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ORIGINAL ARTICLE

Embodying Ethiopia's Global Golden Age on the Muslim-Christian Frontier: The Allure of Glass Beads

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Abstract The period between AD 700 and 1500 has been recently labeled as "Africa's global Golden Age." This is particularly true for the Shay communities living on the Muslim-Christian frontier in the ninth to fourteenth century AD. Located in the center of the Ethiopian highlands, the Shay faced the expansion of the Christian kingdoms and the advance of the Muslim polities. In an increasingly violent context of religious conversion and war between the two religious powers, the Shay stressed their independence by burying their deceased in collective structures, contrary to the mortuary practices of both Christians and Muslims, and by including precious local and global grave goods in their tombs. The laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) analysis of 34 glass beads shows how the Shay communities benefited from the Islamic global trade routes at the time, particularly the Middle East, Egypt, and the Indo-Pacific networks. This article examines the crucial role of global glass beads in the construction of a trans-corporeal landscape among the Shay that served the emergence and consolidation of the social self as a collective identity against their Christian and Muslim neighbors.

Résumé La période entre 700 et 1500 après JC a récemment été qualifiée d'«âge d'or mondial de l'Afrique». Cela est particulièrement vrai pour les communautés Shay vivant à la frontière musulmane-chrétienne entre le IXe et le XIVe siècle après JC. Situées au centre des hautes terres éthiopiennes, les communautés Shay ont fait face à l'expansion des royaumes chrétiens et à l'avancée musulmane. Dans un contexte de plus en plus violent de conversion religieuse et de guerre entre les deux puissances religieuses, les Shay ont souligné leur indépendance en enterrant leurs défunts dans des structures collectives, contrairement aux chrétiens et aux musulmans, et en incluant dans leurs tombes de précieux objets funéraires locaux et importés. L'analyse par spectrométrie de masse à plasma inductif couplée à l'ablation laser (LA-ICP-MS) de 34 perles de verre montre comment les communautés Shay ont bénéficié des routes commerciales inter-régionales islamiques, en particulier avec le Moyen-Orient et l'Égypte, et du réseau indo-pacifique. Cet article décrit le rôle crucial des perles de verre globales dans la construction d'un paysage transcorporel chez les Shay qui a servi à l'émergence et à la consolidation d'un moi social en tant qu'identité collective contre leurs voisins chrétiens et musulmans.

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Introduction

The period between the eighth and sixteenth century AD has been recently labeled as "Africa's global Golden Age," not only because of the tons of gold exported from the continent to other regions of the world but also because of the success of African elites in controlling gold flows and becoming powerful economic world partners (Fauvelle-Aymar, 2017, p. 18). From the seventh century onwards, the rapid spread of Islam shaped a globally interconnected region, from the Atlantic front to the Indian Ocean, which gave birth to diverse and cosmopolitan communities (Derat et al., 2021; González-Ruibal, 2021; Insoll, 2021; Insoll et al., 2021; Loiseau et al., 2021). This cosmopolitanism was particularly true for the Shay, a group of communities who lived in the eastern fringe of the central Ethiopian plateau from the ninth to the thirteenth–fourteenth centuries, flanked by powerful and expansive Christian and Muslim kingdoms (Fig. 1).

The existence of the Shay culture (labelled as 'pagans' because they were neither Christian nor Muslim) is evidenced in the material remains recovered from nearly 300 burial sites (see Fauvelle-Aymar et al., 2008 for a discussion of Shay indigenous religion and culture; Birru, 2020a, 2020b). The 'pagan' label is due, in part, to the intrinsic bias against the practitioners of indigenous African religions in Christian and Islamic sources in the region (Fauvelle-Aymar, 2013; Fauvelle-Aymar & Poissonnier, 2012, p. 13–31, 2016, p. 62; Fauvelle-Aymar, 2020).

Contrary to the Christian and Muslim practices, the Shay buried their deceased in collective monumental funerary structures: mostly tumuli. They also buried their dead in enclosures, dolmens, and hypogea (Birru, 2020b, p. 138–142). The Shay equipped their dead with sophisticated grave goods that reflect their embeddedness in Muslim trade routes between the tenth and fourteenth centuries. In fact, the cultural practices surrounding the disposition of the body, death rituals, and grave goods among the Shay were radically different from both Christian and Muslim communities in the region (Fauvelle-Aymar, 2020, p. 136). In general, and more specifically in Ethiopia, Muslim burials did not include grave goods at all (Insoll, 1999, p. 172; Insoll et al., 2021; Loiseau et al., 2021), and Christians rarely accompanied their deceased with grave goods. However, the Christian cemetery at Qedemt near Lalibäla seems to be an exception, where ceramics, a metal object, and a green glass bead were recovered from four tombs (Gleize et al., 2015, p. 242). The presence of a lone glass bead from the Qedemt cemetery is in salient contrast with the numerous glass beads, carnelian, and agate beads recovered from the Shay tombs in association with sets of ceramics and more than a hundred body adornments made in metal.

Glass beads have been an important focus of archaeological research in Africa (Kanungo & Dussubieux, 2021; Robertshaw, 2020; Wood, 2016;), and the articles in this special issue are examples of the importance of glass beads in the continent. While their typology can indicate chronology (DeCorse, 1989), the analysis of their provenance can shed light on international trade and intercultural connections—especially with the development of laser ablation inductively coupled plasma mass spectrometry (Dussubieux et al., 2016). Indeed, most studies have focused on provenance and origin, overlooking other cultural and social aspects of glass beads (Robertshaw, 2020, p. 386). As Loren puts it, "of course glass beads were traded, but it was their lives beyond that moment of exchange that provides deeper insights into lived experience" (2013, p. 159). It seems, however, that analysis has centered on the typology, glass recipes, and provenance of glass beads (e.g., Dussubieux & Wood, 2021; Wood, 2016) or on their cultural and social aspects (e.g., Loren, 2010, 2013; Scaramelli & Tarble de Scaramelli, 2005; Turgeon, 2005); and only a few have combined both approaches (e.g., Babalola, 2017; Ogundiran, 2002; Robertshaw, 2020; Rødland, 2022). This article follows the latter trend. It focuses on both the LA-ICP-MS analysis of glass beads and the embodiment and the senses of glass beads among the Shay.

