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Research Article

Potting communities and conservatism in the Purépecha empire at Angamuco, Michoacán, Mexico

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Abstract

Stylistic shifts in ceramics are often linked with sociopolitical changes, yet adopting new ceramic designs may indicate anything from shared aesthetic appeal to emulation. Focusing on multiple ceramic technologies is critical for understanding ceramic changes as they relate to wider social fluctuations. The relationships between clay and ceramic recipes, and communities of practice, have not been studied at the urban landscape of Angamuco, Michoacán in western Mexico. Petrographic and geochemical analyses of tempers and fabrics indicate that ceramics, including imperial Purépecha (A.D. 1350–1530) vessels, were created from local and regional materials, and that these materials remained relatively stable for over 1,000 years. Ceramic archaeometry in western Mexico has been relatively limited compared to other parts of Mesoamerica, and this study may be compared to future studies in the region.

Resumen

Los cambios estilísticos en la cerámica a menudo están relacionados con cambios sociopolíticos, en donde la adopción de nuevos diseños ceramistas va desde un atractivo aspecto estético compartido hasta la emulación. Enfocarse en diversas tecnologías cerámicas es fundamental para comprender los cambios y su relación con fluctuaciones sociales más amplias. La relación entre la arcilla, las recetas cerámicas, y las comunidades de práctica no han sido estudiadas en el paisaje urbano de Angamuco, Michoacán, en el oeste de México. Los análisis petrográficos y geoquímicos de desgrasantes y tejidos indican que la cerámica, incluyendo las vasijas imperiales purépechas (1350–1530 d.C.), fue creada a partir de materiales locales y regionales, y que estos materiales permanecieron relativamente estables por más de 1,000 años (250–1530 d.C.). La arqueometría cerámica en el occidente mexicano ha sido relativamente limitada comparada con otras partes de Mesoamérica, y este estudio puede compararse con otros que evalúan los cambios tecnológicos y la continuidad a través de los cambios políticos tales como la formación del imperio.

Este estudio analiza la continuidad y el cambio en la producción cerámica y pone en consideración la participación de los alfareros de Angamuco en las comunidades de práctica en la elaboración de cerámica de estilo Purépecha durante el periodo preimperial e imperial. Se utilizó el Análisis por Activación Neutrónica (AAN) y petrografía cualitativa para analizar 300 fragmentos de cerámica y 30 muestras de arcilla natural del sitio de Angamuco. Los fragmentos fueron recogidos de contextos habitacionales y públicos del periodo preimperial e imperial. El AAN resultó en cuatro grupos geoquímicos (interpretados como recetas distintivas de masa), dos de los cuales son exclusivos de Angamuco y dos que pueden relacionarse con trabajos previos de caracterización en la Cuenca del Lago de Pátzcuaro. Se seleccionó una submuestra de 36 fragmentos y nueve muestras de arcilla para el análisis petrográfico con posible relación con los grupos del AAN. El análisis petrográfico identificó siete grupos principales de tejido cerámico y cuatro agrupaciones de arcilla, de los cuales todos incluyeron desgrasante de basalto y/o de ceniza. Los conjuntos de datos geoquímicos y petrográficos posteriormente fueron combinados y evaluados en busca de patrones cronológicos y espaciales en Angamuco.

Los resultados de este estudio muestran que hay varias fuentes de arcilla y desgrasantes explotados a lo largo de las ocupaciones de Angamuco y que denotan continuidad a lo largo del tiempo. También hay diferentes fuentes utilizadas para la producción de cerámica durante el período imperial postclásico tardío (1350-1530 d.C.). Por ejemplo, existe variación en la cantidad de ceniza añadida a las arcillas durante el período imperial, lo que podría reflejar la elección individual al tamizar o lavar las inclusiones naturales o agregar desgrasantes. No obstante, la continuidad en los grupos de AAN y tejidos desde el periodo clásico hasta los períodos postclásicos tardíos indica que, a pesar de los cambios ambientales y sociales a lo largo de cientos de

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años y cambio en las formas y estilos cerámicos producidos, se continuaban utilizando los mismos recursos y técnicas de producción. Esto no solo refleja la conservación tecnológica en la producción y aprendizaje de la cerámica, sino también el éxito de los productores al aplicar las mismas técnicas y materias primas dentro de una comunidad de práctica. Por último, algunas fuentes de arcilla y desgrasantes pueden relacionarse de manera consistente con otras partes de la Cuenca del Lago Pátzcuaro, lo que sugiere que los alfareros podrían haber viajado a otras fuentes o intercambiado con otros alfareros para obtener materias primas de manera continua. Finalmente, el enfoque en las recetas de arcilla y masa como dos facetas de la producción de cerámica demuestra que pueden proporcionar información importante sobre las elecciones tecnológicas de los alfareros dentro de sus comunidades de práctica.

