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ORANGE WARE PRODUCTION AND EXCHANGE IN FORMATIVE CENTRAL MEXICO AS AN INDICATOR OF REGIONALIZATION OF POTTERY STYLES

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Abstract:	Ceramics present archaeologists with a medium to explore the range and intensity of interactions across space and over time. Style associations between regions indicate, at a minimum, communication, trade, or possibly migration coupled with an open disposition with respect to social identity formation. Conversely, style boundaries may develop for a variety of reasons, including but not limited to geographically restricted levels of interaction and more insular attitudes towards outgroups. Gordon Willey (1991) drew these alternatives into a cyclical model, shifting between broad style horizons and regionalized traditions. Early Mesoamerica style horizons as expressed on ceramics developed through broad networks of open cultural exchanges during the Early and Middle Formative periods. By the Late Formative, however, Mesoamerica fragmented into distinctive regionalized ceramic traditions. We provide a small-scale view of this process at the end of the Middle Formative using compositional sourcing to identify a divergence in the ceramic traditions of two neighboring regions: the Basin of Mexico and Morelos. During this timeframe, groups across lowland Mesoamerica developed an Orange Ware tradition that extended into Morelos. As revealed through neutron activation analysis (NAA) and petrography, the majority of orange/yellow Lacquer Ware found in the Basin of Mexico was imported from Morelos during the late Middle Formative, but Basin potters never adopted Orange Wares into their own style repertoires. The Morelos Orange Ware tradition is the first ceramic style in a long history of interaction between the two regions that was not matched by parallel developments in both regions, thus serving as a reference to an inflection point in the cycling between horizontal integration and regional differentiation that Willey hypothesized. This process continued into the Late Formative when Basin groups realigned with groups to the northwest through the adoption of Chupícuaro ceramic traits.
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Highlights

- Formative Mesoamerican ceramic styles became increasingly regionalized over time
- Regionalization signifies a shift from broad open networks to more insular polities
- We source central Mexican Orange Wares to mark an inflection point in this process
- Morelos Orange Wares were traded to the Basin of Mexico
- Despite interaction, Basin potters did not broadly adopt the Orange Ware tradition

ORANGE WARE PRODUCTION AND EXCHANGE IN FORMATIVE CENTRAL MEXICO AS AN INDEX OF REGIONALIZATION OF POTTERY STYLES

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Abstract

Ceramics present archaeologists with a medium to explore the range and intensity of interactions across space and over time. Style associations between regions indicate, at a minimum, communication, trade, or possibly migration coupled with an open disposition with respect to social identity formation. Conversely, style boundaries may develop for a variety of reasons, including but not limited to geographically restricted levels of interaction and more insular attitudes towards outgroups. Gordon Willey (1991) drew these alternatives into a cyclical model, shifting between broad style horizons and regionalized traditions. Early Mesoamerican style horizons as expressed through ceramics developed along broad networks of open cultural exchanges during the Early and Middle Formative periods. By the Late Formative, however, Mesoamerica fragmented into distinctive regionalized ceramic traditions. We provide a small-scale view of this process at the end of the Middle Formative using compositional sourcing to identify a divergence in the ceramic traditions of two neighboring regions: the Basin of Mexico and Morelos. During this timeframe, groups across lowland Mesoamerica developed an Orange Ware tradition that extended into Morelos. As revealed through neutron activation analysis (NAA) and petrography, the majority of orange/yellow Lacquer Ware found in the Basin of Mexico was imported from Morelos during the late Middle Formative, but Basin potters never adopted Orange Wares into their own style repertoires. The Morelos Orange Ware tradition is the first ceramic style in a long history of interaction between the two regions that was not matched by parallel developments in both regions, thus serving as a reference to an inflection point in the cycling between horizontal integration and regional differentiation that Willey hypothesized. This process continued into the Late Formative when Basin groups realigned with groups to the northwest through the adoption of Chupícuaro ceramic traits.

1.1 Introduction

From the Early to Late Formative periods in central Mexico, trends in pottery production and exchange reflect broader processes in the evolution of Mesoamerican civilizations. The Early Formative marked a time of widespread sharing of ceramic styles and other symbols on a ceramic medium, known as a style horizon (Grove 1993; Willey 1991). Central Mexican groups drew upon two stylistic traditions: one focused to the east that privileged interactions with groups presenting Olmec-style materials; the other focused to the west, bearing similarities to the Capacha and Opeño complexes (Plunket and Uruñuela 2012). A second, more pervasive, style horizon characterized the Middle Formative period, involving shared symbols (double-line-breaks, grater motifs, and other symbols largely derived from the earlier horizon) incised or engraved through a white slip on flat-based bowls. Late in the Middle Formative, Basin of Mexico groups continued the White Ware tradition with rim, lip, and basal form variations, but other regions saw a shift to serving ware styles that consisted of new orange-colored types. This divergence of pottery styles marked the beginning of a processes of regionalization in which different groups, once participating in a style horizon, began to diverge in their artistic canons as expressed through a ceramic medium. In this study, we examine this cultural divergence through the production and exchange of Orange Wares among subregions of central Mexico: Morelos, the Basin of Mexico, and smaller samples from the Toluca Valley and Puebla.

Morelos is situated directly south of the Basin of Mexico, separated only by a volcanic mountain range with transportation corridors connecting them in the eastern and western corners (Figure 1). From Early to Middle Formative periods, all subregions considered here participated in the pan-Mesoamerica pottery traditions described above, though Early Formative contexts in the Toluca Valley are lacking. By the end of the Middle Formative, however, sites in Morelos developed an Orange Ware tradition, with links to coastal lowland groups, that was never fully integrated into the other subregions. The types of Peralta Orange and Orange or Yellow-White Lacquer Ware make up significant percentages of the pottery assemblage at Chalcatzingo and other Morelos sites. Researchers noting a minority of these wares to the north in the Basin of Mexico suggest that they were imported from Morelos. Cyphers (1987:226) notes about Lacquer Ware, "Further analyses are necessary to determine whether when present at [Basin] of Mexico sites it was locally manufactured or represented a Morelos 'export' ware".

In 2013, we initiated a large program of compositional sourcing among the region's earliest ceramics. Among the 1242 specimens in our sample are 20 Lacquer Ware specimens from the Basin of Mexico, Morelos, the Toluca Valley, and Puebla, and 11 Peralta Orange specimens from Chalcatzingo. We did not encounter any Peralta Orange in the Basin of Mexico to sample, but nine specimens were recovered at Temamatla at the southern margin of the Basin (Ramírez et al. 2000). We determine through neutron activation analysis (NAA) and petrography that most of the Lacquer Ware sample recovered in the Basin of Mexico and the Toluca Valley were imported, but from multiple sources. Those made from calcareous materials can be attributed with a moderate degree of certainty to production in Morelos. Others derive either from unidentified sources but differ in their composition from the typical ceramics found at the same site, suggesting they were also procured through a regional network of trades. Only a minority of the Lacquer Ware sample presents a composition that can be attributed to local production at the site where they were recovered.

In what follows, we contextualize these ceramic production and trade relationships into a broader perspective that examines interregional interaction as a cyclical process with pulses of broad-scale integration and intermittent periods of regional differentiation (Willey 1991). We then situate the differential spread of the Orange Ware tradition, in contrast to the widely shared

White Ware tradition, as a bounded process that that marks the beginning of a trend of regional differentiation that accelerates into the Late Formative. Finally, we present the results of compositional sourcing for this sample of Orange Ware ceramics. Though our Orange Ware sample is small, the patterns of production and trade identified here are clear and significant. Groups in the Basin of Mexico, Toluca, and Puebla were exposed to the Lacquer Ware and Peralta Orange traditions of Morelos, but they made no significant attempt to copy them into their own programs of ceramic production. This ceramic style divergence between two closely related regions serves as a proxy to understand similar processes that took place in contemporary regions across Mesoamerica that gave rise to regionalized pottery style traditions of the Late Formative.

1.2 Cyclical Expansion and Contraction of Style Zones

"Global" interactions are dynamic. This led Willey (1991) to define dynamic approaches that investigate the peaks and valleys of broad-scale interaction (see also Jennings 2011; Marcus 1998; Rosenswig 2016; Willey 1991). The term "style horizon" has been employed to explain broad-scale sharing of material culture traditions (Grove 1993; Jennings 2011; Kroeber 1944; Rosenswig 2016; Willey 1991). Style horizons emerged in a variety of contexts, but were particularly common in regions when complex civilizations emerged for the first time (e.g., Burger 1993; Braun and Plog 1982; Friedman 1982; Kristiansen et al. 2017). The formation of style horizons is due in large part to diverse peoples developing external networks of interactions resulting in shared symbols across broad geographic expanses. Shared symbols

In Mesoamerica, two early style horizons formed in relatively rapid succession. The Blackware Horizon (1400-1000 cal B.C.) marks the spread of carved designs and vessel forms of the Olmec style, typically appearing on small dark colored ceramic bowls (Figure 2). Other ceramic types, like white-rimmed black ware (differentially fired), also likely originated on the Gulf Coast and traveled alongside carved Olmec pottery (Rodriguez and Ortiz 1997). Compositional analyses have demonstrated that long-distance pottery trade was one mechanism that spread the Blackware Horizon (Blomster et al. 2005; Herrera et al. 1999; Stoner and Nichols 2019). Trade pots provided an immutable template for local potters to copy. In the Basin of Mexico, potters rapidly adopted Olmec vessel forms and decorative motifs into local production repertoires. These new ceramic designs were found in both elite and non-elite domestic contexts, suggesting that they were not exclusively tied to prestige exchange networks (Joyce 1999; Tolstoy 1989).

The Blackware Horizon gave way to a Whiteware Horizon (1100-800 cal B.C.) that featured white-slipped ceramics with post-slip incision with broadly shared motifs, like the double-line-break and sunburst grater bowls (Figure 3). In the Basin of Mexico, the rising popularity of white-ware serving bowls accompanied a decline in carved Olmec-style decorative motifs. Some motifs appearing on white-ware bowls derived from earlier Olmec styles, but this was more likely due to local processes of generational transmission rather than sustained long-distance interaction with the Gulf Coast. Compositional analysis of a large sample of central Mexican white wares demonstrates that pottery trade continued at a high frequency during the Whiteware Horizon, but the distance those trade vessels moved decreased to a more restricted regional scale (Stoner and Nichols 2019). Rather than direct interaction over long distances, white wares circulated across Mesoamerica through more decentralized interactions among neighbors.

