Chapter 6

Compositional analysis of compound drawn white glass beads from colonial California: Implications for chronology and dispersal

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1. Introduction

As exemplified throughout this volume, beads have been a material hallmark of intercultural interaction the world over. In particular, scholars and the public alike have long viewed glass beads as an important component of colonial encounters between Europeans and Indigenous peoples. In California, beads—both glass and shell—have been at the center of recent approaches to understanding how Native Californian societies persisted despite the impacts of Spanish, Russian, Mexican, and American colonialism. In these contexts, beads play a number of interpretive roles, serving as evidence of postcontact occupation, indicators of the reach of various economic networks, and markers for the persistence of cultural traditions ranging from mortuary practices to personal adornment (Arkush 2011; Crull 1997; Dadiego et al. 2021; Gamble and Zepeda 2002; Panich 2014; Ross et al. 2016).

Nevertheless, the complexity of shell and glass bead assemblages from colonial-era sites in California poses various challenges. With regard to shell beads, archaeologists’ interpretations are facilitated by complex but well-established typologies (Bennyhoff and Hughes 1987; Milliken and Schwitalla 2012) that can be used to determine temporal associations and geographic provenance of particular assemblages in colonial contexts. Detailed glass bead typologies exist (Karklins 2012; Kidd and Kidd 2012; Meighan, in press; Ross et al. 2016), but most types offer only limited insights into exchange or chronology beyond simply marking post-contact occupation of sites. As in other regions of North

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America, the interpretative capacity of glass beads in California is hampered by the predominance of a few common bead types, their seeming stability over long periods of time, and uncertainties about the dispersal of particular bead types by various colonial agents.

Chemical compositional analysis offers an opportunity to expand the interpretive potential of glass beads from California and other North American contexts. Recent archaeometric research into the bead manufacturing process offers greater understanding of the chronological placement of particular glass bead types and, in some cases, the dispersal of glass beads from specific workshops in Europe or elsewhere (Blair 2015, 2017; Blair and Dussubieux, this volume; Burgess and Dussubieux 2007; Dadiego et al. 2021; Dalton-Carriger and Blair, this volume; Dussubieux and Karklins 2016; Hancock et al. 1997, 1999; Hawkins and Walder, this volume; Sempowski et al. 2000; Shugar and O’Connor 2008; Walder 2018; see Annex B). This work has employed several analytical techniques including laser ablation-inductively coupled plasma-mass spectrometry (LA-ICP-MS), instrumental neutron activation analysis (INAA), and x-ray fluorescence (XRF). Here we note that LA-ICP-MS offers two benefits over other analytical techniques: the possibility of spot analysis targeting specific layers of glass in compound beads and the comparability of data collected from different LA-ICP-MS laboratories.

In particular, drawn white glass beads of both simple and compound construction have been at the center of many important compositional studies. Much of this research has focused on determining the temporal patterns associated with particular opacifiers used during the manufacturing process. This work suggests a discernable transition from tin, to antimony, to arsenic, and finally to fluorine (Blair 2017; Hancock et al. 1997; Sempowski et al. 2000). Nearly all of this research, however, has focused on sites in eastern North America (see Table 1 in Blair 2017), and some of the diagnostic shifts in opacifiers predate the onset of permanent European colonization of California in 1769. It is therefore unclear whether the presumed sequence of white glass bead opacifiers noted in previous studies is useful for the analysis of assemblages from California or other sites on the Pacific Coast of North America (but see Blair 2011; Burgess and Dussubieux 2007; Dadiego et al. 2021).