Keywords: community of practice; technological conservativism; ceramics; geochemistry; petrography; Purépecha (Tarascan)

Archaeologists often use ceramic stylistic changes as a way of identifying sociopolitical fluctuations such as state and empire formations, and these stylistic shifts are interpreted to reflect materialization of political identity or authority (Costin 2022; DeMarrais et al. 1996; Pauketat and Emerson 1991). This can be an initial approach for identifying stylistic changes over time, but it has been demonstrated ethnographically that shifts in vessel form and surface treatment can be superficial—by copying designs from neighboring groups (Gosselain 2000, 2008). Adopting new designs may reflect changes in desired relationships between groups, and such changes may indicate anything from a shared aesthetic appeal to emulation. When trying to understand connections in ceramic production and sociopolitical fluctuations, it is important to consider other aspects of ceramics that are less susceptible to copying, such as clay recipes and formation techniques (Roux and Courty 2013; Womack et al. 2019).

One way of exploring how knowledge of ceramic production is passed over time is by considering the role of communities of practice. Often defined as social networks in which potters share knowledge about production and motor skills (e.g., Eckert 2012; Eckert et al. 2015; Sassaman and Rudolphi 2001; Stark 2006), a community of practice usually involves hands-on learning. This type of learning, which has been observed ethnographically (Bowser and Patton 2008; Minar and Crown 2001), may include surface finishing but also temper choice and preparation skills. The identification of ceramic communities of practice suggests that scholars can detect the social networks in which potters learned their craft, and that the study of ceramic technology and any associated social changes should ideally involve analysis of all production steps, including clay recipes and vessel-forming and -finishing techniques.

Understanding continuity and change in ceramic production is particularly salient in contexts where stylistic changes in ceramics have been linked to sociopolitical fluctuations such as state and empire formation. In western Mexico, the precontact Purépecha empire, circa A.D. 1350–1530, has long been associated with imperial-style ceramics that are characterized by spouts, globular supports, polychrome decorations, intricate drawings; and wax-resist firing (Cabrera Castro 1996; Pollard 1993; Rubín de la Borbolla 1939, 1941). The presence of these ceramics is often associated with other material changes, such as increasing numbers of metal artifacts and the appearance of semicircular pyramids called *yácatas*. These material changes are explained as a reflection of state formation sometime during the Middle Postclassic period (A.D. 1100–1350), culminating in the Purépecha empire during the Late Postclassic (A.D. 1350–1530) (e.g., Pollard 2008). Despite these material changes, previous work on pottery production in the imperial core Lake Pátzcuaro region suggests that paste recipes were relatively consistent for over 1,200 years (~A.D. 250–1530) (Cohen et al. 2023; Hirshman 2008, 2017, 2018). Other ceramic paste and mineralogical data from one site in the core region similarly indicates conservative continuation of technology over the same time period (Cohen et al. 2018; Cohen et al. 2019). Moreover, an explanation for continued technological practices of paste recipes and clay procurement within the context of changing ceramic symbols and decorations remains unexplored (however, see Hirshman 2018).

This analysis builds on studies of ceramic communities of practice, which explore the connections between ceramic production, style, and sociopolitical changes. By combining petrographic and geochemical ceramic data, I show that Purépecha potters at the site of Angamuco were part of a community of practice that persisted despite broader political changes. Although these political changes are visible materially in new ceramic forms and surface decoration, I show that ceramics were mainly created using local clays and materials over multiple centuries. I contend that these procurement and production activities were consistent because they reflect a community of practice that resulted in the conservative continuation of technology. This study highlights that although changes in ceramic form and decoration may signal sociopolitical changes such as state and empire formation, information about production techniques and paste recipes can shed light on the technological impacts of these changes.

Social changes in the imperial heartland

Angamuco was an urban landscape mainly located on lava flows in the Lake Pátzcuaro Basin, Michoacán, Mexico (Figure 1). In the centuries before European arrival in Mexico, this lake basin was the center of the Purépecha empire, which at times controlled 750,000 km^2 of western Mesoamerica. Although the exact dates of state and empire formation are unclear, beginning at least during the Early to Middle Postclassic periods (ca. A.D. 900–1350), the lake basin and surrounding regions were home to numerous nucleated