Potters in many regions ceased producing white wares late in the Middle Formative period and instead favored brighter colored orange and red ceramics. The orange-ware ceramics were prevalent along the Gulf and Pacific lowlands (Clark and Cheetham 2005; Drucker 1943; Love 2002; Ortiz 1975; Pool 2007; Rosenswig 2010), but also penetrated north into Guerrero (Paradis 1978; Pye and Gutierrez 2011) and Morelos (Cyphers 1987), likely due to the trade activities at the influential gateway site of Chalcatzingo (Hirth 1978). Potters in Morelos developed two orange types around the same time that white wares were popular in the region: Peralta Orange and Lacquer Ware (Figure 4). Peralta Orange was almost entirely absent in the contemporaneous Basin of Mexico just a few kilometers to the north. We did not identify pieces in our examination of Paul Tolstoy’s collections from numerous early sites in the Basin of Mexico or from our own excavations at the site of Altica in the Teotihuacan Valley, but Ramírez and colleagues (2000) identify nine Peralta Orange ceramic fragments at Temamatla in the southern rim of the Basin. Lacquer Ware also only makes up very low proportions Basin of Mexico and Morelos site inventories, but was much more common in the latter.

Groups in the Basin of Mexico, Morelos, Tlaxcala/Puebla, Hidalgo, and the Toluca Valley, continued the older white-ware tradition up to the end of the Middle Formative. Later examples shifted away from post slip-incision to red-painted decoration over a white slip (Figure 5, bottom).

Chalcatzingo in Morelos was an extremely important site in the intensification of pan-Mesoamerican exchange networks during the Early and Middle Formative periods (Hirth 1978). It displays close connections to the Gulf Coast Olmec sculptural traditions, which had no precedent anywhere else in Central Mexico. The sculptural connection between the Olmec heartland and Chalcatzingo may help to explain the development of the Orange Ware traditions found at the latter (Cyphers 1987; Pool 2007). We note that white/tan rimmed black wares at Chalcatzingo, a ceramic type also appearing earliest in the Gulf lowands, continued in use through the end of the Middle Formative while the type fell out of the ceramic sequence in most parts of the Basin of Mexico by the end of the Early Formative (Cyphers 1987; cf. Niederberger 1976). This too constitutes a marker of disjoint patterns of interaction that saw the Basin of Mexico move away from direct interactions with Gulf Coast groups at the same time that Chalcatzingo in Morelos intensified its connections with that region. By the end of the Middle Formative and into the Late Formative, groups in the Basin of Mexico showed preferential interactions with the Chupícuaro culture to the west, with interactions likely following the Lerma Basin to the northwest (Darras 2006; Healan 2019).

1.3 Definitions and Temporal Placement of Orange Wares in Central Mexico

Orange Lacquer ware was first defined in the stratigraphic excavations conducted by Vaillant (1930) at Zacatenco in the Basin of Mexico. He identified three variants all produced with a thin translucent wash of orange, yellow, to brown/black color over a thicker white slip. The thin translucent wash gives the impression of “lacquer", but it is not a true lacquerware (Cyphers 1987). This color range matches that later described by Grove (1968) at Cerro Chacaltepec and Cyphers (1987) at Chalcatzingo in Morelos, where the type dates earlier, is more common, and is presumably where the style originated. Vaillant (1930) argued for Zacatenco that Orange Lacquer ware “occurs in too small a frequency to be a local ware (1930:91; see also Niederberger 1976 for a similar argument for the type under the name Chilapa Naranja).”

Vaillant related Orange Lacquer Ware to another more common “Yellow-White Ware” that he divided into types A and B (see also McBride 1974, Piña Chan 1958 [Blanco Amarillento]). Both types display a similar technique, but with a yellow wash (rather than orange) over a white slip. Type A displays a hard base clay and hard base slip with simple bowl forms, like hemispherical shapes (Vaillant 1935:224). Type B presents with a soft laminated base and hard base slip on bowls with vertical, often composite silhouette, walls. Vaillant suggested that “it is possible that yellow-white ware B is a local imitation of orange ‘lacquer’ (1930:44)”.

McBride (1974) also refers to Vaillant’s Yellow-White types. Upon inspection of Vaillant’s collections at the American Museum of Natural History, McBride observed that both of Vaillant’s Yellow-White types have a “lacquer” like appearance. McBride (1974) notes that he “... would expect [Yellow-White A] to be a trade ware into the Cuauhtitlan Region (1974:126).” Foreshadowing the results of the current study, both the yellow and brighter orange variants were found among the imports identified through chemical analysis, suggesting that a simple color division of ceramics with a translucent wash over white slip is not sufficient to differentiate local from imported specimens.

The dating of Orange Lacquer Ware – also known as Naranja Laca, Naranja Fugitivo (Fugitive Orange), and Chilapa Naranja by different researchers – in this research relies on stratigraphic frequency seriations anchored by radiocarbon dates principally at Chalcatzingo (Cyphers 1987) and Cerro Chacaltepec (Grove 1968) in Morelos (Cyphers 1987), Atlamica (McBride 1974) in the northwest basin of Mexico, Zacatenco (Vaillant 1930), Tlatilco (Piña Chan 1958) south of the Guadalupe Range, Zohapilco/Tlapacoya (Niederberger 1976) in the southeast Basin, and several other sites excavated by Tolstoy and colleagues (1977). We begin in Morelos to the south of the Basin of Mexico, the presumptive source of the Lacquer Ware style and trade wares that were found in the Basin of Mexico (Table 2).

At Chalcatzingo, Lacquer Ware first appears during the Early Barranca phase and continues to consistently make up about the same proportion of the ceramic assemblage until the Late Cantera phase when it begins to disappear. Cyphers (1987) identified two variants: Lacquer Ware and Imitation Lacquer Ware. Lacquer Ware was so defined due to an orange, yellow, or brown-colored translucent wash over a white-slipped base, as described above (see Figure 4 bottom). Imitation Lacquer Ware lacked a white base slip. The wash was instead applied directly to a light-colored ceramic body. Well-preserved surfaces usually display some degree of polishing. Vessel forms consisted almost entirely of serving bowls. Hemispherical bowls, the most common form observed in this study, displayed the “lacquer” wash on both interior and exterior surfaces, but bowls with everted rims found in Early and Late Barranca phases at Chalcatzingo were only slipped on the interiors (Cyphers 1987:223). Some Lacquer Ware specimens at Chalcatzingo displayed plastic decoration, such as punctation and incision, with the earlier variants presenting double- and triple-line-breaks, and sunburst motifs on flat bases, like similar decorations found on more common white wares. Later variants during Chalcatzintgo’s Cantera phase, were more commonly undecorated. The later variants were more common in the Basin of Mexico and compose most of the current sample.

Lacquer Ware (Chilapa Naranja) at Zohapilco/Tlapacoya in the Basin of Mexico displays a bimodal frequency distribution, with early variants appearing during the Ayotla phase, becoming scarce during the middle to late Manantial phase, and then reaches peak popularity during the Zacatenco phase (Niederberger 1976:163). The type never exceeds one percent of all ceramics in any of the excavated levels at the site. Niederberger associates the later Zacatenco variants with a more yellow than orange color, which she associates with Vaillant’s Yellow-White types A and B discussed above.

Along the western rim of the lake basin, several sites have presented collections of Lacquer Ware, some of which were discussed above. Vaillant (1930, 1935) placed both his

Orange Lacquer and Yellow-White types as time-markers of his Middle Zacatenco period based on his excavations at Zacatenco. Both overlap in time, but Yellow-White ware actually appears in deeper (older) layers, indicating that the temporal association with color identified by Niederberger does not apply everywhere in the Basin of Mexico. Orange Lacquer, which he thought to be an import, peaked at 4.2 percent of the “total of rim and decorated sherds” per level at the end of the Middle Zacatenco period (Vaillant 1930: Table II). Yellow-White ware peaks at 6.8 percent of the middle layer of the Middle Zacatenco period (Vaillant 1930: Table II). Note that these percentages are not directly comparable to those calculated for Zohapilco/Tlapacoya as they normalize to a subset of total sherds per layer. Orange Lacquer and Yellow-White Type A were both rare at the older site of El Arbolillo, and Type B was absent there (Vaillant 1935: 230-231). Both were also absent at his excavations at Ticoman, the type site for the Ticoman phase that post-dates Zacatenco.

Tolstoy and colleagues (1977) and McBride (1974) further tie down the history of Lacquer Ware in the region through the distinction between the La Pastora and Cuautepec subphases of the Zacatenco phase. At the site of Atlamica north of the Guadalupe Range where the types sites of El Arbolillo, Zacatenco, and Ticoman are found, McBride notes the absence of Yellow-White ware in Cuautepec levels of Pits 2 and 3, suggesting that it is completely confined to the La Pastora phase dating between 700 and 425 BCE in radiocarbon years, or between 800 and 450 calibrated BCE, falling in the middle to late parts of Middle Formative period. Diagnostic sherds of the Yellow-White ware peak at 15% of “total distinctive bowl sherds per level”, but we likewise caution that this number cannot be directly compared to either of the percentages cited above, which normalize to total sherds per layer.

A single prior compositional study was undertaken for Lacquer Ware. At Chalcatzingo, Cyphers’ (1987) petrographic study found exclusively volcanic tempering materials among Lacquer Ware ceramics. This is an important point since the most common import we identify in the Basin of Mexico displays a calcareous fabric. We believe that most Lacquer Ware ceramics found in the Basin of Mexico were produced in Morelos, but not specifically at Chalcatzingo. Tertiary and quaternary surface volcanics of the transmexican volcanic belt in central Mexico overlie an older limestone formation. Limestone is exposed across broad areas to the south in Morelos, mostly to the west of Chalcatzingo (see Figure 1). Many of the imports we discuss in this article likely bypassed Chalcatzingo entirely and went directly into the Basin of Mexico. Grove (1968) noted an abundance of Lacquer Ware at the site of Cerro Chacaltepec in western Morelos, situated near the limestone outcrops. Areas to the north of the Basin of Mexico, near Tula, also have limestone exposed at the surface, but the Lacquer Ware type was not a significant component of Formative ceramic assemblages there.

The other ceramic type important for our discussion of the late Middle Formative spread of orange wares is Peralta Orange (see Figure 4, top). Peralta Orange is clearly tied to the emerging Orange Ware traditions in the Gulf and Pacific lowlands, with spotty representation elsewhere (e.g., Paradis 1978; Pye and Gutierrez 2011; Ramírez et al. 2000).

Peralta Orange was made over a long period at Chalcatzingo, where we have best chronological control for the periods in question. Peralta Orange displays a bimodal frequency distribution over time. The first peaks during the Early Barranca phase during the Early Formative. The second peak comes during the Cantera phase, with increasing popularity leading up to the eventual abandonment of Chalcatzingo. Grove (1987:435-437) notes that the specific features of Peralta Orange that resemble lowland Orange Wares (zoned punctations and ridged necked ollas) do not show up at Chalcatzingo until the Early Cantera phase. Zoned punctations are also found on ceramic types at sites in Guerrero: Amuco (Paradis 1978) and *Tinajas Laminar* from Teopantecuanitlan (Reyna Robles 1996).