Given these questions, we conducted a study of drawn compound white glass beads from the central California region intended to test the chronological sequence of opacifying agents. In California, compound white glass beads typically have two layers, and do not conform precisely to the descriptions offered by the original Kidd and Kidd (2012 [1970]) classification. Analysts often refer to the colorless-on-white varieties as IVa11 (despite their lack of a third layer) while white-on-
white varieties are typically classified as IVa13; some California bead researchers have even added a variety IVa20 to more accurately describe the compound white beads from the region (Van Bueren 1983). Despite lingering questions about typology, these beads are ubiquitous at sites from colonial California and were likely in use for at least a century, spanning from the late 1760s onward (Meighan, in press; Ross et al. 2016). Indeed, combined archaeological and documentary research indicates that Native people in the central California region—including the Pomo, Coast Miwok, Ohlone, and others—exhibited a preference for white glass beads as opposed to other colors (Panich 2014:743-744; Ross 1997:192-196; Silliman 2004:143-151).

A sample of 70 beads from three colonial contexts was analyzed via LA-ICP-MS at the Field Museum’s Elemental Analysis Facility in 2019. In chronological order, the sites are the asistencia of San Pedro y San Pablo (1786-1800), Mission Santa Clara (1777-1840s), and the Toms Point trading post (ca. 1840s-1870). Though they were included primarily as a convenience sample, these sites cover most of the period during which compound white glass beads were actively used by Native Californians and Euroamerican colonists. Our results suggest a relatively late (ca. 1840) introduction of lead glass white beads using arsenic opacifiers into the region, as well as some potentially meaningful differentiation among the more common antimony-opacified soda-lime glass beads found at all three sites.

2. Background: glass beads in colonial California

Compared to other regions of North America, European colonization came late to California. A handful of expeditions reached the region by sea during the late 16th and early 17th centuries, and although glass beads likely played a role in those encounters, few archaeological examples are known (O’Neil 1992; Lightfoot and Simmons 1998; Ringelstein 2016). Beginning in 1769, Spain sought to extend its territorial control to California, establishing a series of religious missions, military presidios, and secular pueblos along the coastal strip between San Diego and the greater San Francisco Bay area. The missions were specifically designed to enculturate local Indigenous groups, but all three types of settlements played a role in the dispersal of glass beads. Colonists distributed glass beads as part of gift-giving practices, as enticements into the missions, and as payment for labor. Franciscan missionaries and Spanish military commanders ordered beads directly from suppliers in Mexico (who in turn obtained their beads from Europe), with cargoes arriving once or twice a year via ships from the Pacific Coast port of San Blas (Duggan 2016; O’Neil 1992; Panich 2014; Perissinotto 1998). Native people, for their part, had longstanding traditions associated with shell beads and in most
cases incorporated glass beads into these existing practices. Accordingly, glass beads have been noted at nearly all Native Californian sites—including mission residential areas, cemeteries, and autonomous villages—dating to the Spanish period (Panich 2014; Ross et al. 2016)

The Mexican War of Independence, beginning in 1810, marks a turning point in the history of glass beads in California, after which the waters become increasingly muddied. Due to the conflict, resupplies from San Blas stopped arriving, and colonists began trading more actively with foreign vessels that plied the Pacific Coast (Costello 1992; Igler 2013). Other colonial interests also began eyeing California. The Russian-American Company founded a mercantile outpost at Colony Ross in 1812, although the current scholarly consensus is that they did not import glass beads manufactured in Russia (Blair 2018:77). The Hudson’s Bay Company also started traversing California in the late 1820s, and quickly became the primary source of glass beads throughout the region (Meighan, in press; Sousa 2021; Van Bueren 1983). Around the same time, a newly independent Mexico began shuttering the missions, a process that dragged on for more than a decade. By the mid-1840s, however, the missions were largely abandoned, and Colony Ross had closed its doors, leaving many Native Californians free to return to their ancestral homelands, potentially resulting in bead assemblages from diverse origins. The United States annexed California in 1846, and the subsequent gold rush resulted in dramatic upheaval for Native Californians who faced genocidal violence from the Anglo-American newcomers. Yet many Native people in the formerly missionized coastal zones were spared the worst excesses and used the skills they had acquired in the missions or at Colony Ross as an economic backstop that often connected them to new sources of material goods (Panich et al. 2021).

