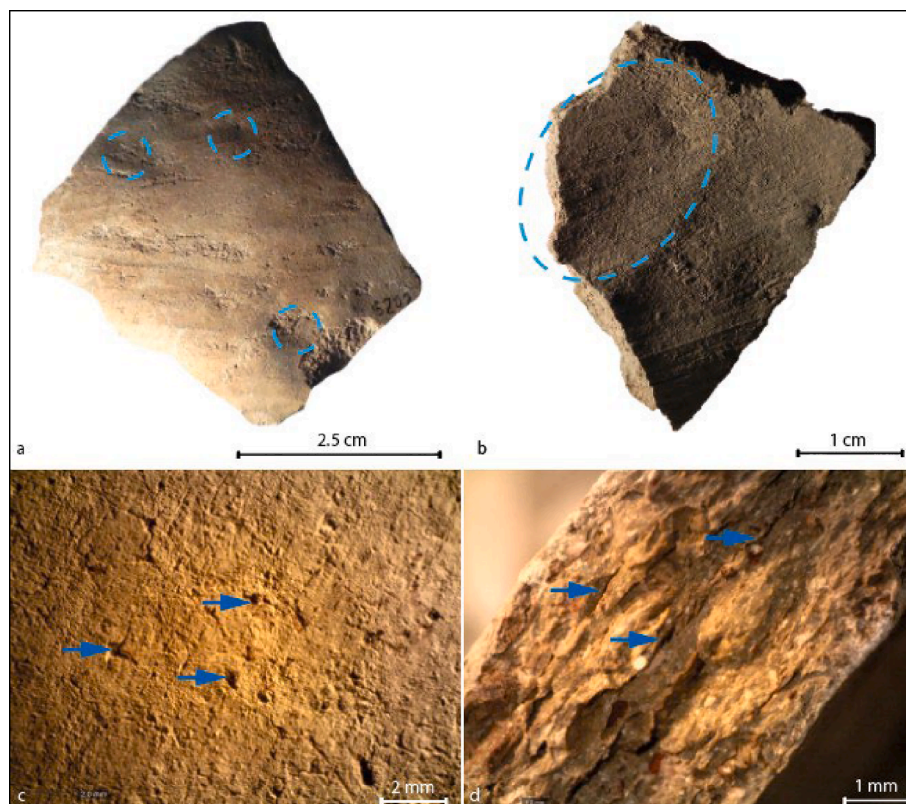


Fig. 11. Diagnostic features of manufacturing in Chaîne Opératoire 2: (a) Irregular macrotopography with depressions; (b) cupule marks; (c) micro pull-outs (magnification: $\times 28$); (d) subparallel voids (magnification: $\times 45$).

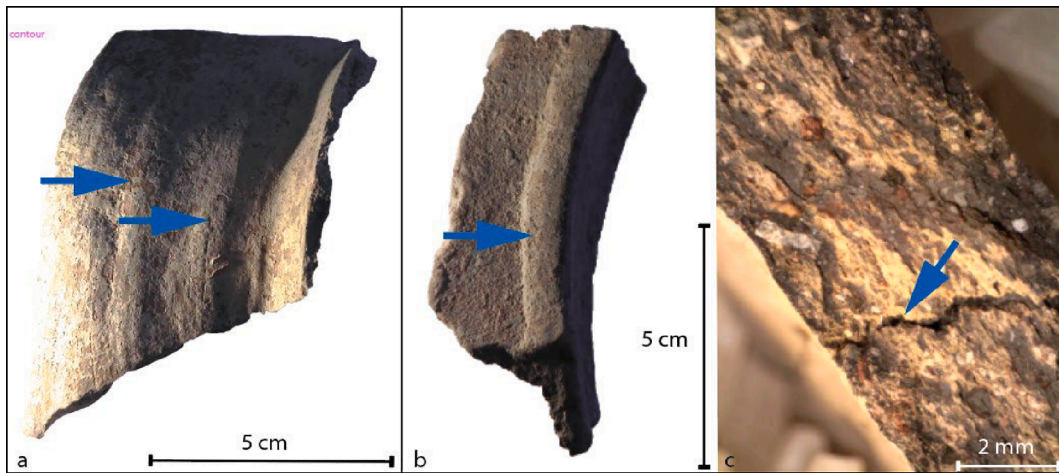


Fig. 12. Diagnostic features of coiling seen on necks of vessels in Chaîne Opératoire 2: (a) undulations; (b) ridges; (c); (d) microscopic fissure visible in cross-section (magnification: x 31).