Just a few kilometers to the north in the Basin of Mexico, the only site that contained any Peralta Orange (n = 9) is Temamatla (Ramírez et al. 2000). Temamatla is located on the southern rim of the Basin, so it is one of the geographically closest sites to Chalcatzingo itself. Moreover, they identify Peralta Orange in Zacatenco phase levels in their excavations, which parallels the Cantera phase mode of popularity at Chalcatzingo. During our broader sampling of Formative wares in the Basin of Mexico, Puebla, Tlaxcala, Hidalgo, and Toluca, we did not identify any examples of any ceramic type similar to Peralta Orange, attesting to its rarity. Cyphers (1992:105) notes that "It is difficult to make comparisons with other types in the central highlands of Mexico because none show great similarities (translation Stoner)". She notes that Vaillant (1930, 1931) identified at Zacatenco and Ticóman composite silhouette bowls with punctations on the shoulders, but the similarities ended there. She continues, "in general terms, Peralta Orange exhibits the closest affinities not with the central highlands, but with southern Mesoamerica (1992:105, translation Stoner)", particularly Tres Zapotes, San Lorenzo, and La Venta in the Gulf lowlands.

A petrographic analysis was conducted on two of the Peralta Orange ceramics recovered at Temamatla in the Basin of Mexico (Ramírez et al. 2000:95). The authors recognize that Peralta Orange is a ware produced in Morelos, but conclude that the small sample they recovered at Temamatla is "not a product of import, but a local product (2000:96)(translation Stoner)". We would not be so quick to call it a local product, however, due to the similar volcanic materials available to both Chalcatzingo and Temamatla. Inclusions identified at Temamatla are 20% oligoclase andesine (Na-rich plagioclase feldspar), 10% andesite rock fragments, 8% hornblende, 8% augite (clinopyroxene), 2% opaque minerals. Peralta Orange at Chalcatzingo has a very similar mineral inventory (Cyphers 1987: 201), with the only difference being the type of plagioclase identified (anorthite rather than oligoclase/andesine) and inclusion of some dacitic rock fragments in addition to andesites. We would not rule out the import of Peralta Orange to Temamatla without additional tests.

1.4 Sampling and Methods

We sampled a total of 1242 ceramics from Formative period contexts to study pottery production and exchange across early Mesoamerica (Stoner and Nichols 2019). The overwhelming majority of these ceramics date to the Middle Formative period from the Basin of Mexico, but we have included other samples from surrounding regions in the Toluca Valley, Puebla, Tlaxcala, the Tehuacán Valley, Morelos, Hidalgo, Northern Veracruz, and the Soconusco region of the Pacific Coast. Samples taken from outside the Basin of Mexico served mainly to fill in gaps in the MURR reference database so we could recognize where any imports were made. We made attempts to sample the range of ceramic types for each site. While the sample does include utilitarian bowls and jars, we did bias sample selection toward serving wares: mostly bowls that are burnished or slipped, many with incised, carved, engraved, or painted designs.

Among the larger sample, only 22 are Lacquer Ware sherds from the central Mexico region. While this is a small sample, the results of the compositional analysis are clear and significant, allowing us to arrive at the decisive conclusion that most of the Lacquer Ware ceramics found in the Basin of Mexico and the Toluca Valley were imported. Lacquer Ware specimens came mostly from Tolstoy's collections within the Basin of Mexico, with a minority from Puebla and the Toluca Valley, provided curtesy of Patricia Plunket, Gabriela Uruñuela, and Yoko Sugiura (Table 2). We also sampled 11 Peralta Orange specimens from surface collections at Chalcatzingo made by William T. Sanders.

Ceramics were sent to the University of Missouri Research Reactor (MURR) for neutron activation analysis (NAA) following their standard procedures (Glascock 1992; Neff 2000). Raw data were interpreted by Stoner in relation to the broader dataset. Raw composition values in parts per million (ppm) were converted to a log-base 10 scale to reduce the magnitude of differences between major and trace metals. Local reference groups were constructed for each area within the broader sourcing region (see Stoner and Nichols 2019). Following the criterion of abundance (Bishop et al. 1982), the most common paste composition found within any given geological context most likely reflects local production of ceramics. This is not necessarily the case in highly commercialized regions of the world, but groups in Formative period Mesoamerica had not yet developed a level of market exchange for pottery that would permit the majority of ceramics at any site to be imported. We also recognize that more than one paste recipe can typify any production site and might represent different material procurement and paste preparation activities of local potters (see Stoner and Nichols 2019).

Reference groups were formed using a variety of statistical techniques, including bivariate scatterplots, hierarchical cluster analysis, principal components analysis, and posterior group evaluation using Mahalanobis distance calculations. Our reference groups in the Basin of Mexico are based on composition, not geography or site, for the purpose of allowing more than one recipe to represent “local” production at each site. Since the current Lacquer Ware sample is not large enough to form robust reference groups within the ware itself, we compare each specimen to the chemistry of other ceramics taken from the same sites to differentiate between imports vs local products.

Any ceramic identified as atypical for a given site was then compared to broader trends in the chemical database to determine potential sources. We employed a geospatial analysis of chemical patterning across space using kernel-based interpolation of ceramic chemistry in ArcGIS (see Stoner 2016). Using a large search neighborhood, we created smoothed prediction rasters for each element. Paste compositions that deviate from the modal recipes are then easily identified by comparing the observed values for each specimen versus the predicted raster to arrive at a standard error. High standard errors (either positive or negative) represent potential trade wares that are evaluated further.

Thin sections of 10 Lacquer Ware ceramics were prepared by Stoner, with many more from each site to serve as comparison. Each thin section was classified through a semi-quantitative analysis that coded the relative abundance of each mineral type on an ordinal 5-point scale (see Supplement). Stoner also characterized the fabric texture, color, optical activity, porosity, and size and frequency distribution of aplastic grains. We follow a general fabric typology established in Stoner (2016), with some modifications, to ease the comparison with NAA data. Both qualitative and semi-quantitative data are useful for characterizing ceramic fabrics, and their relation to the bulk chemistry for each sherd (Stoner 2016).

1.5. Geological and Ceramic Composition Trends in Central Mexico

In this section, we briefly describe the geology of the central Mexico study region in order to contextualize the results of ceramic compositional sourcing. Much of this discussion is based on our own chemical and petrographic analysis of 1242 specimens from the Basin of Mexico and neighboring regions, and we also draw upon geological studies. As seen in thin section, the overwhelming majority of ceramics in our sample are made from volcanic-derived materials. Moving from north to south in the region, the geology transitions generally from relatively felsic rocks (rhyolite and dacite) to intermediate rocks (andesite) and then more mafic rocks (basalt), but no subregion is geologically homogenous. Ceramics in more felsic regions contain more quartz and plagioclase with a minority of potassium feldspar. Felsic formations in the region are older than their mafic counterparts, and volcanic glass in thin sections present various states of devitrification, revealing their older ages of eruption. Ceramics in more mafic regions contain abundances of plagioclase, olivine, and pyroxene. Volcanic glass in mafic rocks retains a black vitric appearance in thin section because those rocks tend to have formed more recently. Ceramics in intermediate composition regions dominated by andesite rocks contain mostly plagioclase, hornblende, and biotite minerals. The chemistry of ceramics displays strong patterns of increasing transition metal composition from north to south in the Basin, particularly with the elements chromium, cobalt, iron, nickel, and scandium. This pattern reflects the increasingly mafic composition of rocks to the south.

Morelos contains many of the same rock formations as in the Basin of Mexico to the north, but with more diversity. Of particular importance for this study is that limestone that underlies the Transmexican Volcanic Belt is exposed in many areas across Morelos. The same can be said for the Tula region in Hidalgo north of the Basin of Mexico, but Lacquer Ware was not identified in our sample from Formative Tula or Tepexi del Río.

To the west of the Basin of Mexico, the Toluca Valley shares many of the same geological formations, but ceramics at the site of San Antonio la Isla tend to be more felsic in composition, likely weathered from the relatively dacitic Nevado de Toluca and dacitic andesites that compose parts of the range that divides the Valley of Toluca from the Basin of Mexico. Like the Basin of Mexico, however, the Toluca Valley is bounded to the south by relatively mafic rocks.

The sites sampled in Puebla and Tlaxcala are also dominated by volcanic materials, but the overwhelming majority of ceramics analyzed there show compositions in the intermediate range. Those ceramics are chemically indistinguishable from the intermediate composition ceramics made in the eastern Basin of Mexico, which presents a complication for sourcing any trade wares. One site in southwest Puebla, Colotzingo, stands out on the extreme mafic end of the continuum. Ceramics at Colotzingo, a site situated near a basalt flow in the southern flanks of Volcán Popocatépetl, display among the highest concentrations of transition metals in the sample, particularly chromium.

1.6 Results: Chemical and Petrographic Composition of Lacquer Ware

As mentioned above, we did not identify any ceramics in the Basin of Mexico comparable to Peralta Orange found in Morelos, which itself is telling of the divergence of ceramic styles during the Middle Formative. The Peralta Orange sample we analyzed from surface contexts at Chalcatzingo chemically resembles the larger sample (n = 53) from the site, indicating local production, with one possible exception (Figure 6).

The Lacquer Ware sample displays a lot of compositional variability, indicating that it was likely produced by several different communities in the broader region. We present the results beginning with the most common composition in the sample and then proceed to evaluate individual specimens in the context of site assemblages and regional chemical patterning.

1.6.1 Calcareous Group (Group G; n = 7)

Seven of the 22 Lacquer Ware ceramics are derived from calcareous materials as their calcium concentrations are 4-5 times higher than the average for ceramics in the Basin: 10-13 percent compared to 2-3 percent for the non-calcareous Lacquer Ware. Besides high calcium concentrations, this group also displays transition metal concentrations that are chemically in range with the intermediate chemical compositions of most ceramics made with volcanic derived materials in the region (see Figure 6). This is due to the addition of volcanic aplastics to temper the paste.