The Shay Sites

In the 1990s, the French archaeological team directed by François-Xavier Fauvelle, Bertrand Hirsch, and Bertrand Poissonnier identified more than one hundred funerary structures in the region of Šäwa

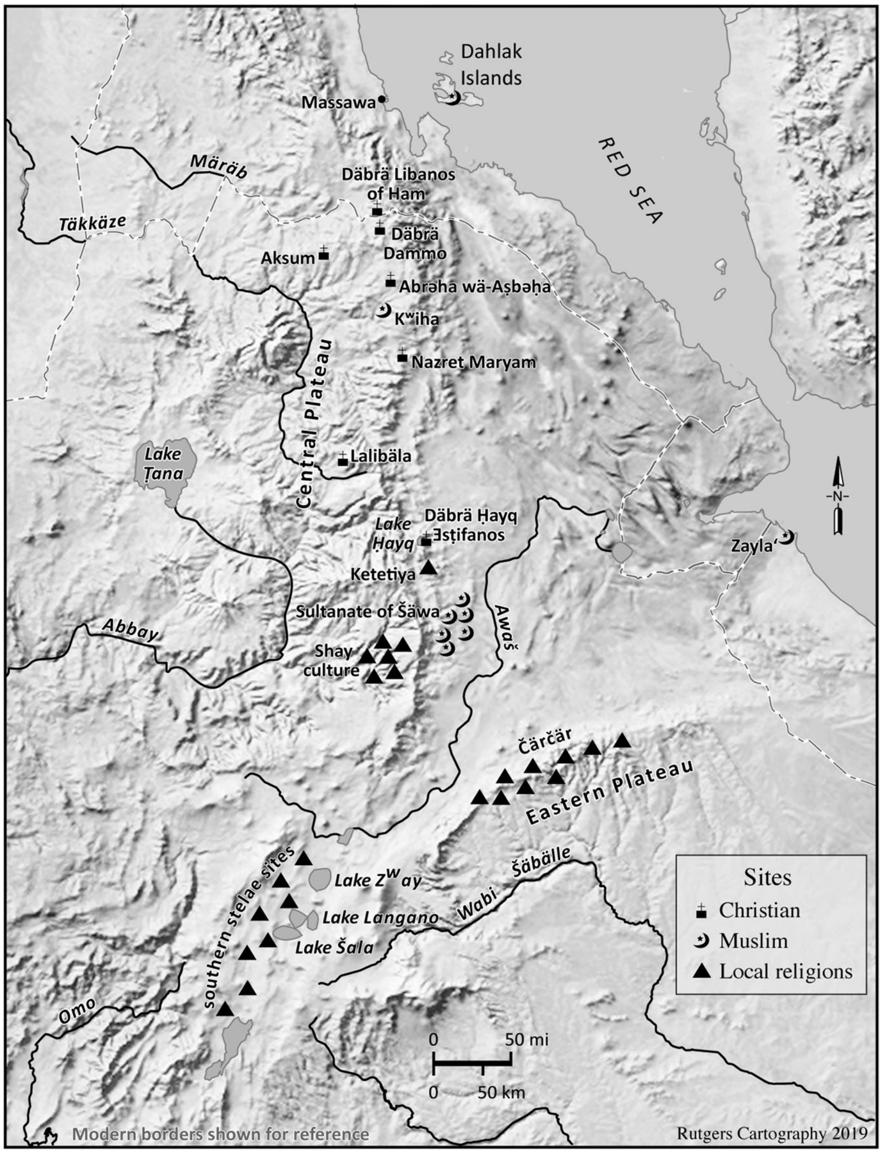
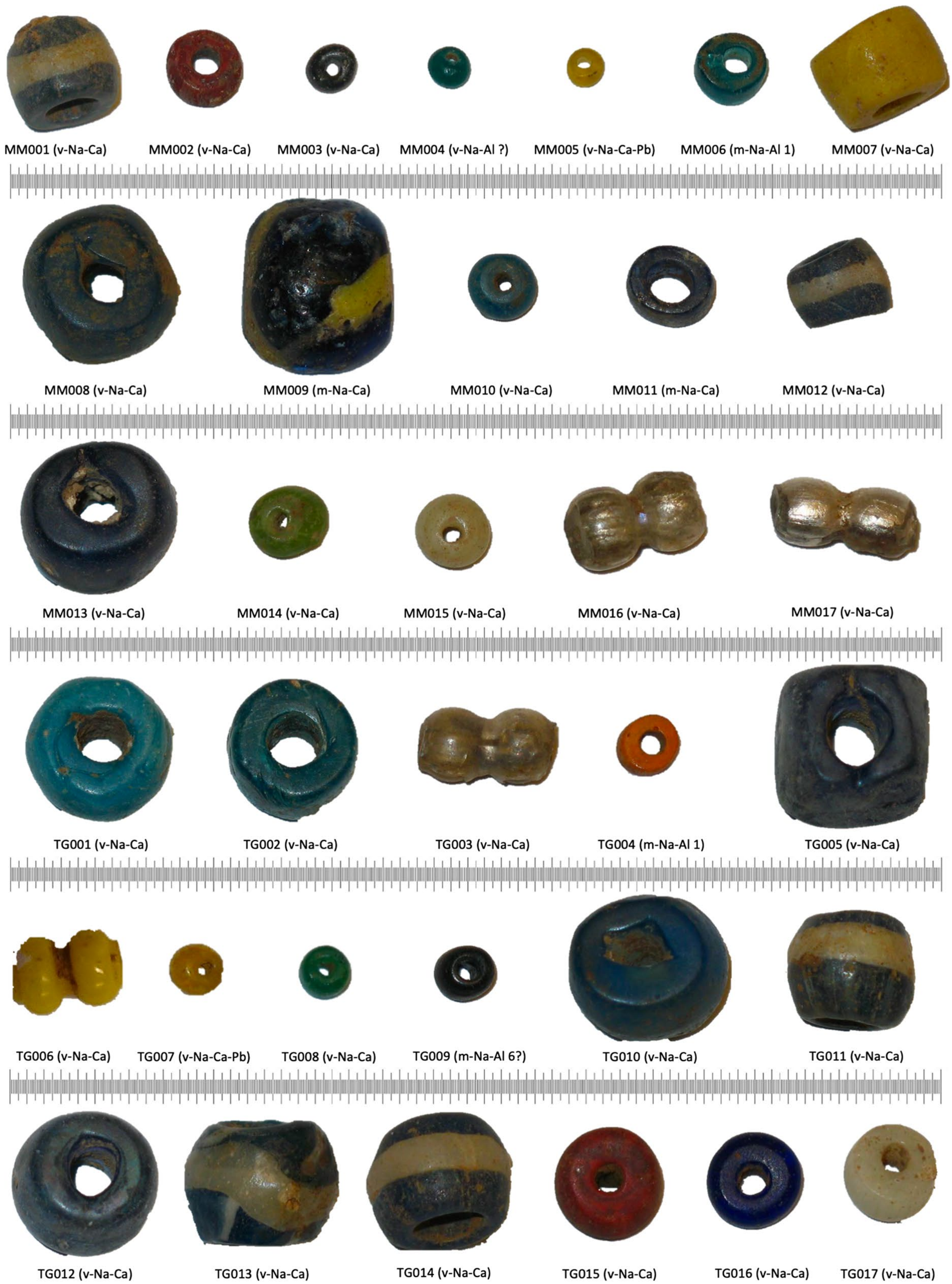