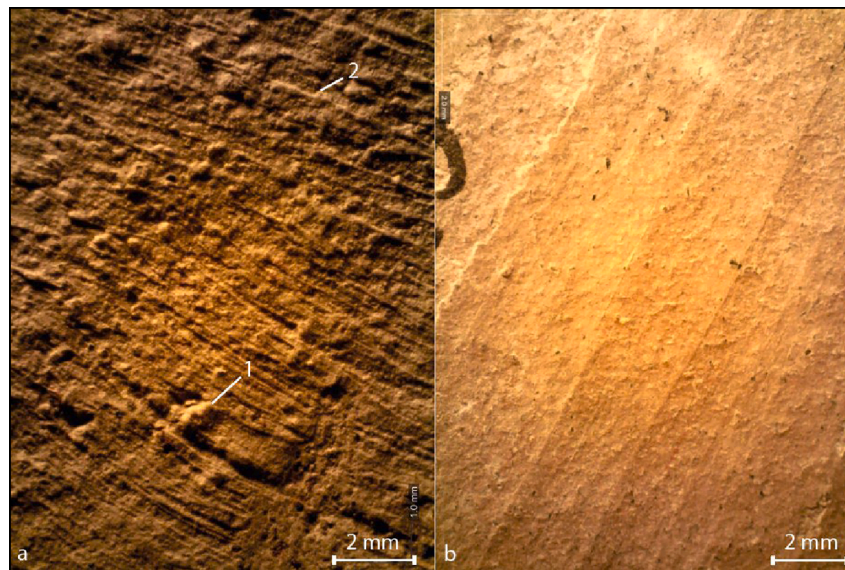


Fig. 13. Microscopic diagnostic features of finishing procedures used in Chaîne Opératoire 2: (a) striations produced by rubbing with ceramic huactanas on a re-wetted leather hard surface (internal): 1-floating grains, 2-thin striation with threaded edges on a compact microtopography (magnification: x 29); (b) surface produced by rubbing of a dry tool on a leather-hard paste on the interior of an unrestricted vessel (magnification: x 26).

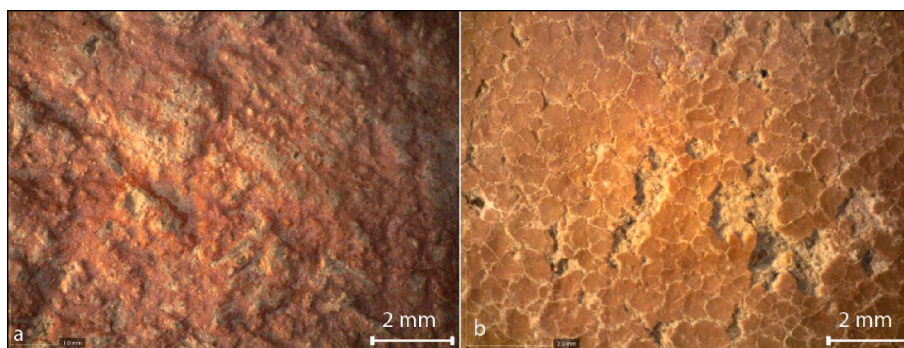


Fig. 14. Characteristics of slips applied in Chaîne Opératoire 2: (a) heterogeneous composition of the coating; (b) extensive cracking of slip on exterior surface of vessel.