As seen in thin section, both the clay groundmass and aplastic fragments in the fabric feature calcite/aragonite-based minerals typical of limestone (Figure 7). All of the calcareous samples also contain abundant minerals associated with the region's volcanic rocks (plagioclase, amphibole, biotite, pyroxene, fragments of andesite, and rarely quartz). This petrographic group was initially labeled as Fabric G (Stoner 2016) because the groundmass is "grainy" as it displays a compact matrix of calcareous grains ranging in size from silt to very fine sand. There are very few voids, and those that do appear are linear cracks running parallel to the vessel surfaces. Voids are often completely infilled or lined with a precipitate that is likely calcium carbonate salts. This is a fundamentally different clay structure compared to the normally lamellar appearance of ceramics made in the Formative Basin of Mexico.

The limestone formation that underlies the Transmexican Volcanic Belt was not directly accessible to potters within the Basin of Mexico, but it does occur at the surface in Morelos and parts of southern Hidalgo. These seven Lacquer Ware ceramics come from collections at Venta de Carpio and Cuanalan in the Teotihuacan Valley, Atoto and El Arbolillo in the western Basin, and Chimalhuacan near the eastern margin of the lake. The dispersal of calcareous ceramic imports at multiple sites in the Basin indicates that a site or group of sites in Morelos situated close to the limestone formations was active in the production of ceramics for export by the late Middle Formative.

1.6.2 Oxidized Volcanic Ash Group (Fabric F; n = 4)

The second most common paste recipe among the Lacquer Ware ceramics was identified primarily on the basis of petrographic analysis. It was not defined in Stoner's earlier analysis (2016). We refer to this as Fabric F in the current analysis. The fabric contains abundant, uniformly sized, well rounded, and spherical globules of a composite material with evidence of iron oxidation due to its red color (Figure 8). These inclusions are not opaque in plane polarized light. In cross polarized light, one can observe small silt-sized inclusions that appear to be plagioclase laths. Their size and shape match other, unweathered grains of volcanic glass with plagioclase laths oriented in a trachytic texture. We believe that the red stained globules are grains of volcanic ash that have oxidized due to weathering. Other minerals observed in this fabric are common to the intermediate to mafic samples in the region, and include plagioclase, amphibole, biotite, andesitic rock fragments, olivine, and pyroxene in order of decreasing frequency.

The chemistry of Fabric F falls in the intermediate to mafic range that dominates the broader Basin of Mexico sample. In thin section, all four of these specimens contain among the highest proportions of olivine in the entire sample of 201 thin sections analyzed to date, but relatively low proportions of pyroxene. The remainder of the mineral assemblage is similar to other intermediate composition ceramics in the region, with abundant plagioclase, amphibole, and biotite, and andesitic rock fragments.

Among our larger sample of thin sections analyzed to date, this type of tempering material is associated *exclusively* with Lacquer Ware ceramics, which strongly suggests that it was imported from a site not represented in our reference groups. While the chemistry is not out of range for the ceramics of the region, it is atypical for the sites where they were recovered in all but one case. Two of the four Fabric F samples derive from the site San Antonio la Isla, which is a ritual offering of vessels deposited into a natural spring (Sugiura 2005). Most ceramics recovered from this site tend to be among the most felsic in composition in the larger sourcing sample, but the two pieces of Lacquer Ware recovered there, as well as another Lacquer Ware specimen (FTV359) of a different fabric, were well out of range for the chemical reference group for the site (Figure 9). The fabric of these specimens as identified in thin section is also very different from the typical paste recipe found at San Antonio la Isla. Another Fabric F specimen recovered in the Teotihuacan Valley, FTV140, displays extreme values toward the mafic end of the continuum, which is also not typical compared to the intermediate to felsic composition of ceramics from several sites in that region. The final Fabric F ceramic (PTO020) found at Tetelco on the south rim of the Basin of Mexico was in range with the bulk chemistry of three other ceramics sampled from the site, but thin sections display very different fabrics. While we are fairly certain that Fabric F was not produced within either the Toluca Valley or the Basin of Mexico, its source of production is unknown. We hypothesize based on the relative abundance of Lacquer Ware in Morelos that the source is also there.

1.6.3 Other Lacquer Ware Imports (n = 5)

The remaining nine examples of Lacquer Ware exhibit compositions common to the larger Basin of Mexico sample, however, many of these also present atypical compositions for the sites where they were recovered. The first (FTV359, see Figure 9) was introduced above and will not be discussed again. We explore the others on a more individual basis in this section.

At Venta de Carpio in the Teotihuacan Valley FTV016 contains a calcium concentration that is double that typical for the Basin of Mexico, but at 5 percent it contains only half the calcium as the calcareous group. We cannot rule out the possibility that some local material is rich in calcium and this may be a locally produced pot, as there are other high calcium pots found at the site. The other Lacquer Ware ceramic from Venta de Carpio (FTV018) measures among the highest in transition metal composition in the entire sample. This is very unusual for ceramics in the Teotihuacan Valley, and this specimen was likely traded in from a more mafic terrane, such as the extreme southeast Basin of Mexico, the mafic regions of southwest Puebla (Colotzingo), or western Morelos.

Ceramics sampled from Tetimpa in western Puebla form a relatively homogenous chemical cluster, indicating that relatively few potters made those ceramics, or that similar materials were used to make most pottery there. The one Lacquer Ware specimen from Tetimpa (FTV194), however, displays a chemistry outside the norm for the site (Figure 10). It possesses abnormally high concentrations of transition metals, particularly chromium, iron, and scandium, and low concentrations of sodium, aluminum, and strontium compared to other ceramics from the site, suggesting it was produced at an unknown location outside the site.

One Lacquer Ware specimen from the site of Altica in the eastern Teotihuacan Valley also is a suspected import (see Figure 10). Specimen FTV478 is part of a larger group of ceramics derived from relatively mafic materials that is unusual for pottery produced at the site. We suspect that the whole group, including the one Lacquer Ware specimen, was imported from the southeastern Basin of Mexico or Colotzingo in southwest Puebla (Stoner and Nichols 2019), but there is some chemical and petrographic ambiguity that prevents confident interpretation (Stoner and Shaulis 2021).

1.6.4 Lacquer Ware Produced Locally (n = 6)

Among all the Lacquer Ware ceramics in the sample, only six specimens (27 percent) appear unambiguously to have been produced at the sites where they were recovered archaeologically: PTO052 (Santa Catarina); PTO762 (Atoto); FTV137 (Venta de Carpio); FTV160 (Cholula); FTV167 (Colotzingo); FTV278 (Chalcatzingo). The interpretation of local production for these specimens derives from their compositional similarities to the dominant paste recipe at the sites of recovery. The remaining 73 percent of our Lacquer Ware sample found in the Basin of Mexico, Toluca Valley, or Puebla was likely imported into the sites where they were recovered archaeologically. Of the ceramics that can be confidently sourced to a location of production, the largest group points to the Morelos based on the abundance of Lacquer Ware documented there, its early appearance, and the availability of calcareous materials at the surface. The source for the others is less apparent, but the mafic regions of the southeastern Basin and Colotzingo in southwest Puebla might have produced the ceramics for trade to other sites occupying the more felsic regions within the Basin. The general direction of exchange implied in any case is south to north.

1.7 Discussion and Conclusions

In response to Cyphers's (1987:226) call to determine if Lacquer Ware ceramics found in the Basin of Mexico are imports, we can say with relative certainty that at least one third of the Lacquer Ware in our sample, spanning all of the color categories mentioned above, was likely produced in Morelos and exported to surrounding regions. The calcareous Lacquer Ware fabrics were made from materials that were inaccessible at the surface in the Basin of Mexico but found in abundance in Morelos. We caution that this calcareous recipe was *not* produced at Chalcatzingo. None of the Lacquer Ware ceramics in our sample strongly matches our chemical reference data from Chalcatzingo, and Cyphers's (1987: 201) petrographic analysis identified only volcanic derived materials in her Lacquer Ware thin sections. The influence of Chalcatzingo was waning by the late Middle Formative, partly due to the rise of hierarchically integrated polities in the Basin of Mexico that shifted exchange to a more centripetal pattern focused on the developing city of Cuicuilco. This does not necessarily mean, though, that Chalcatzingo had no role in the dissemination of the ceramic type. Furthermore, we think it likely that other non-calcareous Lacquer Ware ceramics were imported into the sites in our sample, and that future sourcing should focus on other sites in Morelos as potential sources, particularly Cerro Chacaltepec (Grove 1968), which is located in proximity to limestone formations exposed at the surface.

The larger point to be made with the Formative ceramic composition dataset featured here and elsewhere (Stoner and Nichols 2019; Stoner et al. 2015) is that from the Early

Formative through the Late Formative, style zones steadily contracted. During the Early Formative Blackware Horizon, groups across Mesoamerica sought to import and copy the religious motifs featured on Olmec pottery. The imports and exotic ritual knowledge likely acted as prestigious elements of a strategy for aspiring local leaders to stand apart from the populace (Nichols and Stoner 2019). The adoption of the Olmec style in central Mexico, though, quickly became the basis for a new ceramic identity, not restricted to elites but shared by all. We base this determination on the presence of Olmec materials among burials (or households *sensu* Joyce 1999) of different social rank at Tlatilco (Tolstoy 1989) and households of different size at Coapexco (Paradis 2017; Tolstoy 1989). While vessel forms and execution of decorative motifs varied across Mesoamerica at this time (Blomster and Cheetham [eds] 2017) we argue that these early interactions drew upon a much more cohesive set of ceramic production principles than any of the later horizons.

By the Middle Formative, white-slipped ceramics with post-slip incision featuring double-line-break motifs along the rim and grater motifs on the interior base blanketed most of Mesoamerica. We demonstrate elsewhere, that pottery trade, while still relatively intense, decreased in its geographic extent, which likely initiated the contraction of macroregional style zones (Stoner and Nichols 2019). Shrinking style zones during the Middle Formative might be productively studied through regional design variation of double-line-breaks (e.g., Plog 1976).

The orange wares (here Peralta Orange and Lacquer Ware) that characterized the Middle and Late Formative periods in lowland Mesoamerica were even more geographically restricted and spotty than the previous two horizons. Morelos diverged away from the rest of central Mexico as it is the only subregion there that developed a significant tradition of orange ceramics during the Middle Formative. Grove notes that Peralta Orange was first present in significant quantities during the Early Barranca phase, but the key markers that tie the ware to lowland traditions (punctations and ridged necks on ollas) do not appear until Early Cantera levels. The absence of an equivalent tradition in the Middle Formative Basin of Mexico in particular highlights an intraregional disjuncture in the adoption of ceramic styles. This disjuncture was clearly not due to a total lack of interaction between Morelos and the Basin of Mexico. One needs only to look at the dominance of Otumba obsidian at Chalcatzingo, the source for which is in the eastern Teotihuacan Valley, to demonstrate an intensive level of interaction between the two regions (Charlton 1978, 1984; Stoner et al. 2015). Furthermore, we demonstrate in this study that people in the Basin of Mexico, the Toluca Valley, and other areas directly imported Lacquer Ware ceramics from Morelos. The pottery traditions of the two regions followed parallel trajectories up to this point: each significant tradition that appeared in one region was paralleled in the other. So why did the people living in the Basin of Mexico largely reject integration of Orange Wares into their own production systems?