Fig. 1 Map of Ethiopia in the tenth to fourteenth centuries (Courtesy of Rutgers Cartography with the permission of Samantha Kelly)

(Fauvelle-Aymar & Poissonnier, 2012; Hirsch & Poissonnier, 2000). By 2020, these funerary structures have increased to over three hundred (Birru, 2020a, b). In the area of Məsḥalä Māryām, in Mänz, archaeologists found about 20 burial mounds, of which Tumulus 2 gave significant information regarding burial practices among the Shay in medieval Ethiopia (Boisserie, 2012; Fauvelle-Aymar & Poissonnier, 2012, p. 45–65, 2016, p. 64–66). The upper levels of the mound were disturbed due to looting, but the lower level was still intact. At this level, articulated human bones were recovered in association with bovine and ovine bones. Right below these human and animal remains, a diverse range of complete ceramic pots were buried alongside stone and metal jewelry, glass beads, and carnelian beads. These objects would have been used to adorn the buried individuals.

The poor preservation of the bones made direct dating of the burial impossible. The burial mound was, nevertheless, used in several sequential phases and interpreted as a family tomb. A single individual was firstly buried together with many ceramics as grave goods; in successive phases, many other


MM001 (v-Na-Ca)
MM002 (v-Na-Ca)
MM003 (v-Na-Ca)
MM004 (v-Na-Al ?)
MM005 (v-Na-Ca-Pb)
MM006 (m-Na-Al 1)
MM007 (v-Na-Ca)
MM008 (v-Na-Ca)
MM009 (m-Na-Ca)
MM010 (v-Na-Ca)
MM011 (m-Na-Ca)
MM012 (v-Na-Ca)
MM013 (v-Na-Ca)
MM014 (v-Na-Ca)
MM015 (v-Na-Ca)
MM016 (v-Na-Ca)
MM017 (v-Na-Ca)
TG001 (v-Na-Ca)
TG002 (v-Na-Ca)
TG003 (v-Na-Ca)
TG004 (m-Na-Al 1)
TG005 (v-Na-Ca)
TG006 (v-Na-Ca)
TG007 (v-Na-Ca-Pb)
TG008 (v-Na-Ca)
TG009 (m-Na-Al 6?)
TG010 (v-Na-Ca)
TG011 (v-Na-Ca)
TG012 (v-Na-Ca)
TG013 (v-Na-Ca)
TG014 (v-Na-Ca)
TG015 (v-Na-Ca)
TG016 (v-Na-Ca)
TG017 (v-Na-Ca)

◂**Fig. 2** Glass beads analyzed by LA-ICP-MS from Məsḥalä Māryām (MM) and Tätär Gur (TG), Ethiopia

bodies were buried. Osteoarchaeologists identified at least two senile, twelve adults, and five juvenile individuals.

Compared to Məsḥalä Māryām, the tumulus of Tätär Gur was undisturbed, fully excavated, and radiocarbon-dated. The earliest phase of the monument was in use during the first half of the tenth century (Farago-Szekeres, 2012; Fauvelle-Aymar & Poissonnier, 2012, p. 75–103, 2016, p. 66–67). The latter phase yielded the first documented dolmen—a single-chamber megalithic tomb—in East Africa, dating to the first half of the tenth century. At least 19 adult bodies, in primary and secondary burials, were arranged around an individual buried in a central position. The sex of the latter could not be identified due to the poor preservation of the remains, but it was the only one with silver glass beads sewn on a leather cloak. Below the cloak, there were plenty of colorful beads arranged in monochrome motifs, probably as part of a garment. The individual was also the only one buried with an iron dagger or small sword and a silver torc, indicating that the individual must have occupied a prominent role in society. Several grave goods were recovered from all the individuals buried at Tätär Gur. These include 74 pots; myriad body adornments, such as 152 iron, copper, and silver bracelets; other metal ornamental twists; hundreds of glass and gemstone beads; and textile remains. The association and connection of the beads with metal bracelets possibly suggested that beaded materials were used as hair embellishments, necklaces, bracelets, or anklets.