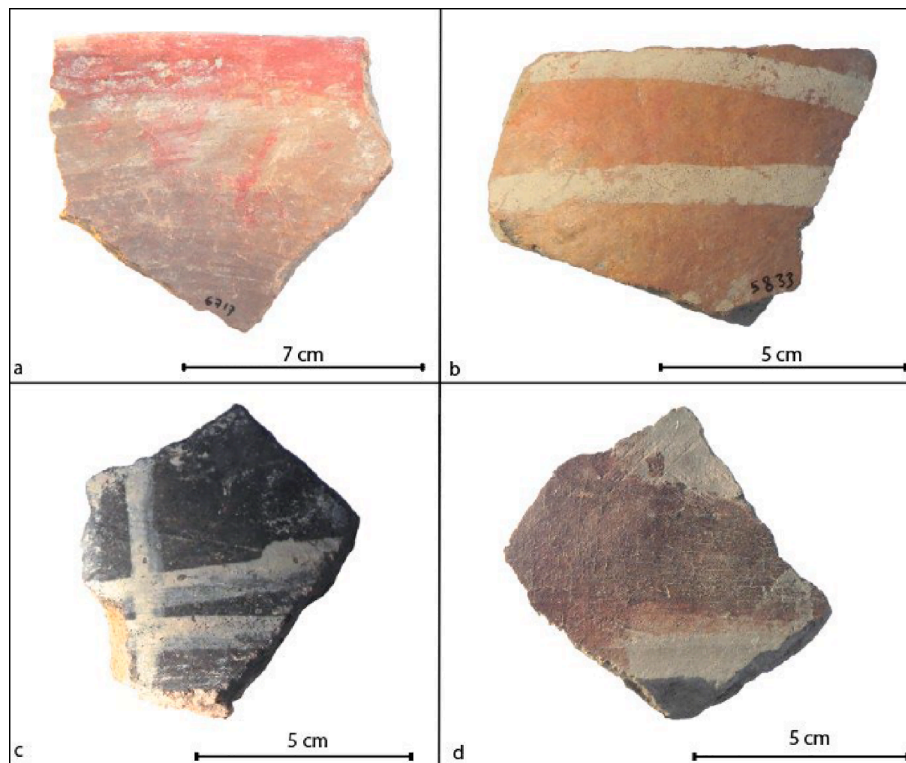


Fig. 15. Main decorations patterns observed in the Chaîne Opératoire 2: (a) painted red rim; painted white bands on body (b) and necks (c); (d) painted red bands on the bottom interior of an unrestricted vessel. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

identity of the potters engaged in the manufacture of imperial Inca-style ceramics in this region. Local archaeologists have previously observed that the quality of Cañari pottery in the period immediately preceding the Inca incursion seems to have declined. Idrovo (2007: 90), for instance, interprets the changes noted as relating to a “drop in the value accorded to pottery” in the region (also Idrovo and Gomis 2009: 38).

The manufacturing techniques typical of the Cañari tradition involve modeling, beating, and coiling with a special set of tools. Inca-style pottery from Ollereros was produced through a combination of coiling and beating—the latter procedure apparently accomplished with the same Cañari toolkit, based on the detailed comparative analyses of the diagnostic marks associated. As noted above, studies of Inca pottery in Cusco indicate that coil building was the primary method of vessel construction. The use of hammer-and-anvil techniques for pottery production in the south-central Andes during the pre-Columbian era has not been previously reported.

A reliance on learned behaviors and traditional techniques to create novel products is not unexpected (see Ramón and Bell 2013: 596; Sjöman 1992: 260; Stark 1991:203). In a set of ethnographic experiments conducted in five different cultural contexts (Ecuador, India, Kenya, Ethiopia and Cameroon), Roux and colleagues (2024) engaged potters to produce vessel forms completely outside the scope of their normal repertoires. Their research demonstrated that (1) potters relied on traditional skills and techniques of manufacture, sometimes combined in different ways, to produce the novel forms requested, and (2) not all potters were equally capable of adequately reproducing the models they were asked to copy. Of further note here is that contemporary potters from the parish of San Miguel de Porotos, who continue to use the mushroom-shaped huactanas to produce their traditional vessel forms, were included in this ethnographic study.