Despite (or perhaps because of) this complexity, early researchers in California largely ignored issues of glass bead origins. For example, in the 1940s Clement Meighan compiled one of the earliest and most comprehensive—but until now unpublished—glass bead typologies for the region. In it, he lamented, “It is not possible to identify the trade beads in California as ‘Spanish,’ ‘American,’ or ‘Russian,’ since the persons who traded beads to the Indians were merely middlemen and not the producers of the glass beads. Furthermore, all of the middlemen were obtaining their beads through the same market system, nearly always going back to the Venetian factories” (Meighan, in press). His pessimism regarding glass beads was echoed by other prominent 20th-century archaeologists, including James Bennyhoff (1977:43), who himself helped create an enduring regional typology for *Olivella* shell beads (Bennyhoff and Hughes 1987). More recent work, however, suggests that a combination of documentary research and archaeometric analysis of archaeological beads may help illuminate the origins
and temporal placement of many of the beads that passed through colonial and Indigenous hands in California and other areas of North America’s Pacific Coast (Blair 2011, 2018; Burgess and Dussubieux 2007; Dadiego et al. 2021; Ross et al. 2016).

3. Materials

White glass beads represent an ideal starting point, given the patterns noted in previous compositional studies and their presence in nearly all assemblages from colonial-era sites in central California. Below, we provide details regarding the dates, occupants, archaeological contexts, and potential bead sources for the sites in our study (Figure 6.1).

![Fig. 6.1: Map of study area with places mentioned in text and other potential sources of colonial-era glass beads.](image-url)
3.1. San Pedro y San Pablo (1786-1800)

The *asistencia* of San Pedro y San Pablo, CA-SMA-71/H, was founded in 1786 on the Pacific Coast of the San Francisco Peninsula. It was intended to serve as an agricultural outstation for Mission San Francisco de Asís, complete with a resident Native Californian population, but was largely abandoned by 1800. Today, the site is best known as the Sanchez Adobe, named for a later mid-19th century occupant. Early excavations at the site focused primarily on the original mission-period quadrangle, which revealed few artifacts dating to that time (Dietz 1979). More recently, construction activity resulted in the data recovery excavations of fifteen Native American burials, all of which appear to date to the late-18th century component of the site. A review of the death records for Mission San Francisco via the Huntington Library's Early California Population project indicates that approximately 150 individuals from various Ohlone communities were buried at San Pedro y San Pablo between 1787 and 1800 (Huntington Library 2006).

Twenty-five compound white beads from San Pedro y San Pablo were included in the LA-ICP-MS study. They were all recovered with Burial 7, an infant, who was interred with a total of 351 compound white glass beads and 895 clamshell disk beads. All of the compound white beads from Burial 7 were visually uniform two-layered colorless-on-white heat-rounded barrel-shaped beads (classified as IVa11, despite their lack of a third layer), measuring between 3.25 and 3.75 mm in diameter and 2.4 and 3.3 mm in length. For context, only six other burials contained glass beads, and Burial 7 was associated with nearly 97% of the compound white beads recovered during the excavations. Other glass beads recovered in large quantities included simple drawn beads of various colors including black (n=764), aqua (n=793), and off-white (n=1440). A few relatively uncommon wound glass beads, along with two burials with faceted jet beads, confirm the early colonial chronological placement of the cemetery. Given the early dates, the beads were likely purchased from agents in Mexico City, either as part of the annual resupplies from San Blas or possibly as provisions for the initial Spanish journeys into California in 1769. All of the materials are being reburied in accordance with the wishes of the Amah Mutsun Tribal Band of Mission San Juan Bautista; the beads will be further described in a future publication.