Most of the recovered beads from the burial mounds at Məsḥalä Māryām and Tätär Gur were made of glass, but several others were made of gemstone, especially agate and carnelian. However, many of the beads originally excavated by the team led by François-Xavier Fauvelle-Aymar have been misplaced. The Shay collections have suffered from several moves from their original storage room at the National Museum of Ethiopia. Now they are held at the Authority for Research and Conservation of Cultural Heritage (ARCCH) building in Addis Ababa, but some boxes are unfortunately lost. Thus, certain bead types, such as the so-called eye beads, could not be sampled and analyzed (Fauvelle-Aymar & Poissonnier, 2016, Fig. 9).

A total of 34 glass beads were sampled—17 from Məsḥalä Māryām and 17 from Tätär Gur (Fig. 2). The samples were analyzed using LA-ICP-MS. Each was selected because of the high representation of the type (more than a dozen) in both funerary structures. Most of the selected beads are monochrome and drawn, except for five translucent wound beads with a white opaque central stripe—MM001, MM012, and TG011 in black color and TG013 and TG014 in dark blue. Among the drawn beads, there are 13 opaque in red, black, yellow, dark blue, green, opaque green, white, and orange; 13 translucent in green, yellow-honey, turquoise blue, dark blue, and yellow; and three are transparent (MM016, MM017, and TG003) and thus colorless.

Methods

The LA-ICP-MS analyses of glass beads were carried out at the Field Museum of Natural History in Chicago, USA, with a Thermo ICAP Q inductively coupled plasma mass spectrometer (ICP-MS) connected to a New Wave UP213 laser for direct introduction of solid samples. The elemental analysis of glass objects with LA-ICP-MS combines laser ablation for the micro-sampling of the objects, using a laser beam that leaves invisible traces at the surface of the artifacts and mass spectrometry for the measurements of a wide range of major, minor, and trace elements (50 or more). LA-ICP-MS is a widely used technique in the study of ancient glass (e.g., Gratuze, 2016). With the measurements of the major (present in the range of 1% and more) and minor (less than 1% but more than 0.1%) elements, it is possible to reconstruct ancient glass recipes that are often specific to a region and a particular period. Trace elements are present in very small quantities (<0.1%) and usually indicate the geological environment of the ingredients. The major component of ancient glass is sand, and workshop locations were often selected based on the availability of sand nearby. Therefore, the composition of ancient glass can help track the glass produced by a specific workshop. It is important to emphasize that raw glass and glass objects are often made at different sites. Thus, the composition of glass is not applicable in identifying places where the glass was transformed into a finished object.

The parameters of the ICP-MS are optimized to ensure a stable signal with a maximum intensity over the full range of masses of the elements and to minimize oxides and double ionized species formation (XO^+/X^+ and $X^{++}/X^+ < 1$ to 2%). For that purpose, the argon flows, the RF power, the torch position, the lenses, the mirror, and the detector voltages are adjusted using an auto-optimization procedure. For better sensitivity, helium is used as a gas carrier in the laser. The choice of the parameters of the laser ablation will not only affect the sensitivity of the method and the reproducibility of the measurements but also the damage to the sample. To determine elements with concentrations in the range of ppm and below while leaving a trace on the surface of the sample invisible to the naked eye, we use the single-point analysis mode with a laser beam diameter of 100 µm, operating at 80% of the laser energy (0.1 mJ) and a pulse frequency of 20 Hz. A pre-ablation time is set to 20 s to eliminate the transient part of the signal and to be sure that possible surface contamination or corrosion does not affect the results of the analysis. For each glass sample, the average of four measurements, corrected from the blank, is considered for calculating the concentrations.

To improve the reproducibility of measurements, an internal standard is required to correct possible instrumental drifts or changes in the ablation efficiency. The element chosen as an internal standard must be present in relatively high concentration so its measurement can be as accurate as possible. To obtain absolute concentrations for the analyzed elements, the concentration of the internal standard has to be known. The isotope Si29 was used for internal standardization. Concentrations for major elements, including silica, are calculated assuming that the sum of their concentrations in weight percent in glass is equal to 100% (Gratuze, 2016).

External standards were used for quantitative analyses. To prevent matrix effects, the composition of standards has to be as close as possible to that of the samples. Three standards were used to measure major, minor, and trace elements. The first external standard is a standard reference material (SRM) manufactured by NIST: SRM 610, a soda-lime-silica glass doped with trace elements in the range of 500 ppm. Certified values are available for a very limited number of elements. Concentrations from Pearce et al. (1997) were used for the other elements. The second series of standards were manufactured by Corning Museum. Corning Glass B and D are glasses that match compositions of ancient glass (Brill, 1999, vol. 2, p. 544).

Results—Glass Groups and Their Provenance

Four distinct soda-based glass groups were identified (Fig. 3):

- Thirty-four samples with alumina concentrations below 4% and magnesia concentrations above 1.5% belong to the soda plant ash glass group.
- Three beads with low alumina and low magnesia concentrations belong to the mineral soda–lime glass group.
- Three other beads with high alumina and low magnesia concentrations belong to the mineral soda–high alumina glass group.
- One sample with high alumina and high magnesia concentrations has a composition that could belong to the soda plant ash–high alumina glass group.

More details about these four glass groups are provided below.