2.1. Special Specialists?

Based on the experimental study undertaken by Roux and colleagues

(2024), it is clear that not every practicing potter is able to reproduce a completely novel vessel form, especially given that shaping is the most complex action in the operational chain (Roux 2019: 41). Their research revealed that only the most skilled or expert practitioners managed to adapt their usual techniques to approximate completely unfamiliar vessel shapes. From a morphological point of view, we note that the traditional Cañari vessel forms are mainly globular or rounded in shape and thus well suited to elaboration through the use of huactanas (for a synthesis of the Cañari morphological repertoire, see Lara 2017). The Inca tall-neck jar, on the other hand, represents a distinctive, composite form involving a conical base joined to an ovoid-shaped body via a pronounced carination, topped by a cylindrical neck with a wide flaring rim. The pointed conical base and the pronounced point of inflection between the base and the body are particularly difficult to achieve through the manufacturing techniques of modeling and beating that were used by the Cañari potters, and that are still today by traditional potters in the San Miguel de Porotos region (Roux et al. 2024: 18).

The challenge of succeeding at the task of producing unfamiliar vessel forms with the learned behaviors and tools at hand underscores the probability that highly skilled, expert potters were those most likely tapped by the Inca state. Not just any pottery-maker would have been able to meet the production standards imposed by the authorities. That the Inca relied on “special” specialists is suggested in the document cited earlier by Gallegos (1965 [1582]:277), who wrote that “since the time of the Inga, there have been very good officials [craftspeople] of this trade [pottery production] here in this town [Pelesú and its surroundings], although they are not native, but rather transferred here due to the good materials that exists for the [manufacture of] said pottery.” Other colonial documents similarly suggest that the Inca selected potters on the basis of their expertise, as well as their ethnicity (Kosiba et al. 2023:3).

We interpret the term “traspuestos” used by Gallegos in his report to refer to the presence of mitmaquna who would have been moved into this region by the Inca. We suggest that such mitmaquna were likely

