Title:

The Production and Circulation of Indigenous Lead-Glazed Ceramics in Northern Peru During Spanish Colonial Times

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Abstract

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In this paper, we characterize the production and circulation of Early Green Glazed (EGG) Ware, an innovative variety of lead-glazed ceramics produced in Peru's North Coast region in the wake of the Spanish colonization of the Andes. INAA of pastes and LA-ICP-MS of glazes of EGG Ware samples collected from sites in Peru's Zaña, and Chicama river valleys reveal contrasting patterns of composition. While paste characterization via INAA identified a great deal of compositional diversity, LA-ICP-MS data from glazes falls into two discrete groups. We interpret these results as evidence of 1) disperse production of pastes, employing either a wide variety of source materials and/or recipes, mirroring the production of Late Prehispanic paddle-stamped wares, and 2) more nucleated collection of materials for glaze production, perhaps from distinct sources of lead ore. We interpret the presence of small numbers of samples with glaze compositions characteristic of the Zaña valley in Chicama Valley assemblages as evidence of possible trade between indigenous communities in artisanal goods and/or raw materials during the late 16th century CE.

Keywords

INAA, LA-ICP-MS, Cultural hybridity, technology transfer, ceramics, Peru

1. Introduction

During the 16th century CE, potters living in what is now northern Peru produced a curious variety of ceramics – vessels with largely pre-Hispanic forms covered with a lead glaze, a surface treatment that appeared in the Andes only after the Spanish invasion of 1532 CE. Previous discussions of these vessels have seen them as icons of the transformation of native craft and technology under Spanish rule (Acevedo Basurto et al., 2004; Acevedo, 1986; Bushnell, 1959; Hecker and Hecker, 1988; Mayer, 1984;

Mogrovejo Rosales, 1996). However, only recently have samples been recovered in archaeological context, permitting discussions to push beyond general speculation about where, when and how this pottery was produced and utilized. Some observers have argued that such vessels were made by native artisans who learned glazing techniques through explicit instruction from Spanish artisans (Bushnell, 1959; Mayer, 1984), while others have emphasized how they attest to the continuity of native ceramic technologies during colonial times (Acevedo Basurto et al., 2004; Tschopik, 1950).

We label these ceramics Early Green Glazed (EGG) Ware, and argue that they were produced by indigenous artisans who incorporated glazing into their existing decorative programs in the 16th century. Rather than being the products of one or two workshops overseen by Spanish ceramicists, we argue that EGG Ware was produced in dispersed locations, not unlike the paddle-stamped ceramics found in domestic assemblages throughout much of the North Coast region since 1000 CE (Cleland and Shimada, 1998; VanValkenburgh, 2012, n.d.). The results of the analyses presented in this study suggest that some North Coast potters incorporated glazing into their decorative programs relatively quickly. At the same time, they likely obtained the lead ores needed to produce glazes from a limited number of sources (perhaps two).

In this study, we present chemical characterization data of both glazes and pastes of samples recovered from Peru's Zaña and Chicama valleys. The samples of EGG Ware were collected from excavations at three sites – Carrizales (Zaña Valley), Mocupe Viejo (Zaña Valley), and Magdalena de Cao Viejo (Chicama Valley), as well as surface collections from three additional single-component sites in the lower Zaña valley – Puerto de Chérrepe, Conjunto 216 and Conjunto 271 (Figure 1). Analysis of glaze

composition suggests that the artisans who produced these materials used two distinct lead ore sources, while the diversity of paste composition suggests that the type's producers employed a variety of clay sources and/or paste recipes – a pattern that may reflect their organization into dispersed workshops. Together, these results underscore the socially and geographically complex nature of technological change in Spanish colonial Peru.

[Insert Figure 1]

2. Background

2.1. Early Green Glazed Ware: Form, Context and Chronology

The glazed surfaces of EGG Ware vessels readily mark them as products of artisans working after the Spanish invasion of the Americas. Current scholarly consensus is that true glazes – thin layers of glass fused onto the surface of ceramics, containing both silica and fluxes – were never produced by Prehispanic potters (Rice, 1987, p. 20). In isolated cases (particularly, the American southwest and Southern Guatemala), ancient American ceramicists produced surface treatments with glassy appearances, but compositional research suggests that these treatments are the products of alternative technologies (Fenn et al., 2006; Habicht-Mauche, 2006; Herhahn, 2006; Neff 2003; Neff and Bishop, 1988; Shepard, 1948; Van Keuren, 2006; Van Keuren et al., 2013).

Among ceramics from Prehispanic South America, no similar examples of “subglazes” or “pseudoglazes” are known. EGG Ware vessels held in museum

collections, which are wholly covered with a thin yellowish to light green glaze underlain by either buff-colored or grey-black paste, have therefore been interpreted as the products of artisans working after the Spanish invasion of the Americas – most likely following the first concerted wave of European colonization of Western South America in 1532 CE. The majority of their forms are almost identical to ceramics of the Chimu-Inka style – a short-lived artistic tradition believed to postdate the establishment of Inka hegemony in the region, circa 1470-1532 C.E., and which we discuss in further detail in section 2.3 below. However, the fact that *in situ* EGG ware samples have only been recovered from colonial period archaeological contexts alongside other diagnostically colonial period material culture makes the possibility that they were produced in Prehispanic times highly unlikely.

The formal qualities of EGG Ware vessels and the archaeological contexts in which they have been found suggest that indigenous peoples of Peru's North Coast region were the type's primary producers and consumers. Of the 25 complete vessels we have reviewed in museum collections, 13 have unmistakably Chimu-Inka forms. A plurality (12) are double or multi-bodied whistling jars – a type common among Chimu and Chimu-Inka mortuary assemblages that whistle when liquid is poured out of their open spouts (Fig 2). One, held in the collection of the Peabody Museum of Archaeology and Ethnology (Cambridge, MA, USA), is a Chimu-Inka stirrup spout bottle with a body shaped like a deer. Nine of the remaining examples have strong similarities to Prehispanic vessels – two bridge-spout bottles, two small pitchers with animal-like mouths, four bottles with animal-shaped bodies, and one *paccha* (an Inka-style ritual drinking vessel) shaped like a *pacay* (guava) fruit.

The presence of non-traditional forms among EGG Ware vessels also suggests that their creators were highly receptive to new designs. Three examples of EGG Ware from museum collections are pitchers whose shapes have no Prehispanic precedents and are therefore likely to have been modeled on Old World tablewares. Moreover, while surface decoration (other than glaze) is rare among the 25 EGG Ware vessels we have observed in museums, several contain low-relief molded decoration of cross cutting vines and leaves – a design unknown among Prehispanic ceramics, which Bushnell (1959) calls a “raised tree” motif.