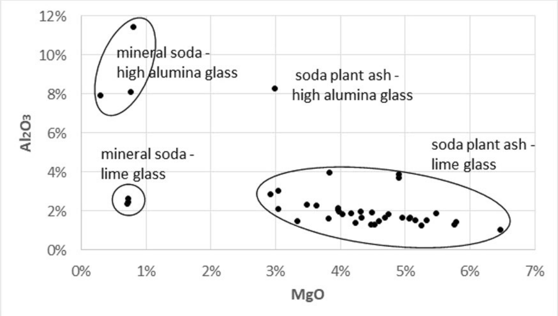


Fig. 3 Magnesia vs. alumina reduced concentrations (recalculated using SiO_2, MgO, Al_2O_3, K_2O, CaO, and Fe_2O_3 to eliminate the diluting effect of colorants and opacifiers) for the beads from Ethiopia. Ellipses are for easy visualization

Soda Plant Ash or v-Na-Ca Glass

Soda plant ash–lime or v-Na-Ca glass is a soda glass with MgO concentrations higher than 1.5%, alumina concentrations lower than 4%, and lime concentrations generally higher than alumina concentrations. This glass is obtained by using the soda-rich ashes of plants growing in saline soil (halophytes) as flux. This ingredient generally contains a fairly high proportion of other constituents (e.g., lime, magnesia, and potash). It is mixed with pure silica obtained by crushing quartz pebbles or other silica-rich materials. The earliest glass was a soda plant ash glass and by the middle of the second millennium BC, production centers for soda plant ash glass operated in both Egypt (e.g., Rehren & Pusch, 2005; Smirniou & Rehren, 2011; Smirniou et al., 2018; Tite & Shortland, 2003) and Mesopotamia (e.g., Degryse et al., 2010; Shortland et al., 2018). From around the eighth to ninth century BC, soda from mineral deposits (e.g., natron) replaced soda plant ash in Egypt and the Syro-Palestinian region (Schlick-Nolte & Werthmann, 2003). Toward the end of the first millennium AD, the use of natron declined (Shortland et al., 2006), and a return to plant ash occurred. The soda plant ash glass tradition continued uninterrupted in Mesopotamia. The Sasanian glassmakers produced soda plant ash glass from the third to the seventh century AD (Mirti et al., 2008, 2009).

Previous studies have identified different subgroups of soda plant ash glass. The compositions of the v-Na-Ca beads were compared to the compositions of four other v-Na-Ca glass beads identified at Chibuene, Mozambique (Wood et al., 2012), and Quseir Al-Qadim, Egypt (Dussubieux, 2017):

- V-Na-Ca 1: This is the most abundant v-Na-Ca glass type and was found similar in composition to Middle-Eastern glass such as the one found at the site of Nishapur. At Chibuene, it was associated with the eighth to tenth century AD.
- V-Na-Ca 2: This glass type has a significantly high amount of chromium correlated with the presence of nickel. It was found in samples in the form of glass sherds or wastes. At Chibuene, it was associated with the eighth to tenth century AD.
- V-Na-Ca 3: This glass usually appears in the form of bluish or greenish drawn glass beads containing a high concentration of trace elements such as Rb, Ce, Cs, Ba, La, and U. It was associated at Chibuene with the earliest context from the seventh to the ninth century AD.
- Glass fragments dating to the thirteenth and fourteenth century AD and found at the Egyptian site of Quseir-Al Qadim were also used for comparison. They have La and Rb concentrations as high as in the v-Na-Ca 3 glass samples, but the concentrations of P_2O_5 are lower in Egyptian glass.

Principal component analysis was conducted considering that the concentrations of MgO, P_2O_5, CaO, Cr, Rb, and La, were found useful for identifying soda plant ashes at the site of Chibuene (Fig. 4). The PCA shows that most of the v-Na-Ca samples form a large group similar to v-Na-Ca 1. Sample MM002 has a composition similar to the Egyptian samples dating to the thirteenth to fourteenth centuries AD.

Recent studies identified distinct trace element signatures for Northern Syria, Iran-Iraq-Southern Syria, Egypt, and Palestine (Henderson et al., 2016; Schibille et al., 2018; Swan et al., 2017). They observed that glasses, possibly manufactured in Northern Syria, Iraq, and Iran, tend to have higher Cr concentrations for a given amount of iron than the glass produced westward due to the availability of different types of sand sources in these regions (Fig. 5). The concentrations in Fe and Cr for the v-Na-Ca 1 glass from Ethiopia follow the same trend as those manufactured in Northern Syria, Iran, or Iraq. Sample MM002 is also classified as Egyptian in Fig. 4, confirming the hypothesis drawn from the PCA analysis.

Two samples, MM005 and TG007, are part of the main group in Fig. 4, but they follow a different pattern in Fig. 5. MM005 and TG007 are two translucent yellow beads with the highest concentrations of lead (42% and 45% of PbO). These high lead beads are made from plant ash compared to China, where lead glass often contains potash. The beads from Ethiopia would have been made from glass likely of the Middle-Eastern production. This is because high lead compositions are not uncommon in the Islamic world from the ninth through the eleventh century AD, although it is often used to manufacture emerald green glass (Brill, 1999, vol. 2, p. 182–183; Freestone, 2020; Wypyski, 2015).