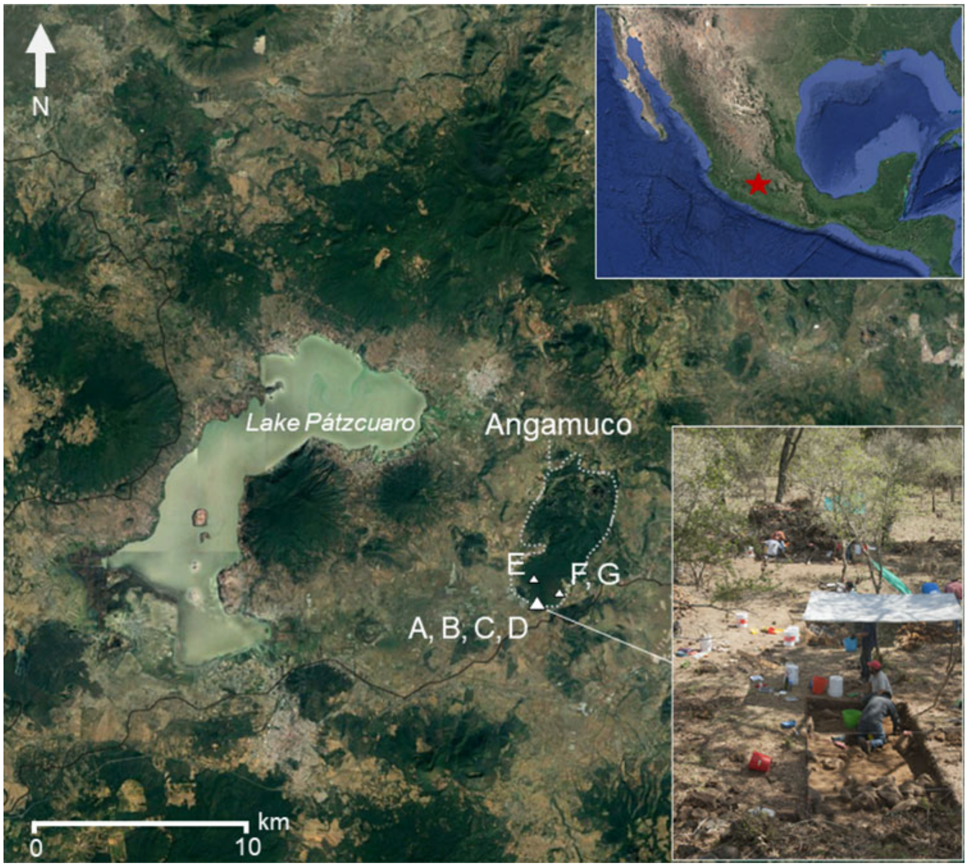

Figure 1. Map showing Angamuco excavation areas (A through G) and excavation overview photo of imperial Area C (map data from Digital Globe 2015).

urban settlements often on raised lava flows (also called a *malpaís*) (Forest 2023; Michelet 2008; Pollard 2008).

Angamuco was occupied from at least the Preclassic through Late Postclassic periods (A.D. 250–1530), including during Purépecha state and empire formation sometime during the Middle to Late Postclassic periods (A.D. 1150–1530) (Cohen 2021). Stone and earthen architecture includes not only monumental features such as rectangular and semicircular *yácata* pyramids, a ballcourt, and plazas, but also domestic features such as rooms, terraces, and roads (Fisher et al. 2019). Survey and excavation data recovered between 2009 and 2014 demonstrates that Angamuco was an urban palimpsest, occupied intensively during certain periods, reorganized, and repurposed during others (Cohen 2021). Some of the earliest occupations date to the Preclassic period, circa A.D. 250, when residents lived on the lower elevations of the site to be close to water resources and cultivatable land. During the Epiclassic and Early Postclassic periods (ca. A.D. 700–1100), the population expanded and settled on the upper elevations of Angamuco, living in plaza groups that were connected by an extensive road system. In the late Middle Postclassic (A.D. 1100–1350), some or all of the upper areas were abandoned, and occupants started repurposing and building large plazas and *yácata* pyramids in the lower zones. Radiocarbon determinations and imperial Purépecha-style artifacts indicate that there was an imperial presence primarily in the lower elevations of Angamuco during the Late Postclassic period (Cohen 2021). Exploring changes in the pre-imperial and imperial-style pottery is therefore an important step in the larger process of understanding the impact of new political formations and technologies on people living in Angamuco and the broader Lake Pátzcuaro region.

Previous ceramic research

Imperial-style pottery in the Lake Pátzcuaro area is hypothesized to have formed out of earlier versions of forms and styles in the region (García García 2009; Hirshman et al. 2010), and geochemical characterization shows that paste recipes have remained relatively consistent over 1,200+ years (Cohen et al. 2019; Cohen et al. 2023; Hirshman and Ferguson 2012). Data from the Lake Pátzcuaro area and the nearby Zacapu Basin suggest that pre-state- and empire-period pottery consisted of both coil and mold-built fine and coarse wares (e.g., Jadot 2016; Pollard 1999). Pre-imperial forms included various bowls, incised bowls for grinding (*molcajetes*), jars, and spoons; decoration was often a reddish or cream-colored slip and occasional painted red stripes and geometric forms. Subsequent Purépecha state- and empire-period ceramics consisted of forms such as bowls, tripod bowls with globular supports, jars, and spouted vessels; decoration included reddish or cream-

