Technological Features of Colonial Glazed Pottery from el Convento de Santo Domingo (Antigua, Guatemala). Similarities and Differences Between Colonial and Spanish pottery

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1 The Convent of Santo Domingo (Antigua, Guatemala)

According to historic documentation, production of majolica at Santiago de Guatemala began no later than 40 years after the foundation of the city in 1543. In terms of majolica production and quality, we can consider the seventeenth century as the high point for majolica production in Antigua. Historic documents reflect the existence of more than 16 majolica masters in the city, who produced Guatemalan majolica pottery that is typified by black-on-white patterns, with green, yellow, and/or blue decorative elements (Luján 1975). Although the first priests of the Dominican order arrived in Antigua in 1559, the convent of Santo Domingo was not built until the mid-seventeenth century. The convent, which was home to more than 80 priests, was recognized as one of the most significant religious centers in Guatemala at that time, and consequently a significant number of majolica tiles, plates and pots were used in its construction and in everyday-life. Unfortunately, the convent was adversely impacted by earthquakes in 1773; the resulting structural damage forced the Dominicans to abandon the site and move to Nueva Guatemala de Asunción, where the capital of the former Capitanía General de Guatemala had moved to in 1776.

2 Goals and Methodology

The main objective of this work is the archaeometric characterization of colonial glazed pottery from the seventeenth century found in the archaeological excavations conducted at the site of the convent of Santo Domingo, both for provenancing issues and for technological features assessment. In order to achieve our aims, 7 majolica sherds out of a sample of 16 ceramic sherds were selected and their glazes

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I. Turbanti-Memmi (ed.), *Proceedings of the 37th International Symposium on Archaeometry*, 77
DOI 10.1007/978-3-642-14678-7_11,

studied by means of laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) and scanning electron microscopy (SEM).

The instrumentation used in this analysis was a Perkin Elmer Elan 6000 inductively coupled plasma-mass spectrometer (ICP-MS). A Cetac LSX-200 Plus Nd: YAG 266 nm laser was used for the direct introduction of solid samples to the ICP. Ablations consisted of patterns of parallel lines, conducted twice in order to remove surface contamination; analysis of the actual sample matrix occurred during the second pass of the laser over the ablation area. For the pre-ablation, laser was operated at 20 Hz using a spot size of 100 μm at a speed of 100 μm/s. The second ablation was performed at 5 Hz using a spot size of 25 μm at a speed of 30 μm/s. Twenty scans were made for each of the isotopes measured. Each sample was analyzed for Ag, Al, As, Au, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Hg, In, K, Mg, Mn, Na, Ni, P, Pb, Rb, Sb, Si, Sn, Sr, Th, ti, U, Zn, and Zr. The normalization approach used is modified from that suggested by Gratuze and others (Gratuze 1999; Neff 2003; Speakman and Neff 2005). Data generated from the analyses, expressed as counts per second, were referred to an internal standard (in this case Al) to normalize for different count rates between samples and standards. Quantitative data were then obtained by comparing the normalized signal in the unknown samples to the normalized signals for standard reference materials SRM612, SRM621, and Brill Glasses A, B, C, and D. Because of low analytical precision for As, Au, Bi, Cd, Hg, Ni, P, Sb, and Zn these elements were removed from consideration during the statistical treatment of the data. Because our focus is on the white glazed areas, data for Co and Mn were not used, since they are the main components of blue and black decorations on Spanish ceramics, and likely would distort the statistical treatment. To achieve a better understanding of the technological features of the Guatemalan colonial pottery, these latter sherds were compared with a sample set of 24 ceramics from Spain: Talavera de la Reina (4), Puente del Arzobispo (7), and Seville (13). Statistical treatment in this work was performed using the Aitchison's procedures for dealing with compositional data (Aitchison 1986; Aitchison et al. 2000).

3 Chemical Characterization

Principal Component analysis was performed to explore the chemical differences between the Guatemalan glazes and the Spanish productions. The first five principal components account for more than 92% of the cumulative variation in the dataset (Fig. 1).

Examination of the LA-ICP-MS data generated for the white glazes reveals four groups that correspond to archaeological provenance – Santo Domingo (SDM), Seville, Talavera, and Puente (see Iñañez 2007 for additional information on Spanish ceramics and deeper discussion, available on line at http://www.tdx.cat/TDX-0205107-115739), and one individual not matching any reference group (Fig. 1).