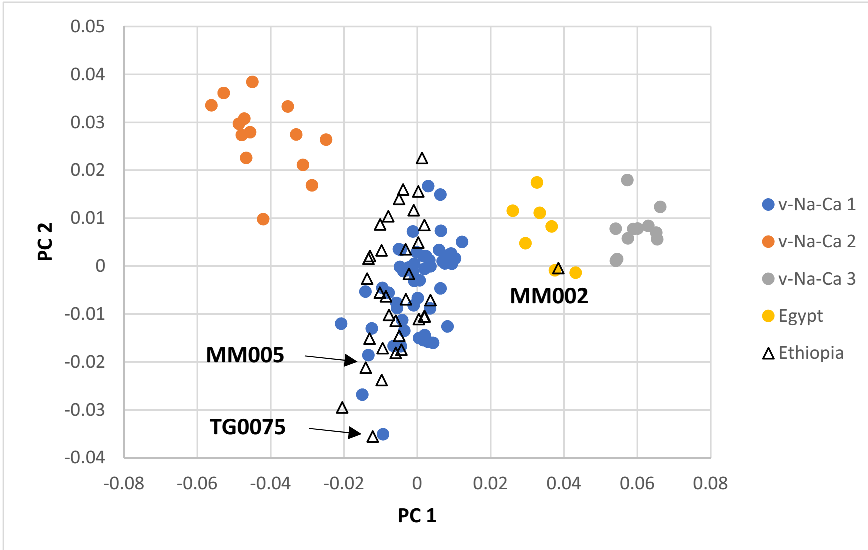


Fig. 4 Principal components 1 and 2, obtained using samples from Chibuene (Wood et al., 2012), Quseir Al-Qadim (Dussubieux, 2017), and the v-Na-Ca glass found in Ethiopia

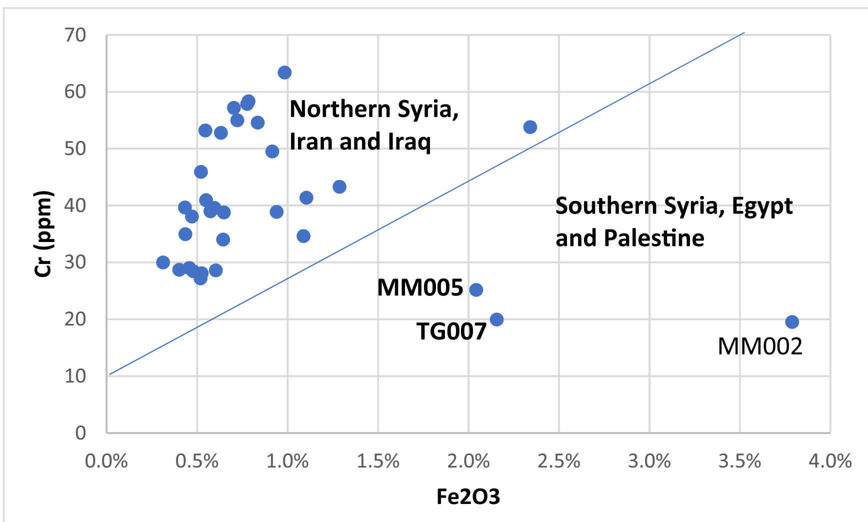


Fig. 5 Scatter plot of Fe_2O_3 vs. Cr for all the samples from Ethiopia. The Northern Syria/Iran/Iraq and Southern Syria/Egypt and Palestine regions were defined according to Swan et al., (2017, Fig. 7a)

Mineral Soda–Lime or m-Na-Ca Glass

Two beads with low magnesia and alumina concentrations, generally lower than lime, have a mineral soda–lime composition. A dark yellow bead (MM009B and Y) and a dark blue bead (MM011) have compositions very similar to that of glass produced in the Syro-Palestinian or Egyptian area during the ninth century BC to eighth century AD. A decrease in the proportion of zircons makes it possible to separate the Egyptian and Levantine glasses based on the concentration ratios of zirconium (Barfod et al., 2020). Egyptian sand tends to have higher zirconium concentrations, lower yttrium to zirconium (Y/Zr), and lower cerium to zirconium (Ce/Zr) ratios compared to glass from the Levant, which was manufactured of sand with lower Zr concentrations (Van Strydonck et al., 2018). Figure 6 indicates a likely Egyptian provenance for the glass used to manufacture beads MM001 and MM009.

The yellow part of sample MM009Y contains tin (1.5%), lead (21%), and antimony (0.2%). As tin has a concentration higher than the antimony concentration, it seems that the yellow was produced by

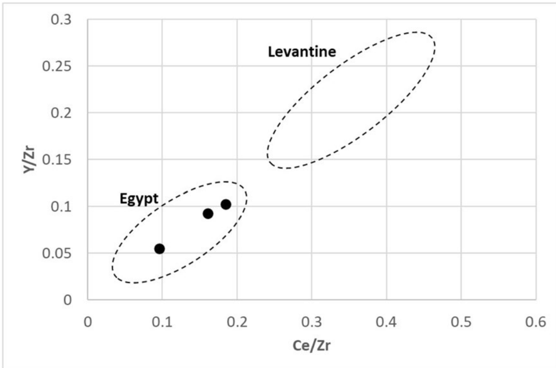


Fig. 6 Ce/Zr vs. Y/Zr for the three Ethiopian m-Na-Ca glass samples. The ellipses refer to the expected general values for materials made from Egypt and Levantine sands

lead stannate. Antimony was the dominant opacifier for yellow ($Pb_2Sb_2O_7$) and white ($Ca_2Sb_2O_7$ or $Ca_2Sb_2O_6$) glasses around the Mediterranean area until the use of tin-based opacifiers was introduced around the second to first century BC and gradually replaced antimony that disappeared by the fourth century AD (Tite et al., 2008).

Sample MM009B and MM011 are made from a dark blue glass containing, respectively, 1152 and 1457 ppm of cobalt. These glasses also contain significant concentrations of copper, lead, and nickel. Dark blue mineral soda–lime glass has a Co/Ni ratio > 24 until the middle of the fourth century AD. Between the fourth and the sixth/seventh centuries AD, a shift occurred, with the Co/Ni ratio ranging between 2.2 and 5.1. Intermediary values higher than 5.1 but lower than 24 could indicate a mixture of the two cobalt types due to glass recycling. These would point toward the manufacture of the glass during the sixth/seventh centuries AD or later (Gratuze et al., 2018). The Co/Ni ratios are 14.3 and 14.9 in beads MM011 and MM009B, suggesting recycling.