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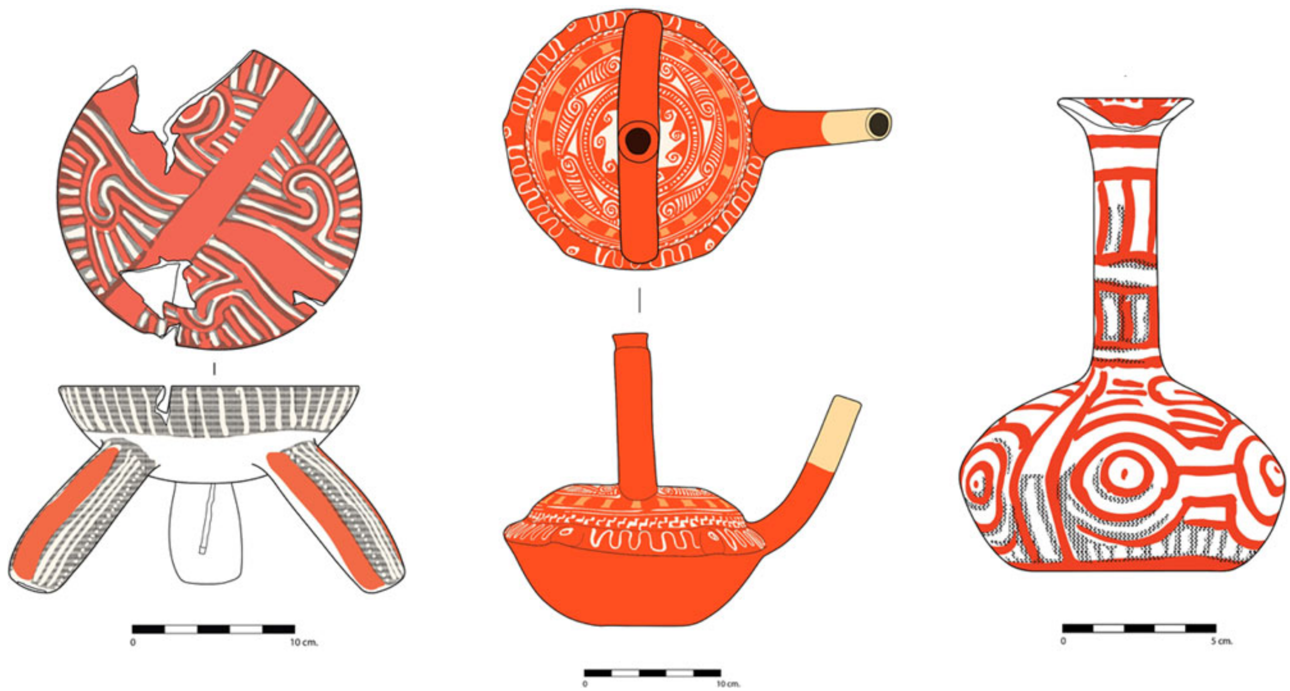

Figure 2. Examples of imperial style pottery from excavation Area C (overview photo in Figure 1) at Angamuco. Imperial Purépecha pottery is characterized by globular supports, spouts, and polychrome and wax-resist firing (negative) decorations. Drawings by Daniel Salazar Lama.

colored slip, sometimes with red, black, and white paint and wax-resist firing (Figure 2) (Cohen 2016:165–174; Hirshman et al. 2010; Pollard 1993, 1999).

Previous ceramic archaeometry in the Lake Pátzcuaro area suggests that most pottery manufacturing was a localized activity (Cohen et al. 2019; Hirshman and Ferguson 2012; Pollard et al. 2001). A regional geochemical (Neutron Activation Analysis, or NAA) study summarized previous work by combining 470 ceramic samples from four pre- and post-state and empire sites (Angamuco, Erongarícuaro, Tzintzuntzan, and Urichu; Figure 1) (Cohen et al. 2023). The study identified eight compositional groups among the samples and found that they were locally produced and long-lived, and that they represent a complex ceramic economy with differential community participation. At Angamuco, petrographic analysis of ceramics and clay indicate that potters exploited local mineral-rich clay sources, adding various tempers and generating numerous, complex paste recipes (Cohen et al. 2018). Similar to the regional geochemical study, the mineral data show that multiple small-scale producers structured pottery production at the site, and that techniques of manufacture likely remained relatively stable over long periods.

These existing pottery data align with some of the broader interpretations of occupation and complexity in the lake basin. For example, excavation and survey data indicate that beginning at least during the state period, Purépecha imperial elites began to exploit local, centrally-produced materials rather than non-local, high-status goods (Pollard and Cahue 1999). An emphasis on local production would have consolidated political economic power in the imperial core region and required co-option of local labor. Yet, the long-term ceramic data demonstrate that regardless of distinctive changes in styles and forms, ceramic manufacturing was consistently a local activity. Technological conservatism has been considered as an explanation for local manufacturing in the Lake Pátzcuaro Basin (Hirshman 2018), but further discussion is necessary for understanding why techniques persisted in a region with substantial political changes over 1,200+ years.

Methods and materials

The methods and initial results of the Angamuco petrographic and geochemical analyses are reported elsewhere (Cohen et al. 2018; Cohen et al. 2019; Cohen et al. 2023); consequently, here the focus is on the combined analyses. To address questions relating to communities of practice and production techniques used to create pre-imperial and imperial style pottery, this study analyzes 300 sherds from Angamuco. Sherds were collected from pre-imperial and imperial habitation and public contexts (Table 1). In addition, 30 samples of natural, local clay are analyzed. All sherd samples were retrieved during stratified excavations that have been chronometrically dated (Cohen 2021). Discussion of the clay sampling both on and around the Angamuco landscape, and ceramic attribute analysis on a larger sample of 5,861 sherds, is available elsewhere (Cohen 2016; Cohen et al. 2018).