Thus far, chemical data indicates the use of different PbO, alkali, and SiO_2 proportions by potters in Guatemala to make the glazed coating when compared with the Spanish productions. Guatemalan majolica glaze generally shows higher

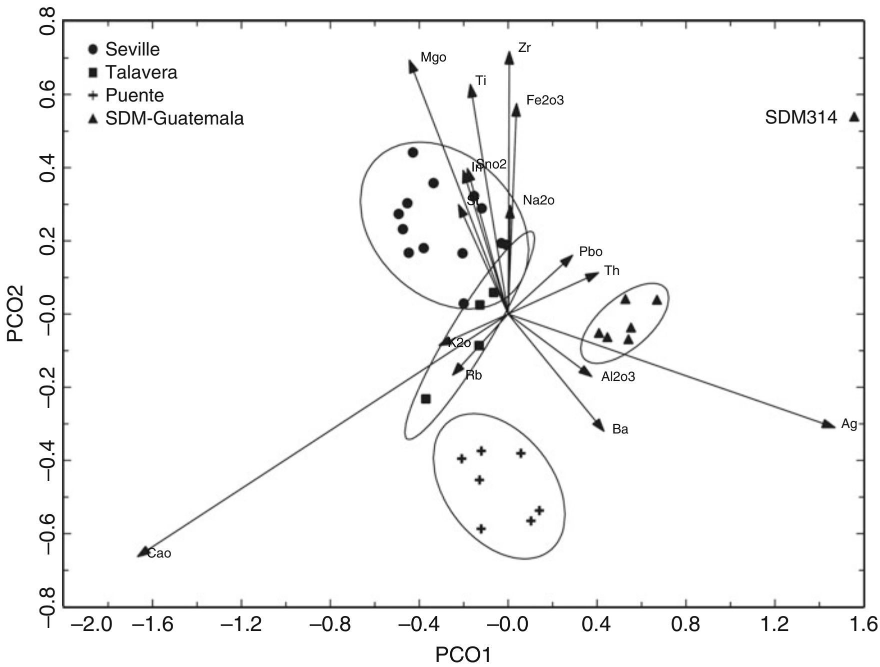

Fig. 1 Plot of the first two components according to the Principal Components Analysis using logarithm ratios and SiO_2 as divisor. Plot shows the three different Spanish compositional groups and the Compositional Group of Convento de Santo Domingo (SDM), Guatemala. *Ellipses* represent a confidence interval of 90%

PbO and lower SiO_2 and K_2O concentrations. Moreover, higher Ag also is detected amongst the Guatemalan colonial pottery, possibly as a result of the lead and silver ore processing. Silver is therefore a discriminating element between Spanish and Guatemalan productions. Seemingly, the amount of SnO_2 used for opacifying the glazed coating might point out some differences between the Spanish and Guatemalan pottery (Table 1).

However, significant differences on the chemical composition of sample SDM314 – mainly on CaO, SiO_2, and PbO contents – may indicate a different glaze recipe or, perhaps, even a different production. Therefore, SDM314 should remain labelled as unknown until future studies might reveal the existence of multiple recipes and/or provenance groups in the ceramics from the Convento of Santo Domingo de Antigua.

4 Technological Characterization

Double firing is the most common firing process for majolica ware according to European majolica making tradition. SEM examination of the samples from Antigua shows that crystal growth at the interface matrix-glaze area is less than 10 μm. This finding supports a double firing process hypothesis (Fig. 2, left) given the very

Table 1 Mean and standard deviations calculated for the chemical compositions of the groups from Convento de Santo Domingo, Seville, Talavera, and Puente