These vessel forms and decorations raise the possibility that some EGG Ware may have been consumed in non-indigenous households. However, as we discuss below, all EGG Ware samples recovered to date from archaeological sites derive from houses and middens with indigenous affiliations. It may be more likely that the appearance of non-traditional forms among EGG Ware vessels reflects changing food practices in indigenous households and a growing interest in new ceramic forms – a pattern also reflected (albeit on different terms) in the increasing consumption of imported tablewares within indigenous households in other regions of the Andes (Jamieson, 2000; Rice, 2013, p. 156; Van Buren, 1993, pp. 309–316).

[Insert Figure 2]

Limited information on the provenance of complete EGG Ware vessels in museum collections and fragments from colonial period archaeological sites provide an outline of the contexts in which EGG Ware vessels were utilized and discarded. Based on these patterns, it seems clear that the type was employed in both domestic and mortuary settings and was produced during a short period of time in the mid to late 16th

Century. While only three whole vessels have been recovered in context, records point to the area of the Pacific coastal plain located between the Lambayeque and Chao valleys as the core region where EGG Ware was both produced and consumed. Rafael Larco Hoyle's excavations at the "Playa de Chope" in the Chicama valley uncovered two complete EGG Ware bottles in association with colonial period burials that also contained glass beads, at a site whose primary period of occupation dates to Late Prehispanic times (ML Cuaderno 3). At the site of Laguna de los Cóndores in the Chachapoyas region of Peru, artifacts found alongside over two-hundred mummy bundles included an EGG Ware double-spouted whistling bottle, as well as native Chachapoyas and Inka pottery (Guillén, 2012). Museum records for two other EGG Ware vessels suggest that one may have been extracted from a site in the Piura valley, a second near the highland town of Recuay, and a third from the Huaura valley (Bushnell, 1959). In isolated locations, where Spanish surveillance of indigenous mortuary practices was limited, EGG Ware was incorporated into existing burial traditions – perhaps relatively soon after the Spanish invasion of 1532 CE.

Excavations in contexts post-dating 1570 CE suggest that EGG Ware continued to be produced after Peruvian Viceroy Francisco de Toledo's initiatives to forcibly resettle indigenous people into planned towns called *reducciones*, carried out between 1569 and 1575 CE (Toledo, 1986, 1867). At Magdalena de Cao Viejo (Chicama valley; occupied ca. 1578-1720 CE) excavations recovered fragments of EGG Ware from household features in the lowest, 16th Century levels of the indigenous town, but not from the site's church cloister, which was staffed by Dominican priests (Quilter, 2011; VanValkenburgh, n.d.). At the site of Puerto Eten, Klaus and Alvarez-Calderón similarly

recovered at least one fragment of EGG Ware from a household midden within a largely indigenous town (personal communication, 2011). VanValkenburgh's (2012) survey and excavations in the lower Zaña valley also recovered EGG Ware from domestic contexts at two *reducción* sites founded in the late 16th Century, Carrizales (C123) and Mocupe Viejo (C74), as well as a colonial port occupied by indigenous people (the Port of Chérrepe [C142]), a domestic site of unknown attribution (C216), and an isolated mortuary site (C271). Excavations of looted contexts in the chapel at Carrizales (C123) have recovered several large (>5cm diameter) fragments alongside dense concentrations of recently looted human remains, fragments of provincial Inka polychrome ceramics, and glass and shell beads, suggesting that at least some EGG Ware was interred with the bodies of indigenous people in Christian contexts (Torres Mora and VanValkenburgh, 2014).

2.2 Technological considerations in the production of EGG Ware

EGG Ware's unique combination of Andean ceramic forms with glazing has led to speculation concerning the social contexts of its production. Several authors have wagered that the indigenous potters who produced EGG Ware learned how to produce glazes through direct instruction from Spanish ceramicists (Bushnell 1954; Mayer 1983; Mogrovejo 1996). A corollary assumption is that EGG Ware was necessarily fired in kilns, whose scarcity in Prehispanic times is often interpreted as a key factor for explaining why ancient Andean potters never produced glazed ceramics, due to their utility in sustaining the high temperatures necessary for complete vitrification of glazes with relatively high melting points. Neither of these propositions has been systematically

203 examined. Although full discussion of EGG Ware technology is beyond the scope of this
204 paper, the examination of technological indices on complete vessels provides clues
205 about production processes. To further investigate these questions, the first and second
206 author, along with colleague Karen Privat, are currently engaged in collaborative
207 research on EGG Ware firing conditions, through the use of refiring experiments and
208 scanning electron microscopy at the Mark Wainwright Analytical Centre, University of
209 New South Wales.

210 Among EGG Ware vessels held in museum collections and samples recovered
211 from archaeological excavations, one set of features consistently found on vessel
212 surfaces are aberrations that appear to be the results of the imperfect control of firing
213 temperatures. Crazeing, crawling, pinholing, running and pooling are nearly ubiquitous
214 among all the samples we have investigated (Fig. 3). Moreover, vessel forms are often
215 visibly asymmetrical, with oblong bodies and spouts that sag to one side rather than
216 standing vertically (Fig 2). These defects provide evidence that the producers of EGG
217 Ware may have been experimenting with glaze compositions and/or firing conditions in
218 order to produce the lustrous effects they desired. According to the evidence we have
219 collected, EGG Ware production was never refined to remove these defects, and it may
220 have relied on indigenous methods such as bonfire firings. Historic documentation of
221 glazing technology among similar lead-glazed vessels from 16th-century highland
222 Mexico further suggests that glazes were produced using powdered galena, cerussite or
223 other lead minerals applied directly to leather hard clay (a technique common in
224 medieval Europe) or ground and mixed in an aqueous solution painted onto leather-
225 hard clay (Lister and Lister, 1982, p. 81).

[Insert Figure 3]

2.3. Late Prehispanic Ceramic Production on Peru's North Coast and Colonial Social Change

The style and technological characteristics of EGG Ware vessels raise questions about the nature of the social and cultural contexts of their production. Their preservation of Chimu-Inka forms suggests at least some continuity in ceramic traditions between Late Prehispanic and Early Colonial times, if not in actual workshops. A consideration of patterns of ceramic manufacture in Peru's North Coast region during Late Prehispanic times provides a framework for interpreting how variation in paste and glaze composition reflect the social organization of EGG Ware production.