Given that artifacts from Angamuco had not been systematically analyzed before this study, the sampling strategy was designed to lay a foundation for understanding the site's chronology and ceramic artifacts. Ceramic specimens were selected from all seven excavation areas

Table 1. Number and location of samples.

Excavation Area Context	Period	No. NAA[1]	No. Petrography[2]
A - elite habitation	Pre-Imperial (Classic), Imperial (Late Postclassic)	68	17
B - mixed use elite building	Imperial (Late Postclassic)	31	6
C - *yácata* pyramid and mortuary	Imperial (Middle-Late Postclassic)	95	6
D - elite habitation next to C	Imperial (Late Postclassic)	18	1
E - habitation	Pre-Imperial (Epiclassic–Early Postclassic)	32	4
F - plaza and probable habitation	Pre-Imperial (Early Postclassic)	52	1
G - habitation	Pre-Imperial (Early Postclassic)	4	1
Geological samples on and <11 km from Angamuco		30	9
	Total	330	45

[1]The total number of NAA samples consists of 300 sherds and 30 geological samples (n = 330).
[2]The total number of petrographic samples consists of 36 sherds and nine geological samples (n = 45). The petrographic samples were subsampled from the NAA sample based on the interpretation of geochemical composition groups.

(A–G in Figure 1/Table 1) and all strata that included identifiable forms and/or decorated examples (Cohen 2016:109–112; Cohen et al. 2018; Cohen et al. 2019). A nonrandom sampling strategy was based on a hierarchy of variables to maximize contexts that crosscut different sociofunctional excavation areas and decorative and formal classes.

From the attribute sample, 300 excavated sherds were selected for NAA at the University of Missouri Research Reactor (MURR). For petrographic analysis, an additional 36 sherds were intentionally selected that were assigned to NAA compositional groups with the greatest Mahalanobis membership probabilities (>78 percent, but most >90 percent) for each group. This was to ensure that the samples were most representative of that geochemical group. Furthermore, this sampling strategy allows for the correlation of the ceramic groupings produced by several methods, and it incorporates a wider petrographic sample, enabling additional relatively rare types to be assigned to petrographic groups.

Thirty clay samples were collected from excavation contexts or within proximity to the site, such as from probable reservoirs to the southeast and southwest of Angamuco. The clays were made into briquettes and then submitted for NAA. Nine clay samples were selected for petrographic analysis that could be linked with NAA groups. Some samples were unassigned and used to evaluate naturally occurring minerals in clays at the site and nearby, and to determine whether the clays could be matched to any of the excavated ceramics.

Geochemical data overview

Sherds and clays were submitted to MURR and analyzed according to the standard protocol (Glascock 1992). The MURR analyses produced elemental concentration values for 33 elements in most of the samples. Cluster analysis, principal components analysis, and discriminant analysis using the MURR Statistical Routines and SPSS for multivariate statistics detected patterns in the elemental concentrations. The NAA analysis identified four compositional groups within the Angamuco sherd and clay sample. These groups were initially reported as Groups A, B, C, and D (Cohen et al. 2019: Figure 3), but they were reanalyzed in a regional study, combined with existing geochemical groups, and renamed systematically as Pottery Group A (PGA), Pottery Group 6 (PG6), Pottery Group 1 (PG1), and Pottery Group 7 (PG7), respectively (Cohen et al. 2023). Some specimens could not be assigned (n = 42 sherds, n = 20 clay); further discussion is limited to the total assigned samples (n = 268).

Of the four geochemical groups identified in the Angamuco sample, two are linked with previously established groups in the region, and two are thus far unique to the site. Group PGA (n = 122) is the largest of the groups and found in imperial Area C (n = 35), but also in earlier Areas F (n = 33) and A (n = 27). PGA corresponds with a previously established potting recipe with a broad procurement zone in the southern part of the lake basin (Hirshman and Ferguson 2012). PG1 (n = 41) is the smallest of the groups and is most common in pre-imperial Areas F (n = 17) and A (n = 11). PG1 also shows a comparable composition to a previously established group from a broad procurement zone in the western and northern parts of the lake basin. Geochemical group PG6 (n = 52) is different from all previous MURR compositional groups and from the Angamuco clay samples. Of the 52 samples assigned to this group, the majority (n = 28) were from imperial Area C, whereas smaller numbers appeared in Areas A (n = 6), B (n = 6), D (n = 3), E (n = 5), F (n = 3), and G (n = 1). Finally, PG7 (n = 43) is the only group that overlaps with the clay samples, suggesting that this group represents a local source (Cohen et al. 2019; Cohen et al. 2023). The 10 matching clay samples were collected from shallow depressions around the site that were probably used to hold water. PG7 samples were recovered in pre-imperial and imperial contexts from excavation Areas A, C, and F (n = 12 each), and in the Areas B (n = 3), D, and E (n = 2 each).