3.2. Mission Santa Clara (1777-1840s)

Mission Santa Clara, CA-SCL-30/H, is located near the southern extent of the San Francisco Bay, and was in operation from 1777 through to the 1840s. Like the *asistencia* of San Pedro y San Pablo, Mission Santa Clara was initially home to Ohlone people, although recruitment shifted towards interior Yokuts groups after 1810. Various archaeological projects associated with construction mitigation have
been conducted at Mission Santa Clara over the past several decades resulting in
the collection of tens of thousands of glass and shell beads (Hylkema 1995; Allen
2010; Peelo et al. 2018). Contextual interpretation of beads from the site indicates
that Native people left them as grave offerings, intentionally destroyed them in
clandestine mourning ceremonies, incorporated them into objects such as baskets,
and lost them incidentally during the course of daily life (Panich 2014).

The small assemblage of compound white beads analyzed here (n=10) was
recovered from contexts associated with an adobe dormitory structure that housed
Native Californians, likely longstanding Ohlone families (Panich et al. 2014).
Eight of the beads in the sample were recovered from nearby colonial-era sheet
midden (ca. 1790s-1840s), whereas one bead was from an interior room and another
was from a discrete pit feature interpreted to have been part of an Indigenous
mourning ceremony, circa 1815. Interestingly, the pit feature contained thousands
of shell beads, but only a handful of glass beads, all of which appear to have been
deposited intentionally. Taken as a whole, the assemblage from Mission Santa
Clara potentially represents a range of bead sources given the varied depositional
and chronological contexts. Compared to the beads from San Pedro y San Pablo,
the Santa Clara beads exhibit more morphological variation. They include a mix of
two-layered colorless-on-white (IVa11) heat-rounded circular and barrel-shaped
beads measuring between 2.5 and 5.2 mm in diameter and 1.7 and 3.3 mm in
length.

3.3. Toms Point Trading Post (ca. 1840s-1870)

The Toms Point trading post operated near the mouth of Tomales Bay, in Marin
County, as part of the California coastal trade during the mid-19th century. The
primary site associated with the trading post is CA-MRN-202, where an American
settler, his Coast Miwok wife, and an unknown number of local Native people
ran the establishment from the 1840s until approximately 1870. The trading
post was likely near the site of Seglogue, a Coast Miwok settlement occupied
from precontact times into the 1820s if not later (Schneider and Panich 2019). In
addition, CA-MRN-201 is a smaller 19th-century site on the Toms Point landform
and appears to be largely contemporaneous with the main trading post site.

Our LA-ICP-MS sample included compound white beads from both MRN-
202 (n=30) and MRN-201 (n=5). The beads from MRN-202 were obtained from
controlled excavations in shallow midden associated with what appear to have
been outdoor activity areas and/or living spaces. Based on stratigraphic context
and material associations, these deposits date to the trading post occupation period
of ca. 1840-1870. Other beads recovered from these contexts include simple
drawn white beads and red-on-white Cornaline d’Aleppo beads, the latter of which
fit well with the post-1840 dates of the trading post (Billeck 2008). Compound white beads comprise more than half of the total glass bead assemblage (n=68) from MRN-202. Beads from MRN-201 were recovered during systematic surface collection. Only seven glass beads were recovered, of which five were compound white beads (Panich et al. 2021). The Toms Point beads exhibit the most visual variation in our sample, including two-layered colorless-on-white (IVa11) and white-on-white (IVa13) heat-rounded circular and barrel-shaped beads ranging from 2.7 to 8.1 mm in diameter and 1.9 to 8.3 mm in length.

4. Results

The 70 beads from the three study sites were analyzed at the Field Museum’s Elemental Analysis Facility from May to August 2019, using the protocols described in Annex A. Both the inner and outer layer of each bead were sampled where possible (Figure 6.2), although in some cases the analyst was unable to determine the exact boundary between the glass layers. The results presented here therefore rely on the chemistry of each bead’s inner layer, which was successfully recorded for all 70 beads in the sample (the outer layer was only sampled for 38 beads; see Table S6.1 for full results). Further, a majority of the beads in our sample have colorless outer layers, in which case the inner layers are likely a better indicator for the presence of opacifying agents (see Figure S6.1 for examples). We note however, that the same broad patterns described below are present even if the analysis is limited to the results from the outer layers for the applicable beads (cf. Shugar and O’Connor 2008).