Mineral Soda–High Alumina or m-Na-Al Glass

Three beads have high alumina and low magnesia concentrations with relatively low lime contents. They have a high soda–high alumina composition usually associated with Indian glass production. Immature sands derived from granite with a relatively high proportion of feldspar would have been responsible for the m-Na-Al glass composition. These sands also contain high concentrations of certain trace elements, including titanium, zirconium, rare earth elements, and uranium. High concentrations of sodium in glass are generally due to the addition of soda. Ethnographic data, as well as scientific experiments (Brill, 2003; Gill, 2017; Kock & Sode, 1995), indicate that in several parts of India, glass makers were using sand naturally mixed with sodic efflorescence, called *reh* and containing large amounts of sodium salts (carbonate, bi-carbonate, and sulfate), and varying proportion of calcium and magnesium salts. Using different oxides and element concentrations: MgO, CaO, Sr, Zr, Cs, Ba, and U principal component analysis (PCA) reveals five different sub-groups of m-Na-Al glass: m-Na-Al 1, 2, 3, 4, and 6 (Dussubieux & Wood, 2021; Dussubieux et al., 2008, 2010). The three m-Na-Al Ethiopian glass beads seem to belong to two sub-groups (Fig. 7). MM006 and TG004 fall in the m-Na-Al 1 glass.

In South India and Sri Lanka, small drawn beads were made from a locally manufactured glass called m-Na-Al 1. The settlement of Giribawa, dating to the third century BC to second century AD and located in the northwestern part of Sri Lanka, yielded glass beads and furnaces lined with vitrified m-Na-Al 1 material and blocks of raw glass with similar compositions (Bopearachchi, 1999, 2002; Dussubieux, 2001; Gratuze et al., 2000). High alumina sand sources were identified in the area (Dussubieux, 2001). The same type of glass is also found in South India, suggesting that it might have been manufactured there as well. But no primary glass manufacturing center has been located in South India (see Abraham, 2016). The small m-Na-Al 1 drawn beads from South India/Sri Lanka were likely exported to Southeast Asia from around the third-second centuries BC although other glass types were also present. The m-Na-Al 1 glass beads became dominant in Southeast Asian glass bead assemblages after the fifth century AD (Dussubieux & Gratuze, 2010). In Africa, this glass type is rare. Current research has recorded the presence of a significant quantity of m-Na-Al 1 beads from Unguja Ukuu on the Island of Zanzibar from an archaeological context dated to the seventh to early eleventh centuries AD (Sarathi et al., 2022; Wood et al., 2017). All other known sites of m-Na-Al 1 yielded only one bead each. These sites include Ungwana on the Kenyan coast

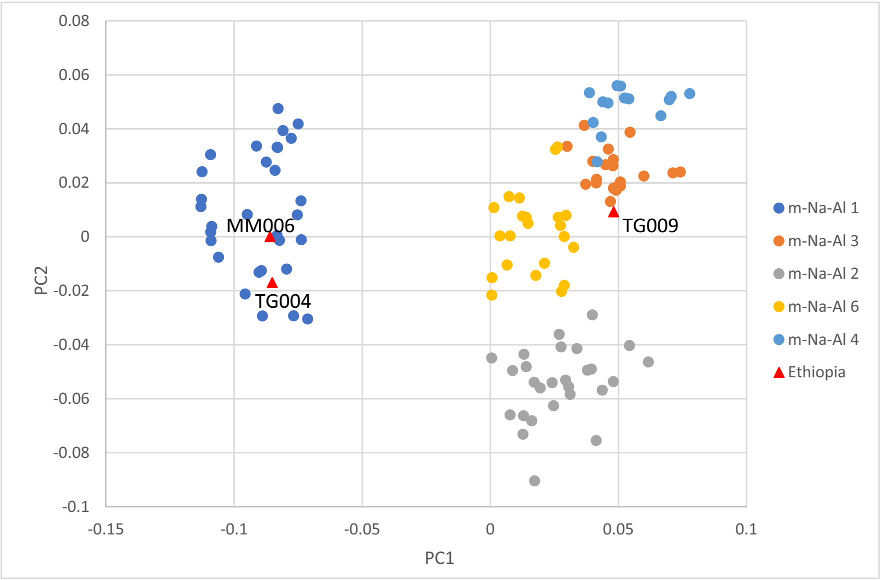


Fig. 7 PC1 vs. PC2 calculated for m-Na-Al 1 (unpublished), 2 (Dussubieux et al., 2008), 3 (Dussubieux & Kanungo, 2013), 4 (Dussubieux, 2009), and 6 (Dussubieux & Wood, 2021) glasses and Ethiopian samples MM006, TG004, and TG009

and Mahilaka in northwest Madagascar, dating to the ninth to sixteenth century AD (Dussubieux et al., 2008, p. 814; Robertshaw et al., 2006). Bead TG009 is close to the m-Na-Al 3 group, but beads belonging to this group have not been affirmatively found in Africa. Comparing the composition of TG009 with the average composition of the other m-Na-Al sub-groups, m-Na-Al 6 would be another option (Table 1). The latter is more likely as this glass type is very common in Eastern and Southern Africa.