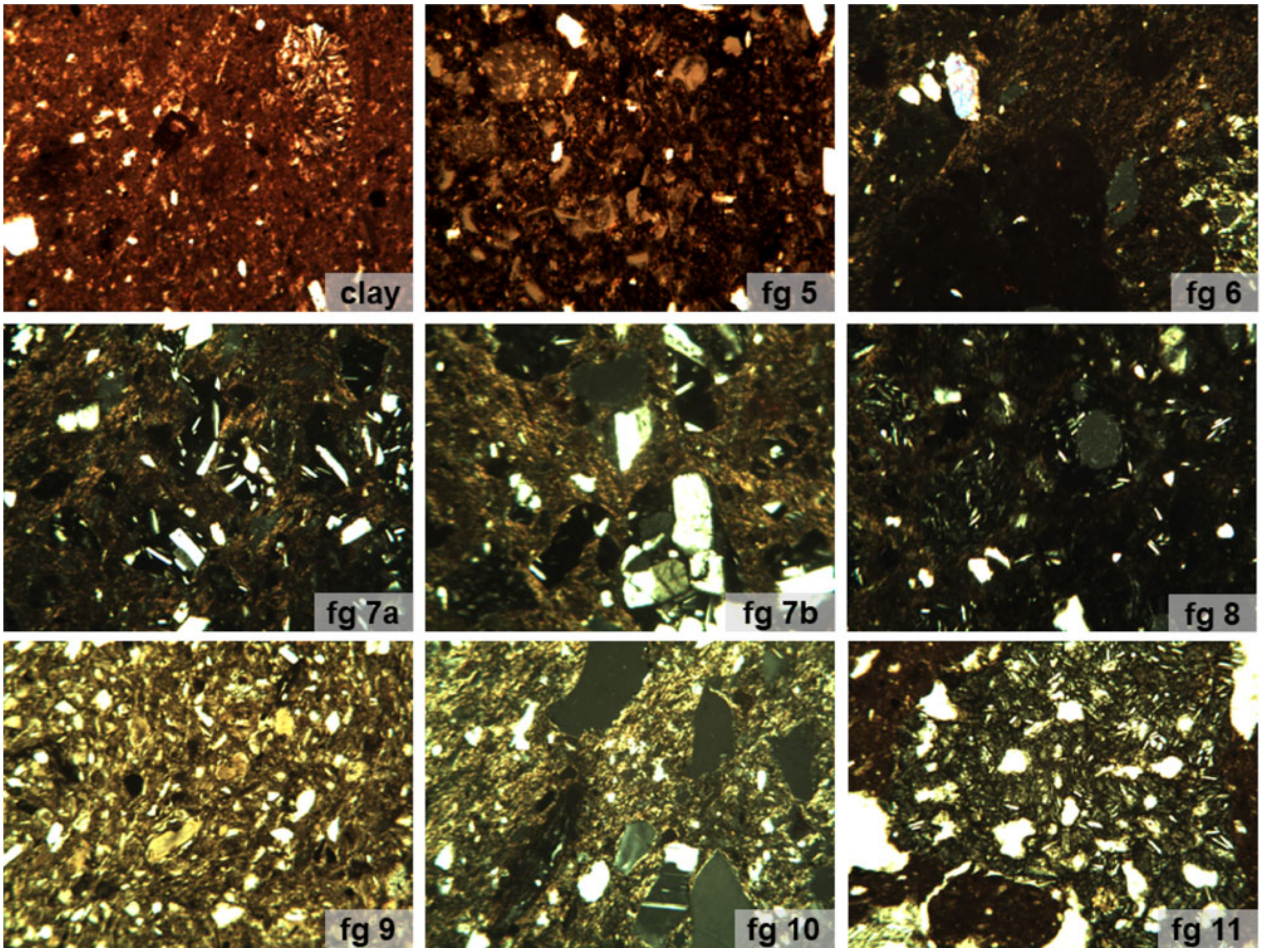

Figure 3. Photomicrographs in cross-polarized light showing the main fabric groups (fg). The differences in the groups are largely based on basalt—whether basalt inclusions are present and whether there are grain-size differences—and on the presence or absence of ash. For example, fg 5 includes small basalt inclusions and ash; fg 6 shows even finer basalt inclusions; the basalts in fg 7a and 7b are small and rounded or coarse; fg 8 basalts are coarse; fg 9 includes rare fine basalt; and fg 11 is coarse vehicular basalt sand. The image of fg 10 shows that it does not include basalt or ash but instead a coarse quartz sand added as a tempering agent. Modified from Cohen et al. 2018:Figure 3. Photomicrographs by Michael Galaty.

Petrographic data overview

The 36 petrographic subsamples were carefully studied under plane and cross-polarized transmitted light to evaluate their mineralogy and clay matrix characteristics. Clay and ceramic groups were constructed based on qualitative analysis of the thin sections, following the methods outlined by Whitbread (1995) that draw from the field of soil micromorphology.