We believe that the demonstrated boundary limiting the adoption of an Orange Ware tradition to the north of Morelos represents a broader shift in the long-term processes of regionalizing identities that peaks during the Late Formative. During the Blackware Horizon, local peoples in the Basin of Mexico were defining their identities in part based on symbols appropriated from the outside, both to the east and west (Plunket and Uruñuela 2012). By the time the Whiteware Horizon developed, most overt expressions of Olmec designs ceased completely in the Basin of Mexico, including the production of basic Gulf-inspired ceramic types such as white-rimmed differentially fired black wares. White ware ceramics that followed circulated through more geographically restricted exchanges (Stoner and Nichols 2019). The uneven distribution of Orange Wares at the end of the Middle Formative further bolsters our ability to demonstrate that ceramic traditions were becoming increasingly regionalized over time. The rejection of the orange ware tradition in the Basin of Mexico despite import of those wares from Morelos shows that style preferences were beginning to solidify and perhaps shift to affiliations with other regions. This does not mean that the Basin of Mexico became closed to foreign ceramic influences, but the direction of those influences diverged away from the regions to the south and east, with the important exception of Granular Ware imports (Padilla 2021). By the end of the Middle Formative and into the Late Formative, the Basin of Mexico as a whole prioritized associations with West Mexican ceramic traditions as seen through Chupícuaro-type serving vessels in most parts of the Basin of Mexico (Darras 2006; Healan 2019; Stoner and Nichols 2020). We also note the dominance of West Mexican obsidian sources at the Late Formative center of Cuicuilco (Plunket and Uruñuela 2012).

What can we learn from the patterns of rearranging ceramic identities discussed here? First, as we argue elsewhere (Stoner and Nichols 2019), the focus of interregional trade after the Early Formative shifts away from symbol-laden objects like ceramics and focuses more on raw materials. Interregional ceramic trade still existed, and may have even intensified into the Middle Formative, but the distance of that trade becomes more restricted. Second, the ideology that drove identity formation became based on more insular patterns of interaction focused on those early regional centers, like Cuicuilco. Whether intentional or not, the centripetal focus of settlement systems and artistic traditions within regions fostered a stylistic divergence between regions over time. This contrasts the apparent message of uniformity and receptiveness to external influences as seen on ceramic media during the Blackware and Whiteware horizons, which likely derived from interactions among relatively open communities (Stark 2017). This temporal shift may help us understand other social and political changes sweeping across Mesoamerica by the late Middle Formative and Late Formative, including the widespread development of regional settlement hierarchies and the shift away from external financing systems to a focus on more internal investments, such as developing regional market systems, agricultural intensification, and public architecture that appear in some regions by this time (Nichols and Stoner 2019). Finally, we argue that a regionalized sense of identity, the defining of “us” versus “them”, expressed in part through ceramic styles, is one of the primary factors that created a proliferation of Late Formative cultural, economic, and political diversity across Mesoamerica that drove the subsequent expansion of Classic period polities through military campaigns and centralized long-distance trade.

The limited analysis of two ceramic types in this paper is not sufficient to evaluate all of the hypotheses presented here. We make these arguments to encourage other archaeologists to focus on the mechanisms that led to the differentiation of material culture styles over the Formative period. Archaeologists have typically been more attracted to the reasons behind the formation of “style horizons”, but the fracturing of those horizons into more restricted zones provides a productive avenue of research when contextualized within a framework of socioeconomic interactions and identity formation over the long term coupled with material sourcing.

1.8 Declaration of Interest

The authors report no conflicts of interest.

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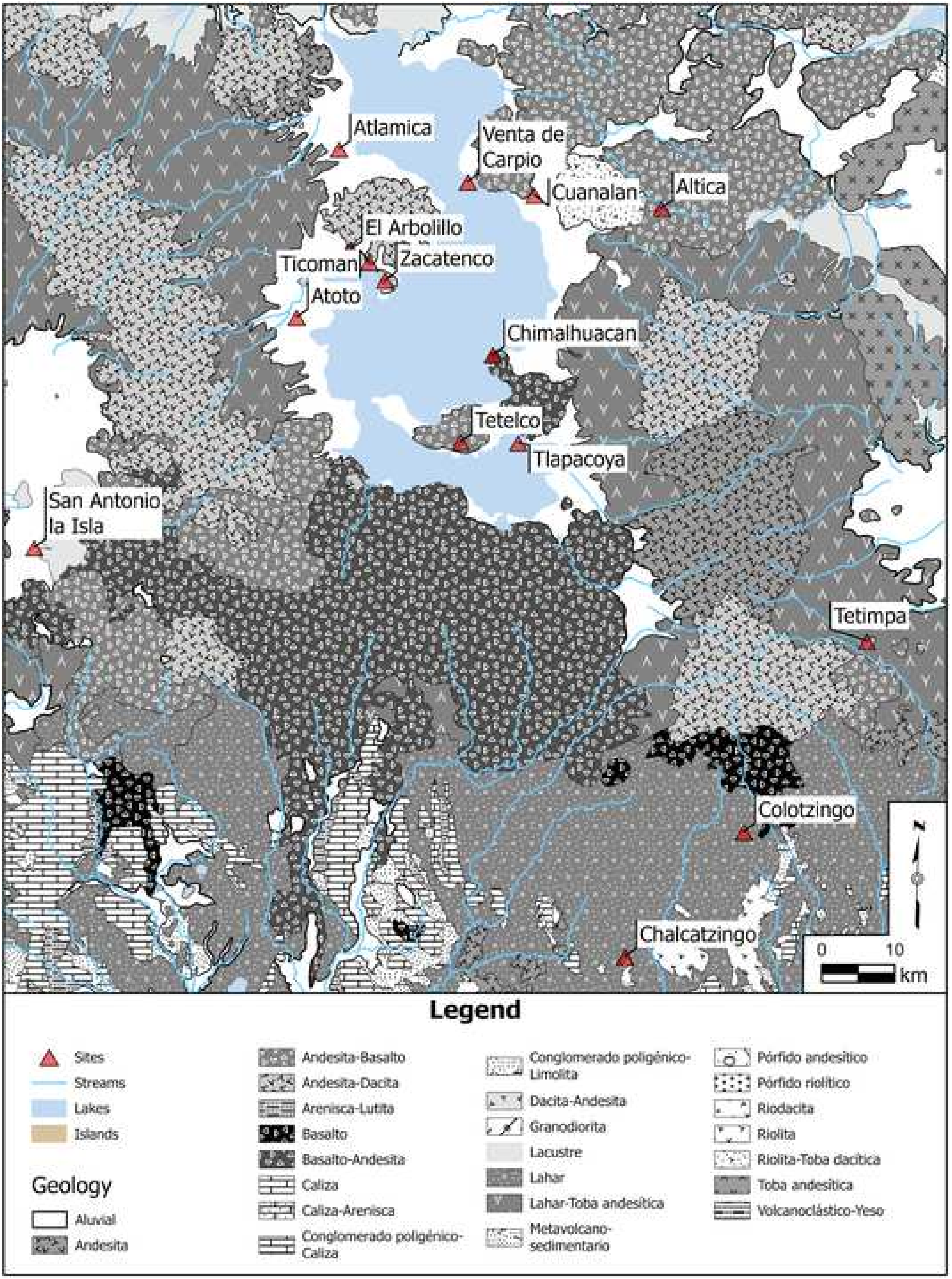

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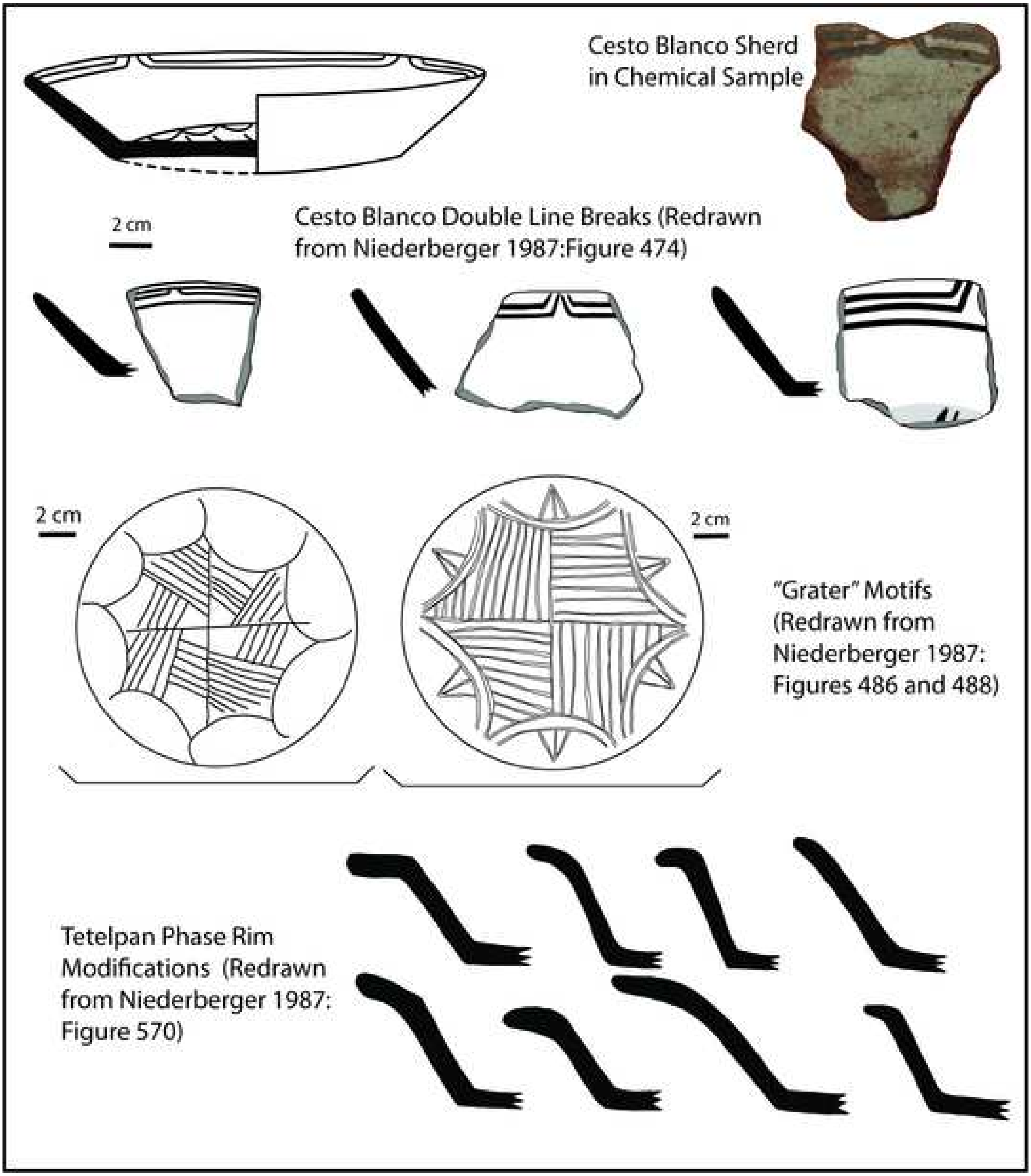