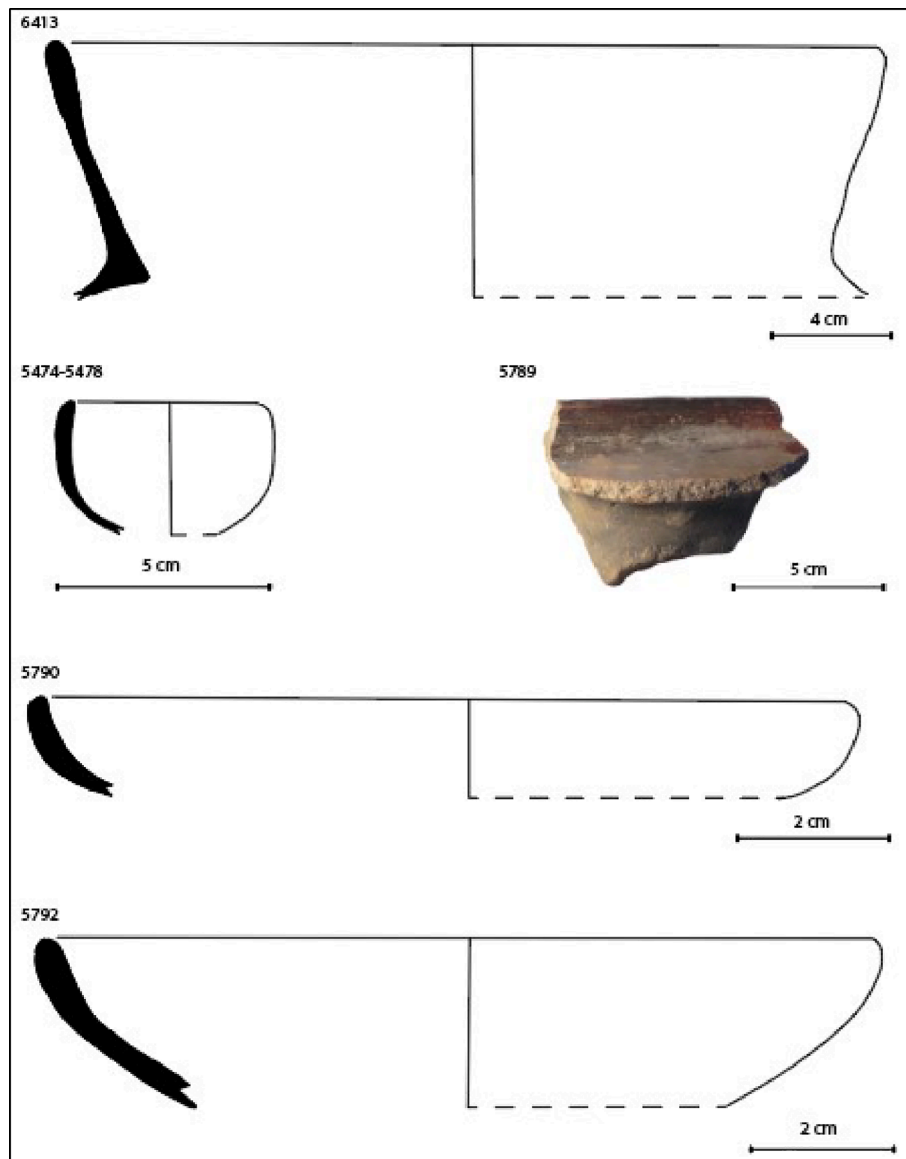


Fig. 16. Main vessel types associated with Chaîne Opératoire 2: Tall-neck olla (6413); small bowl (5474–5478); leg and interior fragment of a tripod plate 5789; shallow bowls (5790, 5792).

the ones who produced the Inca ceramics recovered in our excavations in Olleros. Based on the ceramic chaînes opératoires identified, we hypothesize that these mitmaqkuna were expert ceramicists who had been deported to the Olleros area from a different part of the Cañari territory. Although the best known and most often cited cases of mitmaqkuna correspond to deportations that involved the movement of imperial subjects over great distances, there is also evidence of more localized displacements. Examples of this have been noted by [Idrovo \(2000: 313\)](#) with respect to several Cañari groups, by [Jijón y Caamaño for this and other regions of Ecuador \(1941–43: 45–48\)](#), and in other late sixteenth and early seventeenth century reports from the Cajamarca and Ancash regions of north and central Peru ([Spurling 1992:250](#); [Hernández Príncipe 2003 \[1621\]:763 – 764, 776](#)) and the Titicaca basin ([Spurling 1992:380](#)). In some cases, the ethnohistoric documentation suggests that deportees *and their offspring* were permanently conscripted to labor in the production of ceramic wares for the imperial state (see [Mori and Malpartida 1967 \[1549\]](#); [Ortiz de Zúñiga 1967 \[1562\]](#)). Such observations strongly suggest that new communities of practice would have evolved in the context of Inca sociopolitical maneuvering and empire-building.

In our particular study area, the archaeological evidence suggests that the mitmaqkuna resettled here for the purpose of producing imperial Inca-style vessels likely worked in close proximity to the native Cañari potters of the region. Importantly, the lower levels of our excavation units in Olleros II and IV, which dated to the fourteenth century, contained only Cañari pottery ([Bray and Lara 2023](#)). This indicates that Cañari peoples occupied this area prior to the Inca incursion. The side-by-side presence of two similar though not identical archaeological chaînes opératoires relating to ceramic production in the later, upper levels of our excavations in the Olleros area could suggest either distinct communities of practice, i.e., resident and resettled potters in the same area, or the presence of one community of potters engaged in a kind of “material code switching” that responded to consumer requirements, i.e., those of the Inca state.

Examples of the latter type of practice are known both ethnographically and archaeologically. In the province of Loja in southern Ecuador, for instance, one expert potter and her daughters regularly fabricate both elegant, finely decorated vessels and very different, rough plainwares using different techniques of manufacture, applying different surface treatments, often using different clay preparations, and

Table 2

Summary of the two ceramic chaînes opératoires identified in the sample of archaeological sherds recovered in Olleros, parish of San Miguel de Porotos, Ecuador.