Fig. 6.2: Close-up of compound bead from San Pedro y San Pablo (sample SA-13) showing ablation craters in different glass layers. The bead measures ~3.5 mm in diameter.
4.1. Glass types

At the broadest level, the beads in our sample fall into two primary glass types. The vast majority (90%, n=63) are soda-lime glass. Most (n=58) of the soda-lime beads have calcium oxide (CaO) values ranging between approximately 7-12 weight percent and a general absence of lead (Figure 6.3a). These beads comprise the totality of the assemblages from San Pedro y San Pablo and Mission Santa Clara, as well as a majority of the beads from Toms Point. However, a subset of five soda-lime beads exhibits somewhat lower calcium oxide values (6.5-8 weight percent) as well as lead oxide (PbO) values between roughly 5-12 weight percent. These beads are only present at Toms Point and may represent a distinct glass recipe. A final subset of beads (n=7), all of which are from the post-1840 Toms Point sites, exhibits lead oxide values between 44 and 52 weight percent, which is characteristic of lead glass.

Fig. 6.3: Biplots of relevant LA-ICP-MS data from bead inner layers. (a) log PbO weight percent by CaO weight percent; (b) MnO weight percent by B parts per million; (c) Na₂O weight percent by MgO weight percent; (d) log As parts per million by log Sb₂O₅ weight percent.

Within the soda-lime beads, the colorless-on-white beads from San Pedro y San Pablo display a unique range of values, particularly related to boron and manganese oxide (Figure 6.3b). Although manganese was used as a colorant for black beads, the amounts present in the beads in our sample suggest that its
inclusion was not intentional but rather a product of variation present in the raw materials used to make the glass. Hancock et al. (1997:186) posit that differences in manganese in opaque white beads do not appear to follow temporal patterns and instead likely represent “real sub-groups” (and see Hancock et al. 1999). The beads from San Pedro y San Pablo similarly stand out with regard to MgO, CaO, and Na$_2$O (Figure 6.3c), adding to the argument that these beads were made with a slightly different base glass recipe than most of the other soda-lime beads in our study (cf. Walder 2018:308).

Indeed, when the data are reduced to the seven oxides most useful for understanding base glass composition (Brill 1999; Burgess and Dussubieux 2007), the beads from San Pedro y San Pablo exhibit a narrow range of values distinct from the other soda-lime beads (Table 6.1). Viewed graphically, the reduced compositional values for individual beads from San Pedro y San Pablo separate clearly from the other soda-lime beads from Toms Point and from most of the beads from Mission Santa Clara (Figure 6.4). That three of the beads from Mission Santa Clara do resemble the cluster from San Pedro y San Pablo—sites that overlap chronologically and which likely acquired beads from the same sources in Mexico—suggests that meaningful chemical subgroups are present in the region’s vast assemblages of white compound beads.