The petrographic analysis identified seven main ceramic fabric groups (fg) and four clay groupings (Figure 3). All the sherds analyzed contained one or more possible tempers, including basalt sands (97 percent) and/or ash (75 percent). Possible tempers include coarse or fine basalt sands of various types (i.e., vesicular, feldspathic [ortho- vs. plagioclase], presence/absence of hypersthene, etc.), ash (composed of clear and/or colored glass), and perhaps coarse quartz sand. The differences between the ceramic fabric groupings are thus most visible in the kinds of basalt inclusions present and in their grain-size differences, as well as the presence/absence and amount of ash. For example, fg 5 was defined based on the presence of small basalt inclusions and ash, whereas fg 6 basalt inclusions are finer than fg 5, with less ash and fewer plagioclase inclusions. The basalts in fg 7 are either small and rounded or coarse, and fg 8 temper consists of relatively coarse basalt sands. Fg 9 includes a rare fine basalt and is not ashy, whereas fg 11 tempers are a coarse vesicular basalt sand that is also not ashy. Fg 10 is the only fabric without basalt or ash, and it includes a coarse quartz sand, possibly added as a temper.

Combining the geochemical and petrographic datasets

When examining the NAA and petrographic data in combination, nearly all of the fabric groups appear in the imperial Late Postclassic contexts, but there are several distinct temper sources exploited for pottery production during that time period that are linked to NAA PG7 and local Angamuco clays (fg 6, 7a, 9, and 10—or 44 percent)

(Table 2). Each of these "imperial" tempers provides insight into technological changes or conservativism. For example, in fg 6, the vessels may have been smoothed (Figure 3). They are not reduced, but the groundmasses of some are oxidized (bright red) at the surface. They contain various basalt inclusions, all of which are small and rounded, and a mix of clear and colored volcanic ash. Fg 7a includes mainly reduced and some oxidized surfaces. Samples in this subgroup are nonporous. Small, rounded basalt inclusions are dominant and typically double spaced. The basalt is black opaque with small-to-medium plagioclase inclusions and was probably added as a temper. There is some volcanic ash with clear glass. Fg 9 is reduced and nonporous; samples include very rare, fine basalt sand; and they are not ashy. Mineral inclusions are rare, as are opaques (which, when present, are small and black) and TCFs. Inclusion distribution is open spaced. These samples are very fine compared to all others. Groundmass is inactive, grey in XPL, and tan in PPL. Although it does not appear to include fragments of tuff, the groundmass does perhaps look tuffaceous (i.e., grey in XPL). The clay may be derived from a tuff parent material. Finally, fg 10 is nonporous and very fine, and it contains no basalt and no ash. Mineral inclusions are very rare, suggesting that some processing may have occurred. The sample contains very coarse, quartz sand, which was probably added as a temper. This is unlike the other samples, does not match an NAA group, and could therefore be a long-distance import.

There are some imperial context samples that can be linked to NAA groups PGA and PG1, both of which are hypothesized to originate in the western and southern parts of the Lake Pátzcuaro Basin (Hirshman and Ferguson 2012). Only PG1 matches a fabric group, Group 5, which can be associated with samples that date to the Classic through Late Postclassic periods. In other words, clay selection and paste preparation are not unique characteristics of the imperial style ceramics in this sample.

A comparison of the ceramic groups resulting from the NAA and petrographic studies reveals that they are far from identical, but that they do show some correspondence (Table 2). For example, local fg 6, 7, and 11 can be matched with NAA PG7, which in turn matches local clays. Nonetheless, the results also show incongruities, such as the match between fg 5 and NAA PG6 and PG1. In addition, none of the NAA groups match fg 9 and 10.

Table 2. Links between NAA and petrographic groups.

NAA Group	Petrographic Group	Cultural Period
PGA	None	n/a
PG6[1]	5	Classic–Late Postclassic
PG1	5	Classic–Late Postclassic
PG7[1]	6[2], 8, 7a[2], 7b, 11[3]	Classic–Late Postclassic
None	9, 10	Late Postclassic

[1]NAA groups PG6 and PG7—along with fabric groups 6, 7a, and 7b—are from local materials due to links to local clay samples.
[2]Late Postclassic only.
[3]Classic and Middle Postclassic only.

Nearly all of the fabric groups appear in the imperial Late Postclassic contexts (Areas A, B, C, D), and fg 6, 7a, 9, and 10 (44 percent) were identified exclusively in these imperial areas. Fg 6 and 7a can be matched with local clay sources. These ceramic fabrics could be considered temporal markers for the Late Postclassic period. In contrast, groups 5, 7b, 8, and 11 were identified in excavation contexts that range from the Classic through Late Postclassic periods. Two of these groupings, 7b and 11, are likely derived from local clays. None of the NAA groups were associated exclusively with the Early and Middle Postclassic period areas of Angamuco (Areas E, F, G), although fg 11 was only associated with the Classic and Middle Postclassic period contexts and not the Late Postclassic, which could suggest that the fabric was a temporal marker. The fabric groups can be linked to locally derived clays in all time periods. Overall, these patterns indicate that there was greater variation in ceramic fabric recipes in the later time periods, but that many of the recipes were used throughout the Angamuco occupation.