Chaîne opératoire stage	CHAÎNE OPÉRATOIRE 1	CHAÎNE OPÉRATOIRE 2
Provenance of clay material		Local
Manufacturing (rough-out)	Coiling	Modeling (base/body) and coiling (neck)
Manufacturing (shaping)	of body only	Beating of base and body
Finishing operation 1	On re-wetted leather-hard paste with a wet ceramic tool (huactana)	
Finishing operation 2	On leather-hard paste with a dry tool	
Surface treatment	Inner and outer surfaces (restricted forms)	Inner surfaces of unrestricted forms only
Decorative techniques	Slipping and burnishing Painting	
Firing	Pots removed from the firing structure after the end of oxidation phase	Pots removed from the firing structure before the end of oxidation phase

sometimes even distinct firing structures (Lara, unpublished notes). Archaeological evidence from ceramic production sites in other provincial areas, such as the Titicaca basin (Spurling 1992) and the north coast of Peru (Hayashida 1995, 1999), as well in Cusco proper (Quave 2012:229-230), similarly indicate that multiple styles of ceramics could be produced within a single workshop, presumably by the same resident potters. We also know, however, based on a handful of early reports, that the Inca could order one conscripted community of pottery-makers to focus on the production of fine wares for the authorities, and another to produce basic plain wares of lesser quality.⁶

Which of these scenarios best describes the situation after the Inca conquest of the Cañari region of southern Ecuador remains an open question. What we strongly suggest, however, based on the detailed analysis of the chaîne opératoire of Inca and Cañari style ceramics from Olleros and various ethnographic studies, is that only the most skilled or expert Andean potters could have met the formal technical requirements involved in the production of the wares associated with the imperial Inca state. This, in turn, suggests that the Inca exercised considerable care in their selection of craft specialists to produce the exquisite objects that played such an important role in imperial strategies of persuasion. Such special specialists likely formed their own communities of practice around the Empire, which we can assume centered on areas particularly rich in high quality raw materials, such as the clay deposits and quarries around San Miguel de Porotos, potentially displacing pre-existing, local communities and thus altering the social landscape in significant ways.

CRedit authorship contribution statement

Catherine Lara: Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Tamara L. Bray:** Writing – review & editing, Writing – original draft, Visualization, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence

⁶ See, for instance, Murúa (1987 [1590]:403), who states that there were "... Oficiales olleros de obra pulida para el Ynga; y oficiales de obra tosca."

the work reported in this paper.

Acknowledgments

Our archaeological research in the parish of San Miguel de Porotos, Ecuador, was conducted under the auspices of the INPC, permit nos. Ñ-066-CL-2022-01; Ñ-071-CL-2023. The multi-year project was funded by several organizations, including the Rust Family Foundation, the Gerda Henkel Foundation Research Award, the Society for American Archaeology (H&T King Grant for pre-Columbian Archaeology), Wayne State University, and the UMR 8068 Technologie et Ethnologie des Mondes Préhistoriques. We are grateful for the financial support of these institutions. We also wish to acknowledge the assistance and support of many others who contributed to the success of our project. Within the community of San Miguel, an array of people offered their friendship and support, including local historian, Don Fernando Quintuña; officials in the local government (GAD): Don Manuel Ortiz, Don Juan Sumba, Katalina Calle, Adriana Sarmiento; in the field: Christian Brito, Edwin Piña, Ricardo (Mickey) Peralta, Freddy Ortega, and Matías Rodríguez Calle; and in the community at large: Moisés Pérez, Eduardo Ludizaca, Graciela Matute, Father Carlos Quinteros, Ruth Carrillo, and Ana Gordillo. Wayne State students Gabriela Lloyd Perez and Amanda Ford shared in the fieldwork in San Miguel and contributed in important ways to our community outreach efforts. In Olleros, we gratefully acknowledge those who kindly granted permissions to conduct survey and excavations in their fields, including Alejo Piña, Blanca Jara, Ángel Torres and family, Ángel Inga, Elvia Inga, María Cajas, Olga Calle, Teolinda Tenenpohuay, Teresa Hurtado, and Segundo Inga. Friends and colleagues in Cuenca and Quito also assisted us with various aspects of this project, including Raúl Marca, Victoria Domínguez, Francisco Sánchez, María Patricia Ordóñez, Lenin Uriarte, Cristina Carrasco, Tania García, Richard Santos, and Diana Cotape of the INPC, Marcos Sempértegui and Tamara Landívar of the Museo Pumapungo, and José Luis Espinoza and Benigno Malo of Cuenca.

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