Archaeologists working in the Lambayeque subregion of the North Coast have argued that late Prehispanic ceramic production in that area was carried out at different scales, from at least 900 CE. Beginning in Middle Sicán times (900-1100 CE), delicate mold-made ceramics (many of them reduction-fired, high-luster blackwares) are found alongside great numbers of coarser paddle-stamped earthenwares (*paletteada*) (Cleland and Shimada, 1998, 1992; Kroeber and Muelle, 1942; Schaedel, 1979). Based on excavations at the urban center of Batán Grande, Cleland and Shimada (1998) suggest that there were three separate domains of ceramic production in Middle Sicán times: 1) "attached" specialists producing sumptuary goods for exclusively elite consumption, on a full-time basis; 2) specialists in independent workshops, partially overseen by elite supervisors, producing goods for much broader consumption; 3) independent, part-time producers of paddle-and-anvil ceramics displaying a dizzying array of decorative motifs

(see also Tschauner, 2001, p. 34). While political and economic networks in the Lambayeque region shifted during the course of subsequent centuries, following the dominance of the Túcume polity during Late Sicán (1100-1350 CE) times and the incorporation of the Lambayeque region into the Chimu (ca. 1350 CE) and Inka (ca. 1470 CE) empires, discussions presume a broad division between the crafting of sumptuary ceramics in supervised production centers and more socially and geographically dispersed crafting of paddle-stamped pottery, with its diversity of decoration and composition.

Firing pits found at Chimu and Inka period ceramic production centers in the Lambayeque region suggest that high luster blackwares were produced at a limited number of specialized centers, where artisans had mastered reduction firing techniques (Hayashida, 1999; Tschauner et al., 1994). Paddle-stamped wares were likely produced in a greater number of locations, but early colonial documents suggest that ceramic production was, like other crafts such as silversmithing and featherwork, still not practiced in all households; rather, it was concentrated within specific residential communities of *olleros* (Ramírez-Horton, 1982, 1981; Ramírez, 2007, 1996; Rostworowski de Diez Canseco, 1977; Tschauner, 2001).

Excavations at several loci of ceramic production in Late Prehispanic sites provide evidence that single communities of North Coast potters produced vessels of multiple styles. Tschauner's (2001) excavations at the site of Pampa de los Burros, in the Lambayeque valley, and Donnan's (1997) at an unnamed site near Cerro Cañoncillo in the Jequetepeque valley uncovered both molds and paddles alongside one another and ceramics of multiple different styles, including Inka polychrome. At Inka state-

272 supervised facilities at La Viña and Tambo Real, Hayashida (1999, 1995) found
273 evidence for the parallel production of provincial Inka polychrome and local wares. In
274 these contexts, diversity in production may have arisen from the Inkas' resettlement of
275 artisans from diverse communities into roadside production centers.

276 Chimu-Inka vessels, which combine Inka forms with Chimu surface treatments or
277 Chimu forms with provincial Inka polychrome decoration, seem to have been produced
278 in similar contexts, where local ceramicists were challenged to fashion ceramics
279 suitable for Inka state rituals and diplomacy. Relatively little evidence for the production
280 of Chimu-Inka ceramics has been uncovered from archaeological contexts, but
281 Mackey's excavations within Inka precincts at the administrative center of Farfán, in the
282 Jequetepeque valley, recovered molds used for the production of Chimu-Inka style
283 pottery (Conrad, 1990; Mackey, 2010; Mackey and Jauregui, 2002). Such finds, as well
284 as the diversity and ubiquity of diverse "hybrid" Inka styles that combine the
285 characteristics of standardized Inka ceramic vessels with more localized traditions of
286 form and decoration (such as Ychma, Ica, and Chancay) suggests that they were not
287 necessarily the products of countercultural practices but may have been produced
288 largely in state-administered workshops (Costin, 2008).

289 Between the Spanish invasion of Peru in 1532 and the end of the 16th century,
290 settlement, population, and craft production changed substantially in Peru's North Coast
291 region. As Inka control of the countryside dissipated, some specialized workshops were
292 abandoned. Epidemics of introduced Old World pathogens led to population loss of up
293 to 90% in some indigenous communities and an estimated 72% within the North Coast
294 region as a whole by the 17th century (Cook, 1981; Ramírez-Horton, 1978). Native

peoples continued to produce tribute for local leaders, but they redirected some surplus toward Spanish *encomenderos* and ecclesiastical authorities, and they incorporated new goods into tributary lists, including Old World cultigens (Ramírez, 1996). Spanish settlements were founded at Piura (1532), Trujillo (1535), and Zaña (1563). While viceroy Toledo's *reducción* policy was intended to insulate indigenous populations from wider colonial society, it is likely that at least some indigenous people (particularly muleteers and traders) were frequent visitors to Spanish settlements (Ramírez, 1986; VanValkenburgh, 2012). The organization of ceramic production in and around these new urban centers is poorly understood, but a court case against an *ollero* (potter) in Trujillo in 1614 demonstrates that there was at least one specialized producer operating in that city by the early 17th century (ART Corregimiento 166/572). In our view, however, the presence of EGG Ware and paddle-stamped ceramics in late 16th century sites occupied by indigenous people outline a separate sphere of production.

While the fact that EGG Ware continued to employ Chimu-Inka forms signals continuity in some elements of Prehispanic traditions, only data on its composition and construction can begin tell us more about how its production was organized in the colonial period. We hypothesize that if EGG Ware was produced in one or a very small number of specialized workshops each using a limited number of sources and recipes throughout their duration, then paste composition should form a limited number of groups, across samples collected from sites in multiple regions. In contrast, if its production was more dispersed, involving less specialization and supervision and/or using multiple raw sources and recipes, then pastes should be compositionally diverse. We also hypothesize that the restricted knowledge required to identify suitable raw

materials for glaze production (i.e., lead ores), possible restricted access to such materials, and the specialized knowledge of how to prepare and bind glazes to vessels, should lead to glaze composition being a less sensitive marker of the loci of EGG Ware ceramic production than paste composition.

2.4 The sample collection

The samples characterized here derive from excavations and systematic surface collections at sites in two valleys within Peru's North Coast region, Zaña and Chicama (see Fig 1). Twenty-five samples were recovered from sites in the Zaña valley – 11 from VanValkenburgh's excavations and survey at the site of Mocupe Viejo (C74), eight from excavations and survey at the site of Carrizales (C123), three from survey at an isolated mortuary site (C271), two from a small midden associated with a colonial period canal (C216), and one from the Colonial Port of Chérrepe (C142) (Figure 4). In the Chicama valley, all 18 samples derive from Quilter's excavations at Magdalena de Cao Viejo – specifically, the lowest levels of occupation in the site's town sector.

