Ceramic technology and the global world: First technological assessment of the Romita ware of colonial Mexico

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Abstract - Romita Ware is a unique ceramic found in Colonial archaeological contexts throughout Mexico. The ceramic features a white slip and a very thin transparent lead-silica glazed outer coating on top. The characterisation of the technological choices adopted in the production of Romita ware is assessed by means of scanning electron microscopy.

1. Introduction
Romita Ware, also known as Indígena ware or Loza Indígena, has been considered by many scholars to be an indigenous imitation of Spanish tin glazed ceramics in colonial Mexico. The pottery is found in abundance in colonial contexts in Mexico City, and, as such, it has interested scholars for decades (Lister and Lister 1982). Because this ware is believed to be most likely an indigenous imitation of European tableware, it is considered important in the study of technological change in colonial situations, the adoption of European aesthetics among indigenous people, and competition between colonisers and indigenous people in the colonial market.

In an effort to identify the origin of this ware, scholars have variously assigned it to Italy (Lister and Lister 1976), Mexico (Lister and Lister 1982, 1987; Maggetti et al. 1984; Fournier et al. 2007; Iñañez et al. 2010), and Spain (Rodríguez-Alegría 2002; Rodríguez-Alegría et al. 2003).

Romita ware is an earthenware covered with a white glazed coating, found in many typological forms, such as porringers with leaf-shaped handles, compound-silhouette plates, bowls, and other forms similar to those of European and Mexican majolica. Lister and Lister (1976) named the two main variants of this ware after Rome: Romita Plain for the undecorated variant, and Romita Sgraffito for the decorated variant, since they first believed that the origin of this ceramic had to be sought in Italy (Lister and Lister 1976). Romita Sgraffito has decoration outlined probably by carving through the white slip to expose the red colour of the paste, and then filling the areas of the glaze with green and orange pigments, giving the ware its characteristic bright colours. Decorations visible on the Romita Sgraffito vessels include characteristic decorative elements that may derive from pre-Hispanic indigenous traditions, such as corn or eagles, as well as others more similar to the European Renaissance style, including wavy valances, spirals, and circular motifs (for further discussion of the decorations and images of these ceramics, see Lister and Lister 1982; Rodríguez-Alegría 2002; Rodríguez-Alegría et al. 2003; Fournier et al. 2007; Iñañez et al. 2010).

Archaeological and historic evidence suggest a prolonged period of production and consumption for these ceramics that would have begun in the 16th century and continued until the middle or even the end of the 17th century (Fournier et al. 2007). The geographical distribution of these ceramics is not restricted to Mexico City, where Lister and Lister found mostly the plain variant (Lister and Lister 1982). This ware shows a wide distribution throughout central and northern Mexico and the southern United States, especially of the Sgraffito variant (see Fournier et al. 2007, and references therein).

2. Archaeometric background
An archaeometric study conducted by Maggetti et al. (1984) provided the first chemical and petrographic analyses of the ceramic pastes of Romita ware. Although limited in the number of samples, this research concluded that the petrography exhibited by these samples was compatible with a volcanic geology contrasting with the most common sedimentary tempers used in Spanish majolica, and suggesting that the production area could be a location outside the Valley of Mexico (Maggetti et al. 1984) (Fig. 1). More recently, Rodríguez-Alegría conducted a stylistic analysis and a chemical characterisation study of the ceramics from the Metropolitan Cathedral in Mexico City and concluded that it was a European import (Rodríguez-Alegría 2002; Rodríguez-Alegría et al. 2003).

The chemical composition of the 94 Romita Ware sherds that were analysed by INAA did not match the composition of more than 4,000 samples from Mesoamerica that had been analysed at the Research Reactor of the University of Missouri (MURR). However, Rodríguez-Alegría's study also failed to match the composition of Romita Ware to any European ceramics that had been previously analysed by INAA; nevertheless, the aesthetic features of this ware led him to the conclusion that it had to be European, most likely from Spain. More recently, Fournier et al. (2007) carried out an INAA study that included numerous Romita Ware specimens from the Michoacán region, not only archaeological, but also from ethnographic contexts. The authors concluded that the Romita Ware chemical fingerprint identified by INAA suggested the existence of two different groups, very similar in their chemical composition, that were likely produced in the Pátzcuaro Basin area (Fournier et al. 2007). Additionally, the statistical reassessment of the Romita Ware INAA data and the comparison with the fingerprint of the main majolica and glazed ware manufactured in the Iberian Peninsula and Western Mediterranean during the colonial period allows ruling out such a provenance (see Fig. 2). Lastly, Iñañez et al. (2010) provided the last piece of evidence supporting the hypothesis of a Mexican origin for Romita Ware ceramics after assessing the provenance of the lead sources employed for their glazed coats, following a study of their glazed coatings by Lead Isotope Analysis (LIA). This study confirmed that multiple lead ore sources were exploited in relation to the manufacturing of this ware, all exclusively located within the borders of present-day Mexico. Therefore, after a consideration of all the archaeometric evidence available to date from both INAA and LIA, we can conclusively argue that Romita pottery is a Mexican ware that was likely produced at multiple sites in the Michoacán area.