Figure 4

Figure 5

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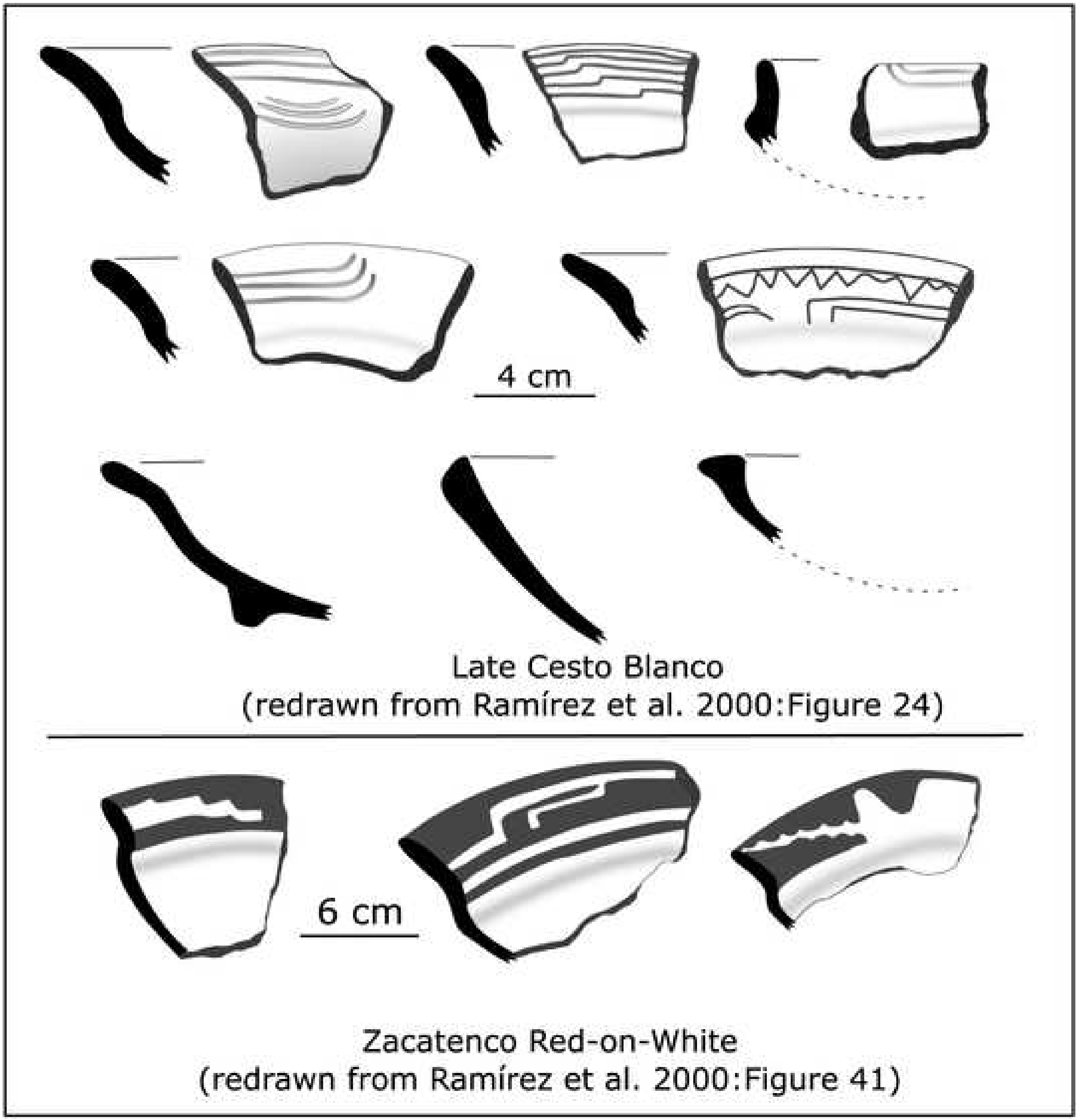
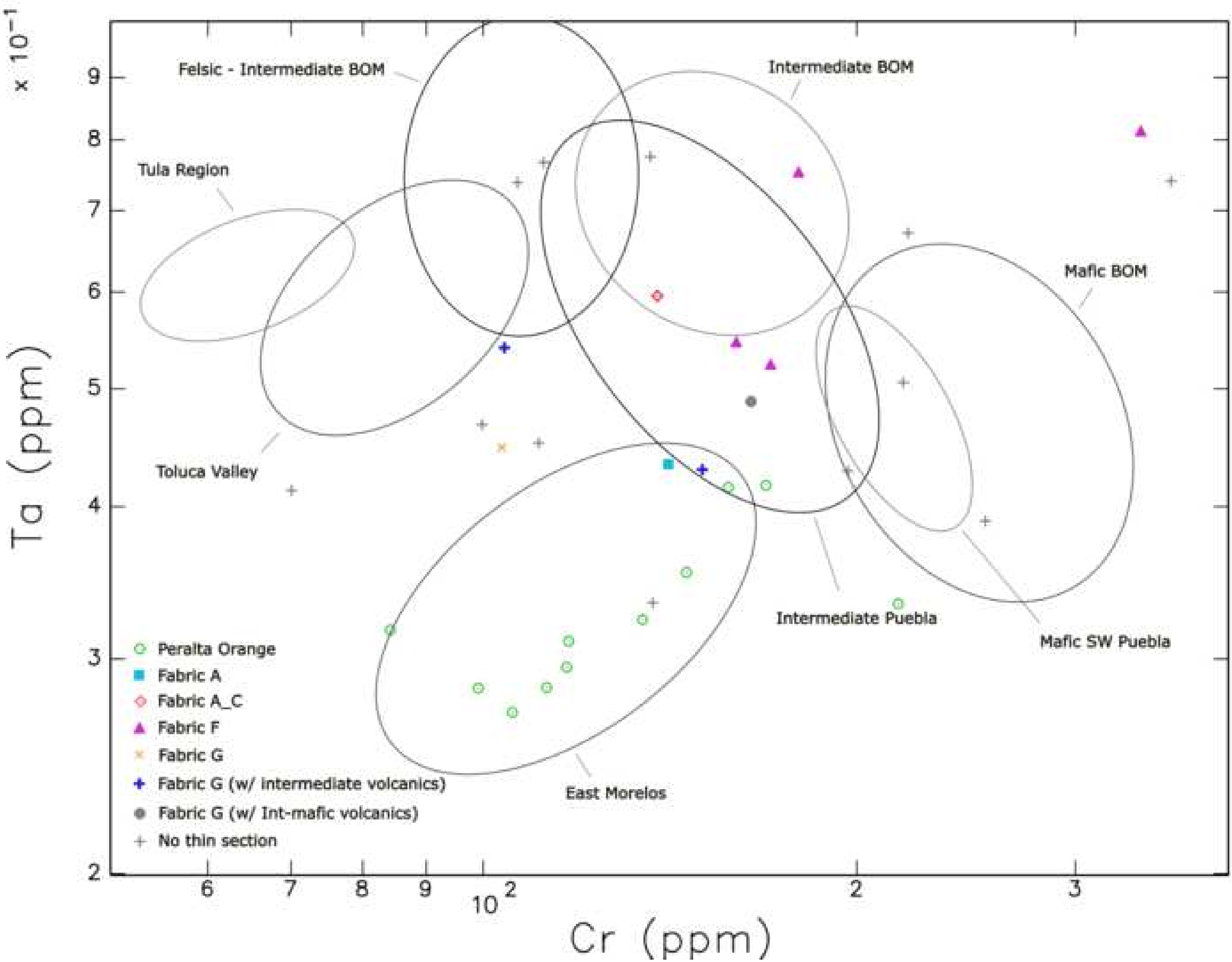


Figure 6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Toluca Valley
Intermediate Puebla
Mafic SW Puebla
East Morelos
Peralta Orange
Fabric A
Fabric A_C
Fabric F
Fabric G
Fabric G (w/ intermediate volcanics)
Fabric G (w/ Int-mafic volcanics)
No thin section
6
7
8
9
10^2
2
3
Cr (ppm)