[Insert Figure 4]

Based on their spatial configuration, ceramic assemblages, and documentary references, it is clear that Mocupe Viejo and Carrizales were both *reducciones* established some time between 1566 and 1573 CE (VanValkenburgh, Walker and Sturm, 2014). Carrizales (C123), where stratigraphy is shallow and the ceramic assemblage is limited to late 16th century material (including Panama Plain ceramics,

but no fragments of Panama Polychrome or Panama Blue-on-White), seems to have been occupied for a very brief period of time – no longer than three decades. EGG Ware samples from Carrizales were recovered from middens closely associated with wattle-and-daub (*quincha*) domestic structures. In contrast, Mocupe Viejo was not abandoned until 1652, when its residents moved up-valley to avoid dunes encroaching on their residences and to have greater access to fresh water.

EGG Ware samples from Mocupe Viejo were recovered both from the town sector and a midden adjacent to the town's chapel. Excavations revealed high levels of deflation at the site, leading its materials to be highly accessible for surface collection but challenging definition of how its occupation changed over time. Here, the presence of late 16th century through mid 17th century ceramic assemblages, as well as historical records tightly date the site's abandonment in 1652 CE, (BNL A310; AGN Ucupe 30: 26r-26v; VanValkenburgh, 2012). The port of Chérrepe, established circa 1563, contains a small (3.5 hectare) colonial settlement occupied until the end of the 18th century. The single EGG Ware fragment recovered at the site derived from a looted area. Fragments from Conjunto 271 were recovered from the surface of a sandy terrace raised 5-10 meters above surrounding agricultural fields, alongside fragmented human remains and Late Preshispanic materials associated with nearby looters' holes. Samples from Conjunto 216 were collected from the surface of a small (1.27 Ha) site, with occupation estimated to date from the late 16th through mid 17th centuries (based on ceramic typology), closely associated with a colonial period canal system.

Quilter's (2011) excavations at the site of Magdalena de Cao Viejo suggest that the town was founded in C.E. 1578 after an El Niño flood, and abandoned sometime in

the early to mid-18th century C.E. (Castañeda Murga, 1996). Eighteen EGG Ware sherds were recovered from the lowest levels of the site's domestic areas, from trash areas within three separate household structures. These occupations appear to be late 16th century in date, based on the absence of material culture typical of mid-17th century assemblages in archaeological sites within the North coast of Peru.

Due to the scarcity of EGG Ware samples recovered in archaeological contexts, the majority of samples studied here are small body sherds. Each was selected from widely separated excavation contexts in order to reduce the possibility of obtaining multiple samples from the same vessel. Samples 02-48, 209-12, and MDC2011-36-03 are rim sherds from small bottles, while 40-019 and 123-30-01 appear to derive from the necks of bottles with diameters of less than 5cm. Sample 05-19 represents the base of a flat-bottomed vessel. Each of these types falls within the range of Chimú-Inka forms. In contrast, samples 684-01 (a rim sherd pictured at far left in figure 4) and 44-023 (a handle fragment) appear to derive from pitchers with no Chimú-Inka precedents. The remaining samples all have glaze applied only to a single, external surface. Surface forms range from flat to highly convex – suggesting pitchers, bottles, and serving jars rather than plates or storage and cooking vessels.

Across the sample collection, glaze color is variable both between and within samples, as is visible in Figure 4. We estimate that color variation within vessels is in part the product of the uneven application of glaze material before firing, as well as running, pooling, and variation in firing temperatures. Four samples (05-019, 40-019, MDC2011-00-02, and MDC2011-46-08) have glaze that is more matted and yellow in appearance, but each also shows signs of surface wear, suggesting that these color

differences may be more closely related with patterns of use and deposition rather than chemical composition.

In sum, the EGG Ware samples studied here derive from a narrow chronological range (50 to 75 years) and a broad geographical area (approximately 100 kilometers along the Peruvian coast), allowing productive comparisons across time and space. By the standards of previous studies of ceramic composition, the total sample size discussed here (n=43) is relatively small. However, it represents virtually all of the EGG Ware fragments recovered via systematic archaeological excavation and survey to date and offers an opportunity for initial characterization of chemical variation in the type.

3. Methods

The pastes and glazes of 43 samples were analyzed using two analytical techniques: instrumental neutron activation analysis (INAA) to characterize pastes and laser-ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS) to characterize sample glazes.

3.1 Instrumental neutron activation analysis (INAA)

Specimens were prepared for INAA using procedures established at the Archaeometry Laboratory, University of Missouri Research Reactor (MURR) (Glascok, 1992; Glascok and Neff, 2003). Fragments of approximately 1cm² were removed from each sherd and abraded using a silicon carbide burr in order to remove surface treatments and adhering soil, to reduce the risk of contamination. The specimens were

washed in deionized water and allowed to dry in the laboratory. Once dry, the individual fragments were ground to powder in an agate mortar. Samples were then prepared as detailed by Glascock and Neff, along with certified reference materials from National Institute of Standards and Technology (NIST) (SRM-1633b (coal fly ash), SRM-688 (basalt rock) and SRM-278 (obsidian rock) and in-house standard, Ohio Red Clay.

Procedures used for the irradiation and gamma ray spectroscopy follow established MURR Archaeometry Laboratory protocol (Glascock, 1992; Glascock and Neff, 2003; Neff, 2000). A total of 32 element concentrations were determined: Al, Ba, Ca, Dy, K, Mn, Na, Ti, V, La, Lu, Nd, Sm, U, Yb, Ce, Co, Cr, Cs, Eu, Fe, Hf, Ni, Rb, Sb, Sc, Sr, Ta, Tb, Th, Zn and Zr.

3.2. LA-ICP-MS

The analyses were carried out at the Field Museum of Natural History in Chicago, USA, using an Analytik Jena Inductively Coupled Plasma - Mass Spectrometer (ICP-MS) connected to a New Wave UP213 laser for direct introduction of solid samples.

Helium was used as a gas carrier in the laser, and scan line analysis mode was selected. To clean the surface of the glaze, a pre-ablation was conducted with a laser beam diameter of 100 μm , a speed of 70 $\mu\text{m/s}$ and at a pulse frequency of 20 Hz. The laser beam diameter for the actual ablation was 65 μm . It was used with a speed of 5 $\mu\text{m/s}$ and a frequency of 15 Hz. For each glaze sample, the average of four measurements corrected from the blank was considered for the calculation of concentrations.