| Glass Type                | SiO$_2$  | Na$_2$O | MgO    | Al$_2$O$_3$ | K$_2$O | CaO    | Fe$_2$O$_3$
<table>
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</thead>
<tbody>
<tr>
<td>All Soda-Lime Glass</td>
<td>68.2</td>
<td>12.3</td>
<td>2.0</td>
<td>1.6</td>
<td>4.3</td>
<td>10.8</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>± 1.1 %</td>
<td>± 1.4 %</td>
<td>± 0.3%</td>
<td>± 0.2%</td>
<td>± 0.6%</td>
<td>± 1.1%</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>San Pedro y San Pablo</td>
<td>67.8</td>
<td>11.2</td>
<td>2.2</td>
<td>1.8</td>
<td>4.5</td>
<td>11.6</td>
<td>0.9</td>
</tr>
<tr>
<td></td>
<td>± 0.5%</td>
<td>± 0.2%</td>
<td>± 0.1%</td>
<td>± 0.0%</td>
<td>± 0.1%</td>
<td>± 0.5%</td>
<td>± 0.0%</td>
</tr>
<tr>
<td>Other Soda-Lime</td>
<td>68.1</td>
<td>12.8</td>
<td>1.8</td>
<td>1.6</td>
<td>4.3</td>
<td>10.6</td>
<td>0.8</td>
</tr>
<tr>
<td></td>
<td>± 1.2%</td>
<td>± 1.3%</td>
<td>± 0.2%</td>
<td>± 0.2%</td>
<td>± 0.7%</td>
<td>± 0.9%</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>Soda-Lime w/ Lead</td>
<td>70.0</td>
<td>14.4</td>
<td>1.5</td>
<td>1.3</td>
<td>3.7</td>
<td>8.4</td>
<td>0.7</td>
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<tr>
<td></td>
<td>± 0.8%</td>
<td>± 1.0%</td>
<td>± 0.2%</td>
<td>± 0.1%</td>
<td>± 0.7%</td>
<td>± 0.6%</td>
<td>± 0.1%</td>
</tr>
<tr>
<td>Lead Glass</td>
<td>76.1</td>
<td>8.7</td>
<td>0.5</td>
<td>0.6</td>
<td>8.4</td>
<td>5.4</td>
<td>0.3</td>
</tr>
<tr>
<td></td>
<td>± 2.9%</td>
<td>± 2.2%</td>
<td>± 0.2%</td>
<td>± 0.2%</td>
<td>± 3.7%</td>
<td>± 0.9%</td>
<td>± 0.1%</td>
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</tbody>
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Table 6.1: Reduced average glass compositions for major categories of glass and specific base glass groups noted in text.

Still, the uniformity of the beads from San Pedro y San Pablo is noteworthy in itself. All 25 beads came from a single, early colonial-era burial that contained the vast majority of the compound white beads recovered from the site, suggesting that these beads may very well have been produced together at the same European
workshop. Moreau and colleagues (2002) make a similar argument based on the elemental homogeneity of a group of 18th-century white beads from Quebec that were apparently deposited together in a bag. In our view, the beads from this burial may represent a single strand of beads produced in Europe, obtained by Franciscan missionaries from merchants in Mexico, and given to an Ohlone family in central California during the early years of the Spanish mission system.

Fig. 6.4: Biplot of principal components derived from reduced compositional values of bead inner layers.

4.2. Opacifiers

Tin, antimony, and arsenic contributed to the main opacifying agents used for white glass beads during the time period in question (Blair 2017; Hancock et al. 1997; Moreau et al. 2002; Sempowski et al. 2000; Shugar and O’Connor 2008). Based on the existing literature, the generally accepted chronology is as follows. Tin was the dominant opacifier during the 17th century (ca. 1600-1700), antimony was used from the mid-17th century until the second half of the 19th century (ca. 1650-1900), and arsenic was introduced at some point in the late 18th century and continued to be used into the 20th century (ca. 1800-1950). Although tin was no longer used as an opacifying agent by the time of the Spanish invasion of California in 1769, we included it due to the possibility that glass beads acquired during earlier isolated encounters were handed down as heirlooms in the form of strands or other beaded objects to the residents of our study sites. Nevertheless, our analysis demonstrated that no tin-opacified beads are present in our sample.
All of the soda-lime glass beads were opacified with antimony and returned values for antimony pentoxide (Sb$_2$O$_5$) between 3.6 and 10.7 weight percent for the inner glass layer (Figure 6.3d). As noted above, five of the soda-lime beads exhibited lead oxide (PbO) values between roughly 5-12 weight percent in addition to the evidence for use of antimony as the main opacifying agent. While this result may point to lead-soda-lime glass, the presence of lead in white glass opacified with antimony is not rare; it can facilitate the precipitation of the calcium antimonate crystals and was used in some Venetian recipes to produce white antimonate opacifiers (Boschetti et al. 2020; Lima et al. 2012). Otherwise, the soda-lime beads in our study are consistent with antimony-rich beads reported elsewhere in the literature (e.g., Hancock et al. 1997:185).