Figure 7 Display in portrait

Click here to access/download;Figure;Figure_7_Cacareous Laq.tiff

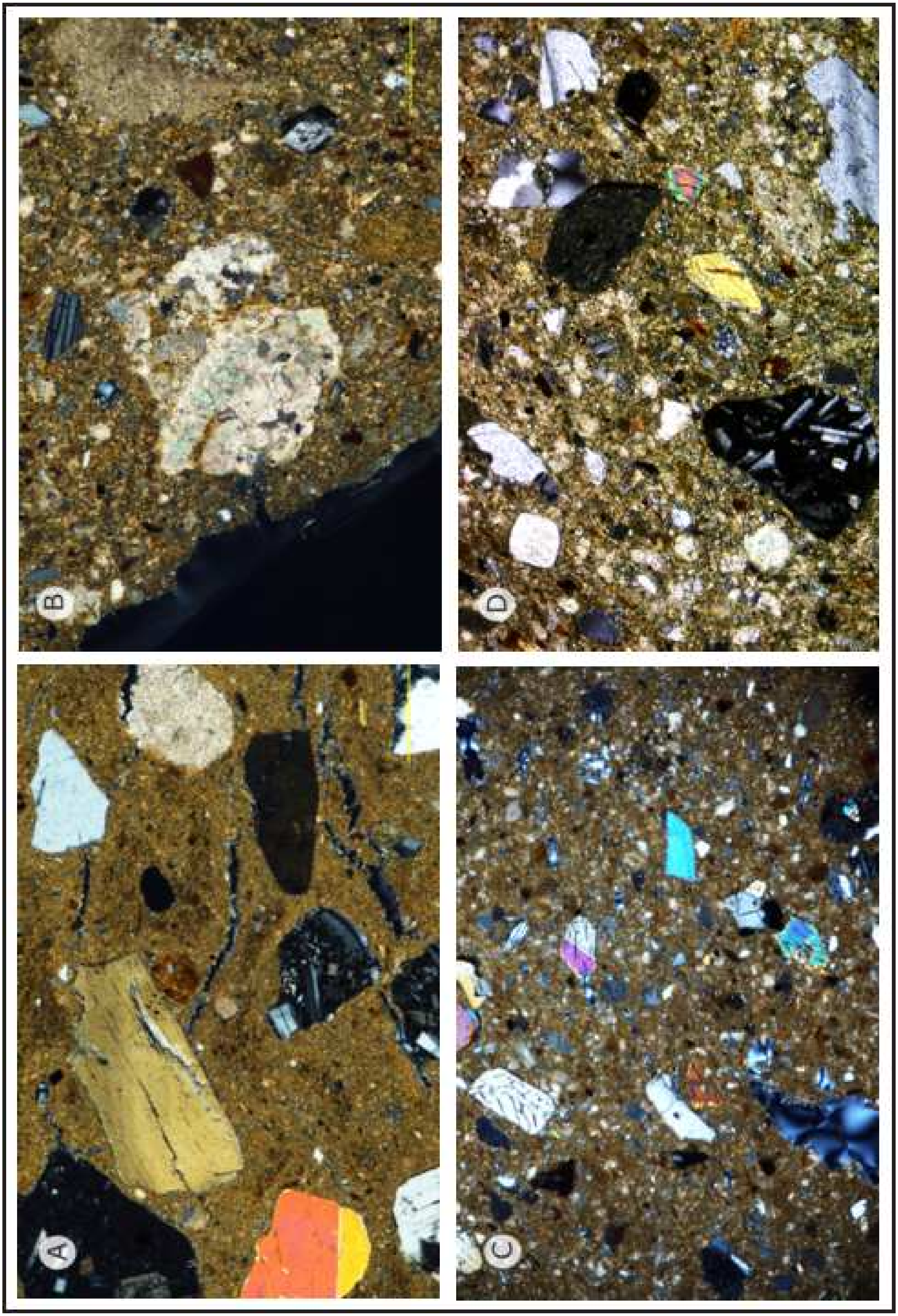

Figure 8 Display in portrait Click here to access/download;Figure;Figure_8_Ash Laq.tiff