The isotope Si29 was used for internal standardization. Concentrations for major elements, including silica, were calculated assuming that the sum of their concentrations in weight percent in glass is equal to 100 % (Gratuze, 1999). Two different series of external standards were used to measure major, minor and trace elements. The first series of external standards are standard reference materials (SRM) manufactured by NIST: SRM 610 and SRM 612. Both of these standards are soda-lime-silica glass doped with trace elements in the range of 500 ppm (SRM 610) and 50 ppm (SRM 612). A total of 48 element concentrations were determined: Li, Be, B, Sc, Ti, V, Cr, Fe, Mn, Ni, Co, Cu, Zn, As, Rb, Sr, Zr, Nb, Ag, In, Sn, Sb, Cs, Ba, La, Ce, Pr, Ta, Au, Y, Pb, Bi, U, W, Mo, Nd, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, Hf, Th. For additional details, see procedures outlined in Dussubieux et al. 2009.

3.3. Data Interpretation

For both datasets (INAA and LA-ICP-MS) principal components analysis (PCA) was carried out on chemical data. In the analysis of INAA data, Ni and Sb were excluded, as Ni was below detection level for most specimens, and Sb could be a potential glaze contaminant. Discrimination of chemical groups was also determined through the analysis of elemental biplots and the mean and standard deviations for groups. PCA using all of the remaining elements determined by INAA failed to provide much discrimination of the Zaña and Chicama valley groups, possibly due to the fact that some elements were acting as noise in the dataset, effectively obscuring patterns in the dataset pertaining to region. Such situations in statistical analysis have been discussed by Michelaki and Glascock (2011) Michelaki, Hughes and Hancock (2013),

and Baxter and Jackson (2001), who discuss eliminating variables/elements from PCA. In our study, this led to the analysis of datasets comprised of 21, 12, 11, eight, six and four elements, with elements for use in PCA determined by the study of biplots and means and standard deviations for each element in each valley group. Ultimately, PCA using eight elements (Nd, Sm, U, Co, Eu, Sr, Tb, Ca) provided the clearest chemical separation between the Zaña and Chicama valley groups (presented here). Log10-transformed data and centred log-ratio (CLR) transformed data (presented here) were used, with both providing similar group discrimination.

In addition to excluding PB, we also excluded Zn, As, Ag, In, Sb and Bi in our statistical analysis of the LA-ICP-MS data, due to high variability in these elements' concentrations and their tendency to associate with lead. Although one would expect that the inclusion of these elements in statistical analyses would allow for good discrimination of groups if different lead sources were used, we found that high variability in their concentrations obscured patterns in the data. It is possible that the lead ores used to produce glazes in our samples have high source variability in trace element composition and/or that some aspect of firing, such as volatilization, has affected these elements. One of us (LD) has encountered similar elemental variability in the analysis of glasses with high lead content.

Gold (Au) was excluded due to low concentrations and detection limits and Pb constituted the major component of most glazes (up to 80%), potentially swamping patterns in the data. PCA and elemental bivariate plots were used to determine chemical groupings. Statistical analyses were performed using Statistica (v7.0), MURR

GAUSS routines (v.8) and Microsoft Excel 2007, with JMP (v.10.0.0) used to create figures.

4. Results

4.1. INAA

Table 1 presents the results of INAA of the EGG Ware pastes. Based on PCA of eight elements described above, the first three principal components (PCs) accounted for 92.7 % variability in the dataset. Figure 5 presents the plot of the first three PCs and associated loadings plot. The separation of the Zaña and Chicama valley sherds is due to significant contribution on PC1 from Ca, Sr and Co, generally higher in the Zaña samples. One subgroup of samples from Magdalena de Cao (consisting of samples MDC2011-130-18, MDC2011-29-09, MDC2011-130-16, MDC2011-14-04, MDC2011-30-34-03, MDC2011-30-12, MDC2011-31-14, MDC2011-36-03, MDC2011-54-05, MDC2011-00-02, MDC2011-00-01) also groups with sample 29-42, from the Zaña valley. SJK 199 and 201 are loosely associated with this groups though and SJK201 might be an outlier but definitely distinct from other Zaña valley samples. A loose subgroup appears in this cluster, consisting of samples MDC2011-130-16, MDC2011-14-04, MDC2011-31-14, and MDC2011-54-05 Of the Chicama valley samples, MDC2011-126-13 and MDC2011-00-07 are outliers. MDC2011-10-11 and MDC2011-46-08 associate with the Zaña samples, and MDC2011-00-06 and MDC2011-130-18 may form a loose group with Zaña sherd 684-001. However, more samples are needed for this series of samples to be called a group, and they currently appear to be outliers.

In contrast, the Zaña samples present as a scatter, with no discernible groups within the sample set. No grouping can be discerned according to the samples' sites of recovery, although they appear generally chemically distinct from the Chicama Valley sherds – with the exception of those Zaña sherds described above. More samples might be required to discern groups within the Zaña dataset.

[Insert Table 1]

[Insert Figure 5]

4.2. LA-ICP-MS

PCA of data resulting from LA-ICP-MS of EGG Ware glazes shows a distinct separation of samples from the Chicama valley and sites in the Zaña Valley. PCA of the first 7 PCs account for 89.2 % of variation in the dataset. Figure 6 shows the plot of the first two PCs and the associated loadings plot.

[Insert Table 2]

[Insert Figure 6]

Of the Chicama valley samples, MDC2011-46-08, MDC54-05 and MDC2011-126-13 appear to be outliers in the analysis of data obtained by LA-ICP-MS, associated with neither other Chicama valley nor Zaña valley samples. Similarly, Zaña valley samples 586-12, 586-22, 29-42, 5-14 and 74-2-42 are also outliers. The two former samples have much higher Sn concentrations than any of the other samples from either valley. Chicama valley sample MDC2011-00-07 appears to be associated with Zaña valley samples although in the statistical analyses of the data resulting from INAA, this sample is an outlier. Further comparing these results with those based on the analysis of data obtained by INAA, the fabrics of MDC2011-126-13, MDC2011-46-08 and

MDC2011-10-11 are outliers, although the latter two seem to have a chemical similarity to Zaña samples. Of these only the two former are also outliers in the analysis of data obtained from LA-ICP-MS of the glazes. The sample MDC2011-00-06 glaze groups with other glazes from Magdalena de Cao, whereas the fabrics appear to be outliers based on analysis of data obtained by INAA.