The lead glass beads (n=7) exhibit evidence of arsenic opacifying agents, returning arsenic values between 20,000-40,000 ppm. These beads comprise 10 percent of the total sample, and are all from the Toms Point sites, two from CA-MRN-201 and five from CA-MRN-202. Although all seven of the arsenic opacified beads are classified as Kidd and Kidd variety IVa13 beads, the bead variety does not seem determinative of chemical composition. The Toms Point assemblage as a whole contains several antimony-rich IVa13 beads and the beads with significant lead and arsenic levels display marked visual variation with regard to size and shape (in addition to the typological problems of distinguishing between IVa11 and IVa13 beads). Still, some visual clues may be apparent between the two compositional groups, as suggested by Hancock and colleagues’ original study (Hancock et al. 1997:185). From our Toms Point assemblage, the lead-arsenic beads have a chalkier, more opaque appearance, whereas the antimony-rich soda-lime beads exhibit a glassier, more translucent white hue (Figure 6.5).

Fig. 6.5: Comparison of glassier antimony-rich (left) and chalkier lead-arsenic beads (right) from Toms Point. The beads are samples TPT-9 and TPT-32, respectively. Scale is in mm.
5. Discussion and conclusion

The results of this study offer a baseline for future chemical compositional studies of white glass beads from California. As expected, our study confirms that 17th-century tin-opacified beads are not likely to be present in most California assemblages. With regard to chronology, the more interesting pattern is the separation of compound white beads into antimony-rich and arsenic-rich varieties. These groups have been previously documented in the literature, but nearly all of the published research on the matter has focused on earlier beads (particularly the switch from tin to antimony opacifiers) in eastern North America. Therefore, this study offers new regional and temporal data regarding the shift from antimony to arsenic opacifiers, as well as some potentially meaningful differences among base glass used to create the antimony-rich beads in our study.

With regard to the chronological placement of the arsenic-rich beads, we can compare our results to the small number of published chemical analyses of white glass beads from colonial California. Dadiego and colleagues (2021), for example, used LA-ICP-MS to analyze 100 opaque white glass beads (most of which were compound beads) recovered from a post-1820 deposit at Mission Santa Cruz. Despite the relatively late date, 99 were opacified with antimony while only one was a lead-arsenic bead similar to those in our study. Further north, Blair (2011) used XRF to analyze eight opaque white beads (including compound white beads) from a pre-1844 context at the Russian-American Company’s Colony Ross (1812-1841). He determined that seven were opacified with a lead-arsenic compound while the other had an antimony-rich composition. These findings generally agree with our results that place lead-arsenic beads in the post-mission period (i.e., post-1830s) in central California.

It is also possible that there is chronologically diagnostic chemical variation within arsenic-rich beads as a whole. For example, we note that Hancock et al. (1997:190) assigned some temporal significance to the amount of sodium in their sample of arsenic-rich opaque white beads from eastern North America, presumably related to the presence of sodium oxide or soda as fluxes (Walder 2018:305). The seven arsenic-rich beads in our study exhibit Na₂O values of between 3.2 and 5.9 weight percent for both the inner and, where measured, the outer layers (see Figure 6.3c). Though we acknowledge the difference in analytical technique, the Na₂O weight percent values for the Toms Point beads generally seem to align with sodium percent values for the 1840±20 period identified by Hancock and colleagues (1997).