	SDM Guatemala (n = 6)		Seville (n = 13)		Talavera (n = 4)		Puente (n = 7)		SDM314
	Average	St. dev.	Average	St. dev.	Average	St. dev.	Average	St. dev.	Conc.
Al_2O_3 (%)	7.49	0.70	2.84	0.83	4.45	1.59	5.96	1.16	5.89
CaO (%)	0.29	0.16	2.06	0.87	2.58	1.54	3.01	0.85	n.d.
Fe_2O_3 (%)	0.71	0.09	0.94	0.32	0.35	0.10	0.24	0.04	0.57
K_2O (%)	1.21	0.17	3.33	1.35	3.61	0.95	3.73	0.31	0.93
MgO (%)	0.17	0.04	0.85	0.33	0.49	0.29	0.13	0.04	0.11
Na_2O (%)	1.04	0.24	1.41	0.38	1.22	0.56	0.73	0.24	0.84
PbO (%)	42.91	4.83	32.20	8.82	23.76	7.37	26.91	8.40	53.70
SiO_2 (%)	42.58	4.49	48.65	6.41	56.76	3.46	53.87	7.87	34.09
SnO_2 (%)	3.28	0.72	6.61	2.29	5.82	2.90	0.35–12.01[a]		3.62
Ag	88	31	0–15[a]		2–9[a]		6–55[a]		158
Ba	603	82	180	82	388	93	537	101	494
Cu	32–2,142[a]		54–2,334[a]		250	48	41–518[a]		338
In	64	14	141	49	141	55	73	32	70
Mn	597	61	58–1,286[a]		165–355[a]		97	53	535
Rb	57	5	139	71	151	11	202	23	43
Sr	61	7	138	60	109	36	68	22	45
Th	6	0	2	1	4	1	2	1	5
Ti	835	86	2,051	556	1,211	577	396	67	677
Zr	41	2	80	47	29	6	15	4	57

All values are expressed as ppm ($\mu g\ g^{-1}$) except those expressed as oxide weight %
n.d. element not determined
[a]Minimum and maximum value

low interaction between glaze coat and paste, in agreement with relevant literature (Molera et al. 1997; Tite et al. 1998).

Moreover, Guatemalan glaze coating averages a thickness around 250 μm, which might be considered as a "typical" thickness for those productions. Although some specimens from Seville and Talavera also studied by SEM showed differences in their glaze coating thickness, most of the ceramics from the Spanish production centers exhibit glaze coating ranging from 150 to 300 μm (Iñañez 2007).

Compositions of pigments composing the chromatic decoration applied on the white opaque glaze also have been characterized. Interestingly, the black decoration is not made from Mn, as is common for most Medieval and Renaissance majolica produced in Spain. In contrast, black decoration on Guatemalan-produced majolica is made of a Fe-based compound (Fig. 2, right). Identification of the specific compound is ongoing.

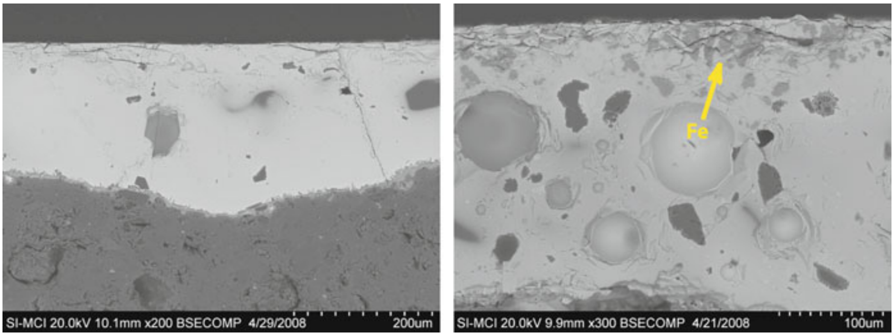

Fig. 2 *Left* SEM-backscattered electron microphotography of the white area of sample SDM314 showing the interface glaze-matrix at 200×. *Right* SEM-backscattered microphotography of sample SDM301 of the black pigment area at 300× with indication of Fe-particles

5 Conclusions

Differentiation of Spanish colonial from Spanish majolica might be possible through the analysis of glaze composition. Additionally, Ag concentrations on lead-tin glazes may be linked to a Guatemalan origin, perhaps related to the lead ores, or to the silver extraction technology during that period in the Americas; however more in depth studies must be undertaken. Although Guatemalan majolica production is apparently similar to that of Spanish majolica, some differences can be highlighted, such as the differential use of PbO, SnO_2, and SiO_2 in their glazing technology. Furthermore, the fact that ancient craftsmen used a Fe-based compound for producing black decoration – which is in contrast with the Spanish tradition – might be related to a secular pottery-making tradition still in existence during the colonial period in Guatemala, revealing the existence of a new hybrid recipe. Future studies, with an increased number of samples, will determine more robustly the differences pointed out in this paper.

Acknowledgements Authors are indebted to James Blackman and Ronald L. Bishop for providing the samples analyzed in this study. In addition, Javier G. Iñañez is also indebted to the Smithsonian Institution postdoctoral fellowship program, and to the IOF Marie Curie Program of the European Commission for their support. Authors are grateful to Dr. Isabella Memmi for her comments on this paper.

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