5. Discussion

5.1 Interpretation of Chemical Data

The two characterization techniques applied here yielded contrasting patterns of chemical association in EGG Ware samples in part because each probes different aspects of pottery production – namely, the creation of the ceramic paste and glazing. Analysis of the glazes indicates that they were primarily composed of lead ore and points to clear differences in raw materials used for glaze production in the Zaña and Chicama valleys. This pattern may imply that access to lead ore and its preparation before application to vessels was specific to each valley. The greater scatter of the Zaña Valley samples may also point to the use of multiple sources of lead ore, the exploitation of more heterogeneous ore deposits or combinations of materials in glaze recipes, as compared with the rather tighter cluster of samples from the Chicama valley. It is possible that different firing conditions, especially firing temperatures, fuel, and soaking times, could also contribute to compositional variation, especially in the analysis of glazes encountered here – for example, through volatilization. Finally, the scatters observed in the Zaña dataset could also be related to the limited number of samples ($n = 25$) collected from five sites, as well as changes in production over time at each site.

Future compositional analyses of EGG Ware would greatly benefit from expanded access to samples, procured through additional excavations at colonial period archaeological sites on Peru's North Coast.

Analysis of our INAA data suggests that there was a high level of diversity in the composition of pastes amongst Zaña valley samples. This pattern is possibly linked to the limited number of samples obtained from five distinct sites, but also likely indicates a larger number of workshops produced the vessels – and/or that a greater variety of materials and recipes were present among Zaña valley EGG Ware producers. Although compositional diversity also exists among the pastes of samples from Magdalena de Cao, the existence of a major cluster within the data suggests that a subset of the Chicama valley samples may have derived from a single source.

Some paste composition outliers among the materials from the Chicama valley are chemically similar to samples from the Zaña valley, but none form a definitive chemical group that crosscuts both regions based on INAA analysis of pastes. The outliers identified during the analysis of data on pastes obtained by INAA of samples from the Chicama valley are sometimes reflected in outliers identified in the analysis of data on glazes obtained by LA-ICP-MS. Some, such as MDC2011-126-13, might indicate both vessel production and glazing occurred outside of sources that contributed to the other Chicama samples and majority of the Zaña Valley scatter. The association of Zaña Valley sample 29-42 paste with the main Chicama valley chemical paste group suggests the same source for the body of the vessel, but glazing using different materials to other Chicama valley samples.

5.2. Inferring EGG Ware Production Patterns

We interpret these compositional patterns, as well as the formal characteristics of EGG Ware vessels, as evidence that the type was fashioned not in one or two workshops but in a diverse (and likely geographically disperse) series of loci. While we cannot rule out the possibility that some EGG Ware may have been produced by non-indigenous ceramicists or consumed by non-indigenous peoples, the archaeological contexts in which EGG Ware has been discovered, as well as its conservation of Chimu-Inka ceramic forms, imply that it was primarily used and produced by people indigenous to Peru's north coast region.

EGG Ware's characteristics also suggest that it was the product of indigenous ceramicists' sustained engagement with novel ceramic traditions – an openness to innovation that is also reflected in the deeper history of Chimu-Inka ceramics in Prehispanic times. Flat-bottomed pitchers, represented both among our samples and among museum collections, as well as raised surface decoration in the form of vines and vegetation, show that EGG Ware potters were receptive to new forms. While indigenous people were socially marginalized within the North Coast region, many lived in close proximity to Spanish colonial urban centers, frequently interacted with broader colonial society, and consumed the products of non-indigenous ceramic workshops, including tin-enamelled tablewares and lead-glazed storage vessels (Torres Mora, 2011; VanValkenburgh, 2012, n.d.). Indigenous consumption of foreign glazed ceramics, as well as interaction with Spanish colonial craftspeople (if not their direct observation of the production of glazed ceramics in Spanish colonial workshops) was surely integral to EGG Ware's creation.

Yet compositional diversity among our sample pastes suggests that the ceramicists who produced EGG Ware were not concentrated in a small number of workshops directly supervised by Spanish artisans. Based on our results, the organization of EGG Ware's production would appear to resemble less the tightly controlled production of provincial Inka polychrome and more the dispersed production of paddle-stamped ceramics, which have dominated domestic assemblages in the Lambayeque region since 900 CE.

These results frame a series of questions that should be addressed through further exploration of samples from archaeological sites and museum collections: What specific sources of lead ore were exploited to produce EGG Ware glazes, and how were these sources identified? Are further compositional groups discernable in EGG ware deposited in site in the Zaña and Chicama valleys? How extensively was EGG Ware moved between valleys? Are continuities observable between EGG Ware and Prehispanic paste groupings? Both chemical studies and petrological analysis should be conducted to address these questions as more EGG Ware samples become available.

6. Conclusions

The chemical composition of 43 samples of EGG Ware, determined via INAA of pastes and LA-ICP-MS of glazes, suggest that the type's pastes were produced by multiple workshops using a diversity of recipes and/or raw materials and a slightly more restricted series of glaze materials and possible recipes/preparation. Observed

compositional diversity in both pastes and glazes is higher among the sample of 25 samples from sites in the Zaña valley, than among the 15 samples from the site of Magdalena de Cao Viejo, in the Chicama valley. Compared to paste composition, less diversity is present among glaze composition, which falls into two groups that correlate broadly with the Zaña valley and Magdalena de Cao Viejo sample sets, respectively – perhaps reflecting the use of distinct lead ore sources and/or preparation in each valley for the production of EGG Ware glazes.

Our analysis represents a study of nearly the entire set of EGG Ware samples recovered from archaeological contexts to date. As additional sites are excavated and greater numbers of EGG Ware fragments are recovered, further compositional study and lead isotope analysis of glazes will allow us to further test the patterns described here. Comparison of EGG Ware paste composition with that of Prehispanic Chimu-Inka materials will enable us to study substantial relationships between Prehispanic and colonial workshops and better understand the effects of colonial political change on craft and artistic practice.

Acknowledgements

Funding for the ICP-MS analysis was provided with the support of an NSF major instrumentation grant to the Analytical Research Facility at the Field Museum (BCS 0818401). INAA analysis was funded by the University of Vermont and through subvention from the National Science Foundation to the University of Missouri Research Reactor (Grant 1415403). Funding for the excavations and field research that recovered samples was provided through an International Dissertation Research Fellowship from the Social Science Research Council (to VanValkenburgh) and a National Endowment for the Humanities Collaborative Research Grant (RZ5115010, to Quilter). Cody Roush provided analytical assistance at MURR. Scott Van Keuren provided helpful comments on an earlier draft of this paper. Ulla Holmquist and Isabel Collazos at the Museo Larco Herrera provided support in the examination of complete vessels and access to Rafael Larco Hoyle's excavation notes. We also thank Ryan Williams, Matthew Piscitelli,

Cristian Mesia Montenegro, Regulo Franco Jordan, Carmen Gamarra Carol Rojas Vega, Rocio Torres Mora, and Rosabella Alvarez-Calderón.