Despite these clues, we cannot fully address the timing of the introduction of arsenic opacified beads in California with the samples in our study. The lack of
such beads at San Pedro y San Pablo is not surprising, as the burials there all date to 1800 or earlier. The small sample from Mission Santa Clara lacks chronological precision but could conceivably cover the period from the early 1790s (the date of construction for the specific dormitory with which the beads were associated) until the 1840s when Native Californians abandoned the site. Of the beads from Mission Santa Clara, only the single bead from the pit feature that appears to have been filled around 1815 can be dated with any precision. Still, the lack of lead-arsenic beads at Mission Santa Clara corresponds well to the recent analysis of white glass beads from nearby Mission Santa Cruz, where only a single lead-arsenic bead was noted in a sample of 100 post-1820 beads (Dadiego et al. 2021). In our study, all seven of the lead-arsenic beads were from Toms Point, sites CA-MRN-201 and CA-MRN-202, which date from the 1840s to about 1870 and are only 40 km southeast of Colony Ross. Though some Spanish explorers and missionaries visited Toms Point, this area was largely outside the sphere of Spanish influence as the San Francisco Bay was the primary focus of missionary and military presence in the area (Schneider and Panich 2019).

Given these patterns, it is possible that the introduction of arsenic opacified white beads to central California has both a temporal and a geographical component. In general, they seem to have appeared relatively late. Arsenic opacified white beads in our study are only present at sites that date to the 1840s onward. Factoring the data from Mission Santa Cruz and Colony Ross, it is possible that they began appearing sometime in the 1820s or 1830s, but without a larger sample it is difficult to estimate exactly when their introduction occurred. Questions about chronology aside, it is notable that nearly all of the very small number (n=15) of lead-arsenic opacified beads thus far identified for California are all from sites in the same general region of the north-central coast. Previous research (Ross 1997) points to the Hudson’s Bay Company as the likely source of many beads used by Native Californians at Colony Ross, and it is therefore possible that lead-arsenic opacified beads are associated with the onset of Hudson’s Bay Company activity in California in the 1820s and 1830s. Nevertheless, Burgess and Dussubieux (2007) report that all of the compound white beads sampled from the Sullivan’s Island collection, most of which likely originated at the Hudson’s Bay Company’s Fort Vancouver, were opacified using a calcium-antimony compound, further complicating the picture. These issues are ripe for future research.

Beyond questions about the relative timing of particular opacifiers, chemical analysis can also help illuminate more subtle patterns in glass bead distribution and use. In our study, we noted two subgroups that warrant further investigation (see Table 6.1). At Toms Point, five antimony-rich beads also had relatively high lead oxide values, a pattern which has a basis in glassmaking practices but has
yet to be widely reported in the literature on 19th-century white glass beads. A more concrete pattern was observed in beads from San Pedro y San Pablo, which stand out from most of the other antimony-rich soda-lime beads in our sample. This suggests that the beads in question stayed together from their origins in a European workshop all the way through to their deposition in California. That a small number of beads from Mission Santa Clara exhibited a similar chemical composition to the beads from San Pedro y San Pablo may point to important subgroups within the region’s antimony-rich white glass beads.

Taken together, our findings underscore the importance of compositional analysis, as these chemical groupings are invisible to the naked eye and therefore their distribution in archaeological contexts cannot be a function of choice on the part of the past people who used the beads (Walder 2018:306). While we recognize the complex ethical issues involved in the excavation of burials and the analysis of accompanying grave goods, our results support Marcoux’s (2012) observation that burials and other short duration contexts can be especially useful for refining bead chronologies—and in this case, chemical profiles. Each of these patterns will require future research to substantiate fully, but our study nevertheless offers an iterative perspective that will be useful for developing future glass bead compositional studies from California and western North America.

Acknowledgments

We thank the Federated Indians of Graton Rancheria and the Amah Mutsun Tribal Band of Mission San Juan Bautista for their permission to include beads from Toms Point and the asistencia of San Pedro y San Pablo, respectively, in this study. We also thank Andrew Galvan, of the Ohlone Indian Tribe, for his support of research at Mission Santa Clara and San Pedro y San Pablo. LA-ICP-MS analysis at the Field Museum was supported by a Collaborative Research Grant from the National Science Foundation (BCS 1558987 and 1559666) to Schneider and Panich and the NSF subsidized program at the Field Museum’s Elemental Analysis Facility (BCS 1649742). The chapter benefited from the constructive comments of Heather Walder and the participants of the Field Museum bead workshop in November 2020.

References