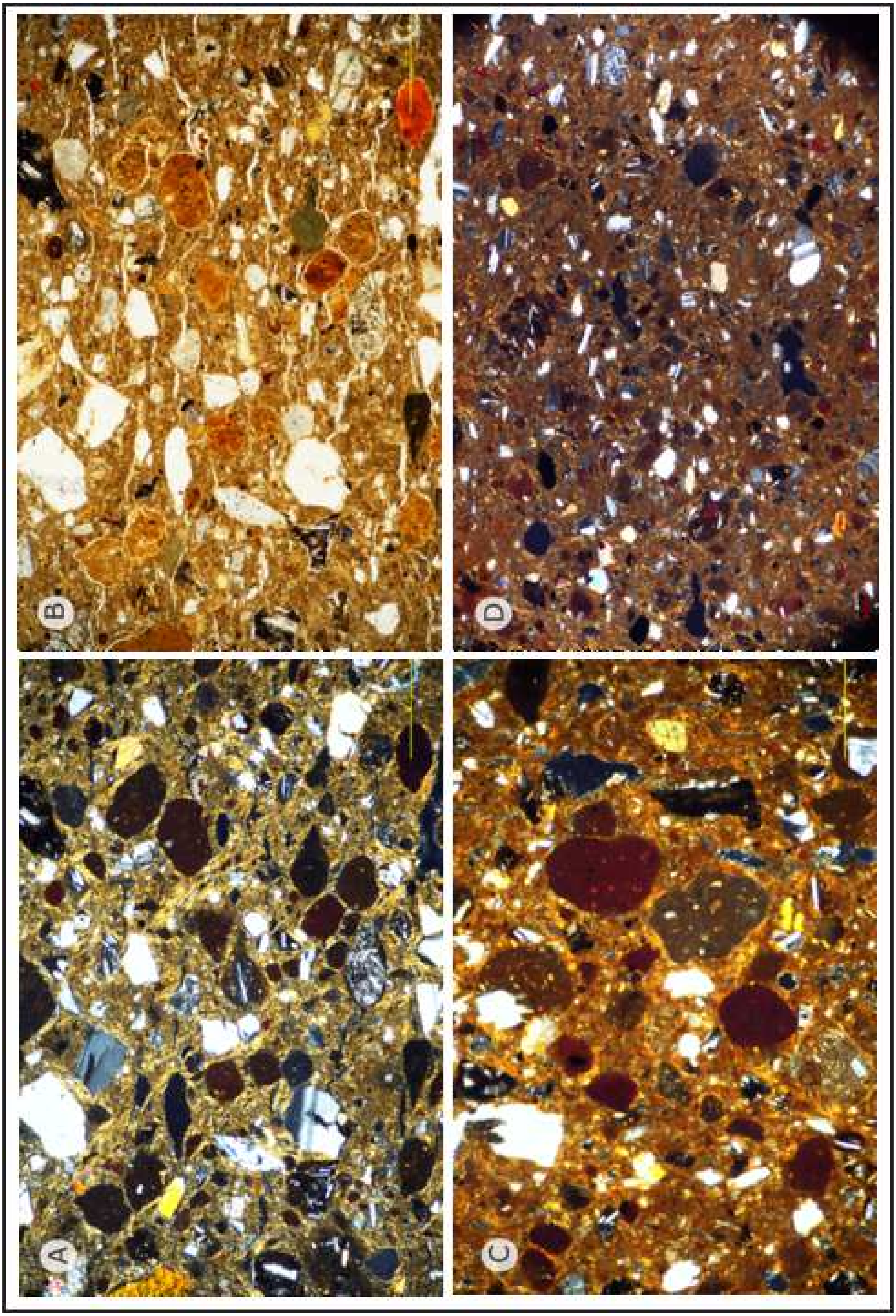

Figure 9 Can be small, single column display

Click here to access/download;Figure;Figure_9_Toluca outliers.tif

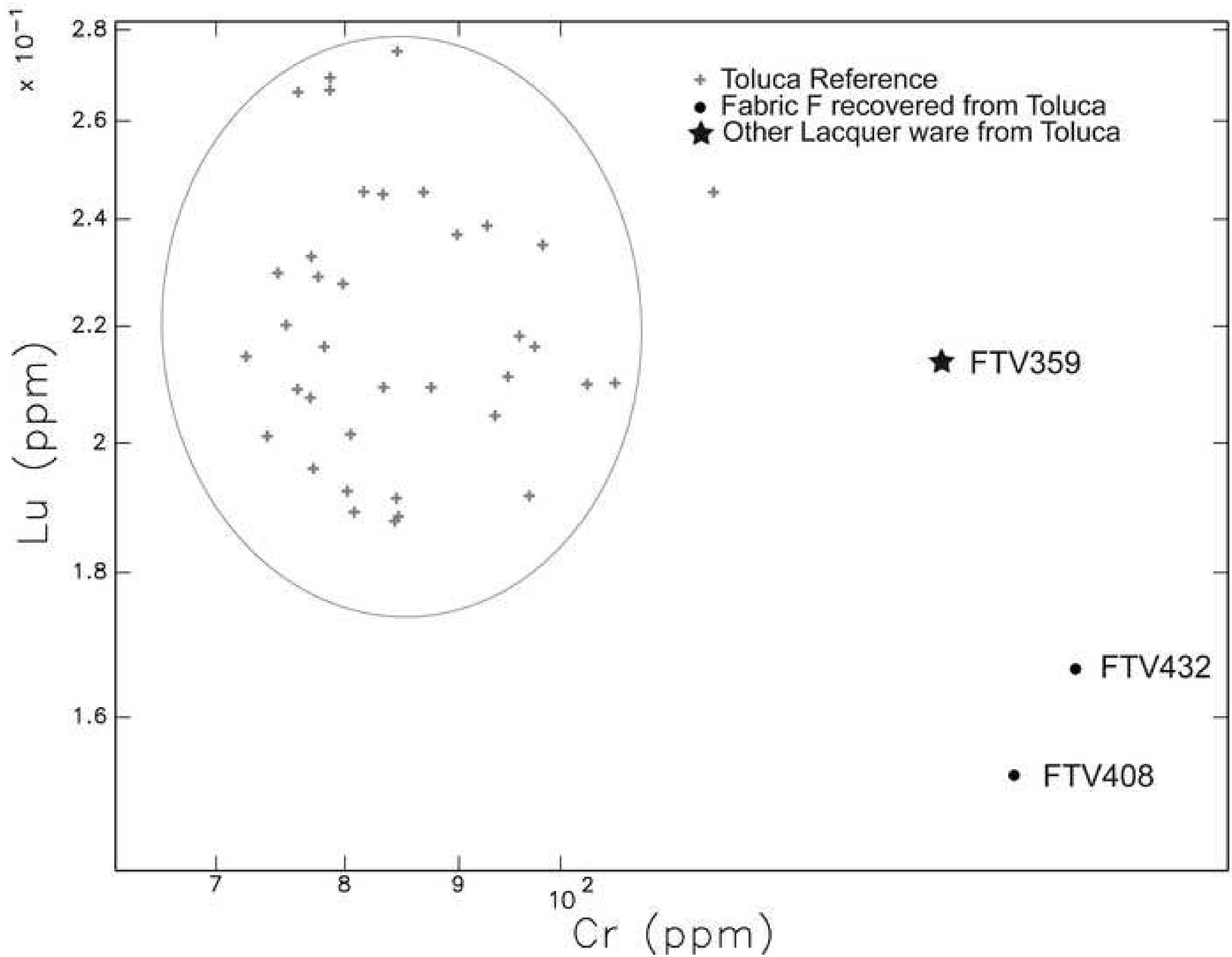

Figure 10 span columns

Click here to access/download;Figure;Figure_10_Altica_Tetimpa.tiff

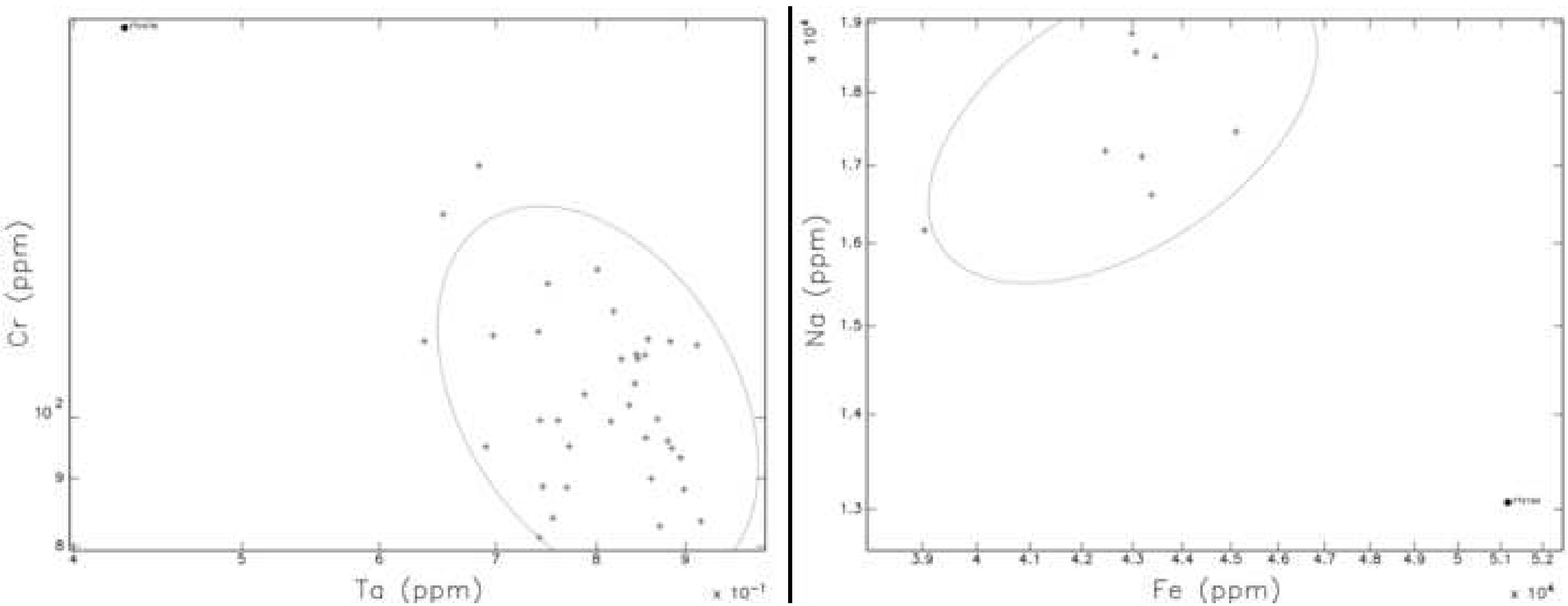

Figure 1. Map of the sample region showing sites mentioned in the text. Grayscale zones represent elevation classes in 500 m increments.

Figure 2. Early Formative ceramics found in central Mexico. All specimens redrawn from ceramics recovered at Zohapilco/Tlapacoya. Photograph in the upper right corner is Ayotla Phase Pilli White from excavations at Tlapacoya done by Tolstoy.

Figure 3. Whiteware ceramics found in the Basin of Mexico. All examples redrawn from ceramics recovered at Zohapilco/Tlapacoya in the southeast Basin of Mexico. Photograph in the upper right corner is a double-line-break white ware from Manantial Phase Altica in the Teotihuacan Valley.

Figure 4. Orange Wares. Top (A-B): Peralta Orange recovered at Chalcatzingo. Bottom: Lacquer Ware from C: Chalcatzingo, D: Toluca, E: Venta de Carpio. Black bars are 1 cm. We note that Lacquer Ware specimens when found in the Basin of Mexico tend to be highly fragmented and the orange wash severely eroded.

Figure 5. Late white wares in the Basin of Mexico, all ceramics redrawn from ceramics recovered at Temamatla in the south rim of the Basin.

Figure 6. Composition of Lacquer Ware and Peralta Orange specimens (points) displayed relative to major central Mexican compositional groups (ellipses) on axes of chromium and tantalum. Points that are not identified as Peralta Orange are coded according to petrographic fabric.

Figure 7. Lacquer Ware specimens that exhibit a calcareous ground mass and larger fragments of calcite/aragonite aggregates that likely derive from limestone. All specimens also feature minerals associated with volcanics that were either added to temper the fabric or that naturally settled in the clay through volcanic ash fall. All

photographs in cross-polarized light A) PTO798 10x objective. B) PTO761 10x objective. C) PTO760 5x objective. D) PTO774 5x objective.

Figure 8. Thin sections of Lacquer Ware Ceramics showing Fabric F. A) FTV432 5x objective in cross-polarized light. B) FTV 432 5x objective in plane polarized light. C) FTV408 5x objective in cross-polarized light. D) PTO020 5x objective cross-polarized light.

Figure 9. Samples from San Antonio la Isla in the southern Toluca Valley showing 3 Lacquer Ware specimens compared to the core reference group for the site.

Figure 10. Lacquer Ware samples from Altica (Teotihuacan Valley) and Tetimpa (western Puebla) showing their divergent chemistries compared to reference groups for both sites.

Table 1 Excel editable

Click here to access/download;Table (Editable version);Table_1_BOM Chronology_Final.xlsx

Uncal ^{14}C years B.C.*	Cal B.C.**	General Periods	Chalcatzingo, Morelos (Grove 1987)	Basin of Mexico (Tolstoy 1978)	Zohapilco (Niederberger 2000)	Teotihuacan Valley (Sanders 1994)
1	50 A.D.					
		Terminal Formative		Patlachique	NA (Tzacualli)	
	1 B.C.					Tzacualli
100	65					
	130		NA	Ticoman IV		
						Patlachique
200	160					
	230***	Late Formative		Ticoman III	Ticoman	Tezoyuca
300	260					
	370			Ticoman II		
400	400		Late Cantera			Cuanalan
				Ticoman I		
	460					
500	580			Cuautepec		
				Late la Pastora	Zacatenco	
	630			****		
600	750					
		Middle				Chiconautla
	800	Formative	Early Cantera	Early la Pastora		
700	810					
	850				Tetelpan	
800	880			El Arbolillo		Altica (Sanders)
	950		Late Barranca			
900	1000			Bomba	Manantial	
	1080		Middle Barranca			Altica (Tolstoy et al. 1977)
				Manantial		
1000	1160					
	1230	Early Formative		Ayotla		
1100	1310				Ayotla	
			Early Barranca			
	1350					
1200	1425			Coapexco		
	1470					
1300	1520		Late Amate			
					Nevada	
	1570			Nevada		
		Initial				
1400	1640	Formative	Early Amate			
	1700					
1500	1750					

*Phase breaks reported as uncalibrated ^{14}C years B.C..
**Recalibration of all radiocarbon time dates based on IntCal 13 (Reimer et al. 2013)
with Conventiontional Radiocarbon Age input using the Libby Half-Life (Stuiver and Polach 1977)
*** Direction of the curve reverses here, I present the lower probability date.
**** Tolstoy crowds several subphases in a particularly flat part of the curve, and has date reversals in the sequence between 700 - 400 BC uncalibrated. I combine Early and Late Cuautepec and Late La Pastora for this reason.

Table 2

Type	Early Amate	Late Amate	Early Barranca	Middle Barranca	Late Barranca	Early Cantera	Late Cantera
Amatzinac White	0.5	1.1	20.5	21.0	22.2	27.6	31.7
White-Rimmed Black	0.7	0.6	2.9	3.8	3.8	3.5	1.6
Peralta Orange	0.9	1.2	20.6	12.8	15.4	17.7	24.3
Lacquer Ware	0.0	0.1	4.6	5.7	5.4	4.0	2.5

Table 3

	Zacatenco			Manantial			Ayotla	
Layer →	4	5a	5b	6	7	8	9	10-11
Chilapa Naranja	0.22	0.72	0.90	0.22	0.10	0.56	0.52	0.42

Table 4

Lacquer Ware	**Generalized Surface Color**	**Comments**
Teotihuacan Valley		
• FTV140 (general context)	UNID	Small fragment
• FTV478 (Altica)	Orange wash over buff paste	Flat based bowl w/ outslanting walls
• PTO798 (general context)	Yellow wash over firm white slip	Flat base incised with possible grater design
Atoto (BOM)		
• PTO761	Orange wash over thin white slip	Small fragment
• PTO762	Orange wash over white slip	Small fragment
• PTO773	Brown wash over firm white slip	Small fragment
Chimalhuacan (BOM)		
• PTO138	Orange wash over thin white slip	Two small fragments
Cholula (Central Puebla)		
• FTV160	Orange wash over firm white slip	Hemispherical bowl, Double line incision exterior rim w/ dip (not a complete break)
Colotzingo (SW Puebla)		
• FTV167	Orange wash over firm white slip	Rim of hemispherical bowl, no decoration
Cuanalan (Teo Valley)		
• FTV077	Yellow over buff colored paste	Hemispherical bowl
El Arbolillo (BOM)		
• PTO760	Orange over firm white slip	Small fragment
• PTO774	Brown wash over firm white slip	Small fragment
San Antonio la Isla (Toluca)		
• FTV359	Orange wash over firm white slip	Kidney shaped bowl, orange wash exterior and wrapping around to cover upper rim interior
• FTV408	Bright Orange over firm white slip	Small fragment, double line incision through white slip but orange wash added after.
• FTV432	Orange wash over firm white slip	Hemispherical bowl, no decoration
Tetelco (BOM)		
• PTO020	Orange wash over firm White slip	Small fragment
Tetimpa (Puebla)		
• FTV194	Orange wash over cream slip	Bowl no decoration
Tlaltenco (BOM)		
• PTO052	Yellow/Brown wash over white slip	Small fragment
Venta de Carpio (Teo Valley)		
• FTV016	Yellow/Brown wash over white slip	Punctations on lip of bowl, like early examples from Chalcatzingo (cf. Cyphers 1987:Fig 13.30 f-h)
• FTV018	Yellow/Brown wash over White slip	Hemispherical bowl, no decoration
• FTV137	Orange wash over thin white slip	Hemispherical bowl, no decoration
Chalcatzingo (East Morelos)		
• FTV278	Bright Orange over firm white slip	Small fragment, double line incision interior.

Table 1. Chronology of the Formative Basin of Mexico.

Table 2. The percentage of four pottery types over the occupational history of Chalcatzingo as determined through stratigraphic excavations (Cyphers 1987:Table 13.2). Refer to Table 1 for the chronology of phase names.

Table 3. Percent Chilapa Orange to total ceramics according to excavation layer at Zohapilco (Niederberger 1976: 164).

Table 4. Lacquer Ware Sample (n = 22).

Author Contributions

Stoner conducted sampling, analysis, data reporting, conceptualization, and writing.

Nichols conducted sampling, conceptualization, and writing, but she passed away prior to the revisions and did not have the opportunity to shape the final product.

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Supplementary File
Supplement.xlsx