Archival Sources - Abbreviations

AGN – Archivo General de la Nación, Lima, Peru

ART – Archivo Regional de Trujillo, Peru

BNL – Biblioteca Nacional, Lima, Peru

ML – Museo Rafael Larco Herrera, Lima, Peru

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Table 1

Sample ID	Valley	Site	As	La	Lu	Nd	Sm	U	Yb	Ce
123-30-001	Zaña	Conjunto 123 (Carrizales)	4.1	40.7	0.4	30.8	6.0	3.5	3.1	85.9
123-9-019	Zaña	Conjunto 123 (Carrizales)	3.4	36.8	0.4	34.0	6.7	4.4	2.7	72.5
139-039	Zaña	Conjunto 74 (Mocupe Viejo)	6.1	27.6	0.3	19.4	4.3	3.3	2.0	49.6
139-041	Zaña	Conjunto 74 (Mocupe Viejo)	8.5	33.2	0.4	32.4	6.8	2.6	2.5	73.5
187-009	Zaña	Conjunto 123 (Carrizales)	3.3	36.0	0.4	27.8	5.3	3.2	2.6	67.8
209-012	Zaña	Conjunto 123 (Carrizales)	3.7	46.7	0.5	40.5	7.5	3.7	2.9	90.3
209-014	Zaña	Conjunto 123 (Carrizales)	2.2	45.5	0.4	35.7	7.2	4.1	3.2	86.9
219-013	Zaña	Conjunto 142 (Port of Chérrepe)	3.4	31.6	0.2	22.5	4.9	2.7	1.4	62.0
219-014	Zaña	Conjunto 142 (Port of Chérrepe)	3.4	30.9	0.2	23.5	4.8	2.4	1.4	70.2
245-014	Zaña	Conjunto 123 (Carrizales)	11.4	33.7	0.3	21.8	4.9	4.0	1.9	62.5
25-013	Zaña	Conjunto 74 (Mocupe Viejo)	5.6	37.1	0.4	28.4	5.8	3.5	3.0	71.4
29-042	Zaña	Conjunto 271	4.4	60.3	0.7	50.6	10.6	6.8	4.4	124.9
395-001	Zaña	Conjunto 216	4.0	40.1	0.3	26.4	5.6	2.4	2.2	73.2
40-019	Zaña	Conjunto 74 (Mocupe Viejo)	8.0	42.7	0.5	38.9	7.5	3.5	2.8	90.0
44-023	Zaña	Conjunto 74 (Mocupe Viejo)	6.3	34.5	0.4	28.9	5.8	2.9	2.5	73.1
5-014	Zaña	Conjunto 74 (Mocupe Viejo)	5.6	57.1	0.6	47.2	9.4	5.1	3.9	119.1
5-058	Zaña	Conjunto 74 (Mocupe Viejo)	3.5	37.7	0.4	33.8	6.7	3.1	3.0	74.2
586-010	Zaña	Conjunto 271	4.0	41.5	0.4	37.7	7.4	2.9	2.8	87.1
586-012	Zaña	Conjunto 271	5.8	33.9	0.4	27.6	5.5	2.6	2.7	69.9
586-022	Zaña	Conjunto 271	4.4	28.5	0.3	20.4	4.3	3.1	1.8	56.1
684-001	Zaña	Conjunto 123 (Carrizales)	6.7	50.6	0.5	40.0	7.8	5.4	3.6	103.9
72-019	Zaña	Conjunto 74 (Mocupe Viejo)	11.7	35.7	0.3	24.9	5.1	3.0	2.1	71.4
74-7-004	Zaña	Conjunto 74 (Mocupe Viejo)	4.2	49.1	0.6	41.8	8.4	3.9	3.7	101.6
74-9-042	Zaña	Conjunto 74 (Mocupe Viejo)	12.2	40.2	0.3	28.3	5.8	4.5	2.0	73.8
74-9-016	Zaña	Conjunto 74 (Mocupe Viejo)	9.5	29.1	0.2	25.7	4.6	2.2	1.4	74.1
MDC2011-00-01	Chicama	Madalena de Cao Viejo	8.1	53.4	0.6	46.1	10.7	4.5	4.4	118.2
MDC2011-00-02	Chicama	Madalena de Cao Viejo	2.3	56.5	0.5	43.9	9.4	5.6	3.4	117.7
MDC2011-00-06	Chicama	Madalena de Cao Viejo	7.3	43.6	0.5	33.7	6.4	4.0	3.4	89.5
MDC2011-00-07	Chicama	Madalena de Cao Viejo	4.5	52.4	0.5	47.6	8.3	4.0	3.4	105.8
MDC2011-10-11	Chicama	Madalena de Cao Viejo	2.4	35.1	0.4	28.0	5.2	2.9	2.6	69.6
MDC2011-126-13	Chicama	Madalena de Cao Viejo	17.3	24.1	0.4	21.5	5.0	2.5	2.5	52.3
MDC2011-130-16	Chicama	Madalena de Cao Viejo	3.9	45.6	0.5	40.2	7.9	4.6	2.8	93.5
MDC2011-130-17	Chicama	Madalena de Cao Viejo	5.5	63.9	0.6	52.4	10.1	5.1	4.1	143.5
MDC2011-14-04	Chicama	Madalena de Cao Viejo	4.7	51.9	0.5	45.6	9.4	5.0	3.7	110.4
MDC2011-29-09	Chicama	Madalena de Cao Viejo	3.7	64.4	0.7	61.2	11.1	7.2	4.3	140.3
MDC2011-29-10	Chicama	Madalena de Cao Viejo	4.4	61.9	0.6	54.1	10.8	6.5	4.2	138.4
MDC2011-30-12	Chicama	Madalena de Cao Viejo	3.8	63.2	0.7	57.4	10.9	6.9	4.3	140.7
MDC2011-30-15	Chicama	Madalena de Cao Viejo	4.0	60.2	0.6	51.3	10.3	6.0	4.2	135.6
MDC2011-30-34-3	Chicama	Madalena de Cao Viejo	4.1	62.9	0.6	52.5	10.8	7.1	4.8	136.5
MDC2011-31-14	Chicama	Madalena de Cao Viejo	3.3	53.2	0.5	45.1	8.0	5.0	3.4	123.5
MDC2011-36-03	Chicama	Madalena de Cao Viejo	4.1	62.8	0.6	57.1	10.8	7.3	4.2	137.6
MDC2011-46-08	Chicama	Madalena de Cao Viejo	1.5	34.9	0.4	25.3	5.1	2.7	2.5	69.8
MDC2011-54-05	Chicama	Madalena de Cao Viejo	4.3	55.1	0.6	47.8	8.5	5.5	4.0	114.4