Discussion

This study focuses on clay and paste recipes as two facets of ceramic production that can provide information on the technological choices of potters within their communities of practice. There are several clay and temper sources exploited throughout the Angamuco occupations that show continuity over time, yet there are also distinct sources used for pottery production during the imperial Late Postclassic period. During each time period, several NAA and fabric groups are present in the sample. One of these, fg 5, was probably produced by taking lake basin clays and adding small basalt inclusions and ash. There is some variation in the amount of ash added, which could reflect individual choice when sifting or levigating out natural inclusions or adding temper. Similarly, during the Late Postclassic imperial period, when potters produced fineware vessels, they relied on local Angamuco clays but used finer basalt inclusions and occasionally some ash.

The persistence in the NAA and fabric groups from the Classic through Late Postclassic periods indicates that despite widespread environmental and societal changes over hundreds of years and a shift in the ceramic forms and styles being produced, the same resources and production techniques were being used. This reflects not only the technological conservatism of the ceramic production and learning, but also the success of the producers in applying the same techniques and raw materials. Although there was a social shift that motivated potters to produce imperial-style vessels, it was not so extensive that they changed the raw materials they selected or the techniques that they used to prepare their clay. Related regional analysis of standardization of form and decoration reinforce the notion that shifts in pottery were confined predominantly to form and surface treatment (Hirshman 2008; Hirshman et al. 2010).

Also noteworthy is that not only was local production continuous throughout Angamuco's occupation, but exchange of vessels or raw materials within the lake basin persisted. Some of the sources of clay and temper used to produce Angamuco vessels can be linked to other parts of the Lake Pátzcuaro Basin based on NAA groupings and previous clay sampling (Hirshman and Ferguson 2012). This suggests that potters would have travelled to other sources or traded with other potters for raw materials, and/or that vessels were produced elsewhere and traded through exchange networks. Significantly, these fabric types and paste recipes continued throughout the Angamuco occupation.

It is important to mention that this study incorporates data from both paste recipes derived via NAA and from added tempers visible in petrographic samples. This is relevant because ethnographic work with potters has shown that any interpretation of paste continuity over time should take into consideration the thresholds of energy that potters use to travel for resources and locally available raw materials (Arnold 2000). Today—and in the past—most potters do not travel more than 1 km to obtain clays and tempers, and few likely travel more than 7 km (see also Levine et al. 2015). This means that potters often use local sources of clays and tempers, and that this distance impacts the variability of pastes and interpretations of the variability (discussions in, for example, Arnold et al. 1991; Arnold et al. 2000). By including the petrographic data and geological samples, this study takes into account potential internal variability of the clays. Discussion of the regional NAA dataset and associated raw material sources elsewhere in the Lake Pátzcuaro area (Cohen et al. 2023; Hirshman and Ferguson 2012) supports the interpretation of (1) local (to Angamuco) sources of raw materials and (2) links to paste recipes elsewhere in the lake basin.

When considered with ethnographic accounts in western Mexico, the likelihood that communities of potters were passing down knowledge of raw material sources and paste recipes is unsurprising. In her review of 80 years of ethnographic literature in the Purépecha region of Michoacán, Hirshman (2020) emphasizes the resilience of household, kin-based production organization throughout periods of sociopolitical and economic changes in the twentieth century. As a household craft, pottery production persisted through demographic shifts resulting from migrant wage labor to Mexico City and the US, government artisanal programs, and modern construction activities. George Foster's work (1948, 1955, 1965:47) pointed out that mid-twentieth-century Lake Pátzcuaro–area potting communities were highly conservative in terms of their technological techniques over time and their broader economic structure. Eduardo Williams (2018) found similar patterns nearby in the town of Huancito, and he interpreted this conservatism as avoidance of economic catastrophe. In sum, the clear continuity in raw material use, paste recipes, and/or trade relationships indicates that although vessel forms and styles changed over time, the potting communities producing and exchanging these ceramic goods were resistant to wider societal changes, including state and empire formation.

Conclusion

This research on ceramic technologies reinforces the importance of examining production techniques such as temper choice and paste recipes alongside larger sociopolitical shifts. As discussed here at the site of Angamuco, Mexico, despite changes in pottery form and styles, long-lived production techniques persisted for centuries. The self-sufficient potting communities of practice were conservative in their production methods, directly passing down knowledge and techniques over the centuries.

Similar methods can be applied to other archaeological investigations of social change. The study of ceramic technologies can provide information on the location of raw materials, the methods of ceramic production, and the extent of exchange networks. This would strengthen understanding of potential continuities or changes in communities of producers, and how they were impacted by large-scale social changes such as empire formation and colonial contact.

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