In the present paper, we bring together evidence pertaining to the chemical composition and the technological features of these ceramics as assessed by SEM-EDS, in order to address a previously unexplored aspect of Romita Ware: the interesting characterisation of the glazing technology of this ceramic. Revealing the technological characteristics of Romita Ware is of paramount importance for assessing the degree of technological ‘influence’ of European potting traditions to indigenous societies during the first periods of contact. Surely, as identified in the studies of other aspects of life under contact situations in other regions and by other populations, from food to social relationships, the struggles, dominations, and cultural influences occurring during these contacts resulted in many new expressions that agglutinated to various extents cultural and technological influences from the different agents that took part in them (e.g., Deagan 1996; Ortiz 2002 [1940]; Armstrong and Hauser 2009).

Figure 1. Map showing the main locations mentioned in the text and purportedly the Romita Ware production area, represented by a dashed-lined circle.
Along these lines, indigenous pottery production also seems to have been affected by these transculturation processes, since, according to the current archaeological knowledge, these pots probably began to be produced around the mid-16th century in West Mexico. Therefore, the Spanish colonisation of this area may have represented an important cultural and technological influence, which might be traceable by analytical means.

3. Analytical methodology

Chemical analyses of Romita Ware and Spanish majolica and utilitarian ware ceramic pastes were conducted by neutron activation analysis (NAA) at the Archaeometry Laboratory of the University of Missouri Research Reactor (MURR)\(^1\). Exterior surfaces of the ceramics were mechanically removed using a silicon-carbide abrader to remove slip, glaze, and other surface contamination. Samples were then ground and homogenised in agate mortars or using an automatic mill with a tungsten carbide cell, and the resulting powdered material was transferred to glass vials. Prior to weighing, the powdered pottery samples were oven-dried at 100 °C for at least 24 h. Approximately 150 mg of sample were weighed in small polyvials used for short irradiations. At the same time, 200 mg of each sample were weighed into high-purity quartz vials used for long irradiations. Along with the ceramic samples, reference standards of SRM-1633a (coal fly) and SRM-688 (basalt rock) were prepared, as well as quality

<table>
<thead>
<tr>
<th>wt%</th>
<th>Average</th>
<th>St.dev.</th>
<th>Average</th>
<th>St.dev.</th>
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<tbody>
<tr>
<td></td>
<td>Glaze</td>
<td>Slip</td>
<td>Glaze</td>
<td>Slip</td>
</tr>
<tr>
<td>Na(_2)O</td>
<td>0.6</td>
<td>0.3</td>
<td>1.3</td>
<td>0.6</td>
</tr>
<tr>
<td>MgO</td>
<td>0.2–1.0</td>
<td></td>
<td>0.5</td>
<td>0.3</td>
</tr>
<tr>
<td>Al(_2)O(_3)</td>
<td>9.9</td>
<td>4.4</td>
<td>36.8</td>
<td>7.4</td>
</tr>
<tr>
<td>SiO(_2)</td>
<td>31.6</td>
<td>5.2</td>
<td>52.2</td>
<td>5.6</td>
</tr>
<tr>
<td>PbO</td>
<td>56.0</td>
<td>8.6</td>
<td>0.0–7.9</td>
<td></td>
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<tr>
<td>K(_2)O</td>
<td>0.0–0.6</td>
<td></td>
<td>0.8</td>
<td>0.4</td>
</tr>
<tr>
<td>CaO</td>
<td>0.1–0.9</td>
<td></td>
<td>0.1–4.0</td>
<td></td>
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<tr>
<td>Fe(_2)O(_3)</td>
<td>0.0–5.1</td>
<td></td>
<td>4.4</td>
<td>2.7</td>
</tr>
<tr>
<td>TiO(_2)</td>
<td>0.4</td>
<td>0.2</td>
<td>1.2</td>
<td>0.2</td>
</tr>
<tr>
<td>SnO(_2)</td>
<td>0.0–0.8</td>
<td></td>
<td>0.0–0.4</td>
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control samples of SRM-278 (obsidian rock) and Ohio Red Clay. At MURR, the NAA of pottery consists of two irradiations and a total of three gamma counts. Short irradiations involve a pair of samples being transported through a pneumatic tube system into the reactor core for a 5 s neutron irradiation using a thermal flux of $8 \times 10^{13}$ n cm$^{-2}$ s$^{-1}$. After 25 min of decay, the samples are counted for 720 s using a high-resolution germanium detector. This count yields data for nine short-life elements: Al, Ba, Ca, Dy, K, Mn, Na, Ti, and V. For the long irradiation, bundles of 50 or 100 of the encapsulated quartz vials are irradiated for 24 h at a flux of $5 \times 10^{13}$ n cm$^{-2}$ s$^{-1}$. Following the long irradiation, samples decay for seven days, and then are counted for 1800 s (known as ‘middle count’) on a high-resolution germanium detector coupled to an automatic sample changer. This middle count yields determination of seven medium half-life elements: As, La, Lu, Nd, Sm, U, and Yb. After an additional two-week decay, a second count for 9000 s is carried out on each sample. This final measurement allows quantification of 17 long-life elements: Ce, Co, Cr, Cs, Eu, Fe, Hf, Ni, Rh, Sb, Sc, Sr, Ta, Tb, Th, Zn and Zr (for a detailed discussion of the analytical conditions, see Glascock et al. 2007).

Scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS) was conducted on a subset of 10 Romita Ware ceramics. Samples were cross-sectioned using a Buehler Isomet slow speed saw before casting and embedding them in epoxy resin. Metallographic polishing was conducted using diamond paste and alumina in different steps in order to achieve an optimal specular surface for SEM microanalysis. After each polishing step, specimens were sonicated in distilled water baths for 30 s in order to remove any adhering polishing compound. Polished specimens were subsequently mounted on aluminum stubs and carbon coated for SEM examination. SEM examinations were conducted at the Conservation Institute of the Smithsonian Museum using a Hitachi S-3700N variable pressure SEM and Bruker EDS. Chemical microanalyses were acquired for 200 live seconds in areas of interest (ca. 50 μm or larger at 500x magnification). The operational conditions were kept at an optimal working distance for microanalyses of 10 mm, and an acceleration voltage of 20 kV under full vacuum.

4. Results and discussion
The characterisation of the glazing technology is of great importance for the study of Romita Ware, in order to assess technological features that this pottery may or may not share with European majolica. Therefore, SEM-EDS examinations appear crucial to understanding the materials and technical traditions that potters used to manufacture Romita Ware ceramics.

SEM-EDS examinations reveal the nature of the technology employed by ancient Mexican potters for achieving a certain degree of opacification in Romita Ware glazes. The purpose of opacifying the intrinsically transparent lead...
The characteristics of the Romita white slip from the previous photograph, due to its different textural above the clay matrix can be identified as the white slip of the ceramic matrix. In Figure 4, the layer immediately existence of two different layers of material applied on top layer (Figs. 3 and 4). SEM examinations corroborate the was subsequently covered by a transparent thin lead glaze was applied to the external surfaces of the ceramic, which was achieved by the use of a white mineral or clay slip that (Table 1). Instead, opacification in Romita Ware ceramics (Fe2O3), contrasting with the buff light coloured pastes of Spanish majolica (Iñañez et al. 2008), in which the process of incorporation of iron oxides into calcium iron silicates has already been established (Molera et al. 1998).

When compared to a true majolica, Romita Ware lacks most of the technological features that are characteristic of majolica ceramics. Thus, the opacification is not achieved by the use of tin in the glaze mixture, but taking advantage of the use of a clay-like slip dominated by silica and alumina. Furthermore, the thickness of the glaze is unequivocally different. On the one hand, the glaze of Romita Ware consists of a very thin transparent layer, with no apparent inclusions. In contrast (Fig. 4), majolica glaze consists of a thick opaque layer, whose opacity is achieved by the use of tin oxides, usually ranging from 200 to 500 μm in thickness, and often presenting different inclusions, such as quartz and feldspar grains. Finally, while the majority of the majolica bodies are consistent with calcareous pastes, with lime content usually ranging between 15 and 25 wt% (Iñañez 2007; Tite 2009), Romita bodies were manufactured from non-calcareous clays, with lime contents around 1 wt%, according to the NAA data (Rodríguez-Alegría 2002). Therefore, the coloration of Romita pastes is dark reddish or brownish, likely due to the presence of hematite (Fe2O3), contrasting with the buff light coloured pastes of Spanish majolica (Iñañez et al. 2008), in which the process of incorporation of iron oxides into calcium iron silicates has already been established (Molera et al. 1998).

5. Conclusion
As presented in other studies (see Fournier et al. 2007; Iñañez et al. 2010), chemical data from INAA of the ceramic pastes demonstrates a New World origin for Romita Ware ceramics, with the Michoacán region (Mexico) being the likely production locale. Moreover, these results allow us to unequivocally rule out a Spanish provenance for these ceramics.
The present study represents the first attempt to characterise the glazing technology of the Romita Ware ceramics. Its results indicate that Romita Ware shows a very characteristic technological choice, i.e., the use of white slips under a thin transparent lead glaze layer. A relationship between these ceramics and products of European manufacture, majolica in this case, clearly exists. The similarities between Romita and majolica ceramics relate primarily to the external appearance of the vessels; Romita artefacts clearly resemble some of the forms and shiny metallic surfaces that are characteristic of Spanish majolica. However, the technological choices of the craftsmen who produced the Romita pottery were substantially different from Spanish majolica producers. Thus, the choice of non-calcareous clays, as well as the use of slip for achieving white opacification, can be seen as a continuation of traditional potting traditions as well as constraints on the availability of local clays and other materials (e.g., tin), although in an effort to imitate the new products brought by Europeans colonisers. Therefore, Romita Ware ceramics can be interpreted as the successful combination of two different technological traditions that, as a consequence of acculturation processes, resulted in the emergence of a new pottery technology.

Note
1. For additional information see Rodríguez-Alegría (2002); data is published on-line at http://archaeometry.missouri.edu/datasets/datasets.html.

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