Table 2

Sample ID	Valley	Site	Si	Na	Mg	Al	K
123-30-001	Zaña	Conjunto 123 (Carrizales)	55846.2	1718.8	844.4	16739.2	2610.5
123-9-019	Zaña	Conjunto 123 (Carrizales)	64770.1	1026.8	1114.2	21826.4	3417.2
139-039	Zaña	Conjunto 74 (Mocupe Viejo)	54353.9	347.3	604.8	14866.1	1330.6
139-041	Zaña	Conjunto 74 (Mocupe Viejo)	77920.9	667.9	1303.7	28087.2	3655.2
187-023	Zaña	Conjunto 123 (Carrizales)	109370	1111.1	1576.7	27814.4	4490.5
209-012	Zaña	Conjunto 123 (Carrizales)	50625.3	514.2	983.8	17667.8	3128.8
209-014	Zaña	Conjunto 123 (Carrizales)	93906.8	727.9	1589.2	33029.6	4801.8
219-013	Zaña	Conjunto 142 (Port of Chérrepe)	100635.4	4118.3	3293.9	36868.2	6123.3
245-014	Zaña	Conjunto 123 (Carrizales)	97496.8	1049	2060.4	32918.6	4560.4
25-013	Zaña	Conjunto 74 (Mocupe Viejo)	57062.9	594.6	1212.2	15528.5	2386.2
29-042	Zaña	Conjunto 271	72553.1	1021.3	1058	25469.6	2302.8
395-001	Zaña	Conjunto 216	101012.5	6303.1	2554.1	35428.2	8438
395-001	Zaña	Conjunto 142 (Port of Chérrepe)	98534.1	3203.4	3183.5	32007.2	6922.8
40-019	Zaña	Conjunto 74 (Mocupe Viejo)	47412.4	1147.1	787.4	17383.5	5178.1
44-023	Zaña	Conjunto 74 (Mocupe Viejo)	49790.3	586.4	813.8	15585.9	3918.7
5-014	Zaña	Conjunto 74 (Mocupe Viejo)	105128.1	1777.8	1548.3	43259.9	14172.8
5-058	Zaña	Conjunto 74 (Mocupe Viejo)	77765.7	2239.9	1201.6	24819.8	6947.9
586-010	Zaña	Conjunto 271	56451.9	464	576.6	13761.2	1493.9
586-012	Zaña	Conjunto 271	62684	246.4	859.7	11560.3	2224.8
586-022	Zaña	Conjunto 271	67354.8	1461.9	932.2	17420.3	3392.4
684-001	Zaña	Conjunto 123 (Carrizales)	57955.8	528.3	1225.7	21121	3361.8
72-019	Zaña	Conjunto 74 (Mocupe Viejo)	94182.5	1364.1	1894.2	29670	4137.1
74-7-004	Zaña	Conjunto 74 (Mocupe Viejo)	68931.7	1091.4	850.8	23866.3	3362.8
74-9-016	Zaña	Conjunto 74 (Mocupe Viejo)	69647.1	1724.4	913.9	24115	2237.3
74-9-042	Zaña	Conjunto 74 (Mocupe Viejo)	77411.2	755.1	1184.3	37854.7	1685.8
MDC2011-00-01	Chicama	Magdalena de Cao Viejo	81726.4	150.2	3823.7	50617.4	4062
MDC2011-00-02	Chicama	Magdalena de Cao Viejo	59872.9	644.9	2456	28668.6	4091.9
MDC2011-00-06	Chicama	Magdalena de Cao Viejo	86717.9	143.2	1679.7	33917.1	1517.2
MDC2011-00-07	Chicama	Magdalena de Cao Viejo	52515	623.2	1878.4	20746.4	2406.1
MDC2011-10-11	Chicama	Magdalena de Cao Viejo	82143	1012	3384.2	23998.2	3774.1
MDC2011-126-13	Chicama	Magdalena de Cao Viejo	141046.5	5982.1	17732.1	55582.2	10651.9
MDC2011-130-16	Chicama	Magdalena de Cao Viejo	63696.3	143.5	1985.3	26744.9	1929.2
MDC2011-130-17	Chicama	Magdalena de Cao Viejo	83820.5	351.4	2791.9	38432.3	4408.8
MDC2011-14-04	Chicama	Magdalena de Cao Viejo	73967.5	97.6	2362.4	29406.1	2158.6
MDC2011-29-09	Chicama	Magdalena de Cao Viejo	58577.1	571.2	1908.4	21229.9	4155.5
MDC2011-29-10	Chicama	Magdalena de Cao Viejo	83157.3	307.3	3092.4	33848.3	4729.5
MDC2011-30-12	Chicama	Magdalena de Cao Viejo	69714.9	133.1	2359.8	27638.2	2465.8
MDC2011-30-15	Chicama	Magdalena de Cao Viejo	77809.1	420.6	3020.6	35441	5896.1
MDC2011-30-34-3	Chicama	Magdalena de Cao Viejo	69403.9	442.4	2320.1	27893.3	4161.8
MDC2011-31-14	Chicama	Magdalena de Cao Viejo	89476.2	526.6	2983.1	37255.9	2292.2
MDC2011-36-03	Chicama	Magdalena de Cao Viejo	75408	216.8	2455.7	27585.1	3623.8
MDC2011-46-08	Chicama	Magdalena de Cao Viejo	139464.3	1350	5661	37967.6	6616.1
MDC2011-54-05	Chicama	Magdalena de Cao Viejo	117837.9	1802	4955.6	32964.3	6818.2

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 1 – Regions and sites discussed in text.
(BW in print; Color digital)

Figure 2 – EGG Ware double-bodied whistling vessel, adorned with a figure playing an instrument, perhaps an ocarina (Catalog number ML017537). Image courtesy of the Museo Arqueológico Rafael Larco Herrera.
(BW in print; Color digital)

Figure 3 – Regional map of archaeological sites in the Zaña valley from which EGG ware samples were collected. The base image is a processed ASTER Image captured in 2007, courtesy of NASA.
(BW in print; Color digital)

Figure 4 – Close-up photographs of EGG Ware samples collected in Peru’s Zaña valley. Samples 684-01, 245-014, and 123-30-1
(BW in print; Color digital)

Figure 5 – Principal Components analysis of INAA data from EGG ware sample pastes.
(BW in print; Color digital)

Figure 6 – Principal Components analysis of LA-ICP-MS data from EGG ware sample glazes.
(BW in print; Color digital)

Table 1 – INAA data from samples

Table 2 – LA-ICP-MS data from samples