The Soda Plant Ash–High Alumina Glass Group

A single sample (MM004) is manufactured from a soda glass with high magnesia (> 1.5%) and high alumina concentrations (> 4%). The lime concentration in this sample is 4.4%. This glass was likely manufactured from soda plant ashes and high alumina sand. Trace elements are generally lower compared to the m-Na-Al glass. This group of glass is also called vegetable soda–high alumina or v-Na-Al glass. Soda plant ash–high alumina glass can be found in Central Asia (Carter et al., 2019; Dussubieux & Kusimba, 2012; Siu et al., 2020; Then-Obłuska & Dussubieux,

Table 1 Average compositions with standard deviations for key constituents for 5 m-Na-Al glass types and the concentrations for the same constituents of the 3 Ethiopian m-Na-Al glass samples

	MgO	CaO	Sr	Zr	Cs	Ba	U
m-Na-Al 1	0.7%	2.5%	333	502	0.5	895	9
	0.7%	1.1%	86	140	0.3	290	9
m-Na-Al 2	1.0%	4.8%	233	153	0.6	353	110
	0.2%	0.9%	52	66	0.3	87	41
m-Na-Al 3	1.3%	2.5%	121	145	3.4	357	58
	0.2%	0.4%	25	36	0.6	122	22
m-Na-Al 4	0.8%	1.3%	99	298	3.7	635	107
	0.2%	0.5%	25	61	0.8	260	39
m-Na-Al 6	0.8%	2.5%	235	216	1.5	402	57
	0.2%	0.7%	88	35	0.4	166	22
MM006	0.3%	2.8%	254	453	0.4	570	8
TG004	0.7%	3.8%	522	418	0.4	722	8
TG009	0.75%	2.19%	118	164	1.9	271	81

2016), and the glass used for the v-Na-Al glass beads must have been produced there, although it is not certain where the beads themselves were manufactured.

Robertshaw et al. (2010) identified two v-Na-Al glass sub-groups in southern Africa: the Mapungubwe Oblate (MO) bead series dating from the thirteenth to fourteenth century AD and the Zimbabwe (Z) bead series dating from the fourteen to fifteen century AD with higher soda, phosphorus, and barium but lower magnesia in the latter compared to the former. Siu et al. (2020) distinguished four different v-Na-Al sub-groups: types A, B, C, and D. Types C and D only include glass vessels and are therefore not relevant to this study. They placed the MO bead series in type A glass and the Z bead series in type B glass. The type A glass beads are also found in the fifteenth- and sixteenth-century AD site of Mambrui, Kenya, which are at the center of the Siu et al., 2020's study. Although the composition of MM004 is comparable with the overall compositions of the v-Na-Al glass previously identified, the composition of the trace elements is quite different, with lower Ti, Zr, and Ba. The difference in the trace element of MM004 concentrations, compared to the v-Na-Al glasses from the types A and B sub-groups, suggests a different source of raw material and quite likely a different place of production (Table 2).

Summary of the LA-ICP-MS Analysis

The beads included in this study are dominantly of the v-Na-Ca glass group, especially of the v-Na-Ca 1 variety. Wood et al. (2012) have placed v-Na-Ca 1 in the eighth- to the tenth-century AD timeframe for southern Africa. Of course, the closeness of the objects examined for this study to the possible point of origin of the glass (Middle East) could imply a different chronology for this glass bead group in Ethiopia. One bead could be made from a glass likely coming from Egypt and have a later date (thirteenth to fourteenth century AD).

Two beads (one with two different colored glasses) were identified as belonging to the m-Na-Ca glass group with a possible provenance from Egypt. In this region, the transition from natron to soda plant ashes occurred around the middle of the ninth century AD (Gratuze et al., 2021; Schibille et al., 2019), suggesting a dating of the glass used for the two beads before this period. We need to keep in mind that glass recycling was common, especially while the transition from natron to soda plant ash was occurring; therefore, the beads could be more recent than the glass.

Regarding the m-Na-Al glass samples, we will ignore sample TG009 in the discussion due to the uncertainty of its group attribution. Samples MM006 and TG004 belong to the m-Na-Al 1 glass group. This type of glass was mostly reported from sites dating from the eleventh century AD or earlier. This glass type is relatively rare on the east coast of Africa, with the exception of Unguja Ukuu on Zanzibar Island. This site, dating from the seventh to eleventh centuries AD, yielded significant quantities of m-Na-Al 1 glass beads (Sarathi et al., 2022; Wood et al., 2017). One single m-Na-Al 1 glass bead was found in Ethiopia at the GQ165 site in the lowland of northwestern Ethiopia (Trombetta et al., 2022), dating to the mid-fourteenth century AD. All the other

Table 2 Comparison of the v-Na-Al composition of MM004 with beads found at Mambrui, Kenya (Siu et al., 2020) and beads from the Mapungubwe Oblate and the Zimbabwe bead series (Robertshaw et al., 2010; Siu et al.,; 2020)

		Type A		Type B
	MM004	Mambrui beads (Siu et al., 2020)	Mapungubwe Oblate	Zimbabwe
Na_2O (%)	12.8	16.1 ± 1.1	12.40 ± 2.09	14.56 ± 2.89
MgO (%)	3.0	4.33 ± 0.59	5.28 ± 1.84	4.01 ± 0.74
Al_2O_3 (%)	8.3	5.55 ± 0.41	7.18 ± 1.43	6.51 ± 1.14
K_2O (%)	3.4	3.15 ± 0.55	3.30 ± 0.58	3.54 ± 0.60
CaO (%)	5.5	5.50 ± 0.87	6.13 ± 1.73	6.54 ± 1.30
Ti (ppm)	381	1268 ± 247	1422 ± 413	1421 ± 244
Sr (ppm)	383	361 ± 46	489 ± 120	487 ± 104
Zr (ppm)	24	69 ± 12	119 ± 25	200 ± 38
Ba (ppm)	100	407 ± 30	486 ± 126	635 ± 175

beads at the site were v-Na-Al, and the unique presence of the m-Na-Al 1 bead was interpreted as evidence of glass recycling. The m-Na-Al 1 bead was indistinguishable in typology from the other beads. However, they all seemed to be from the same workshop. Another m-Na-Al 1 glass bead was found in Ethiopia at the site of Harlaa (Insoll et al., 2021). The v-Na-Al bead does not fit very well into the known v-Na-Al glass group dated to the thirteenth to the sixteenth century AD. Due to the uncertain origin of this bead, we will also ignore it for discussion.

To summarize the scientific analysis, all glass types identified for this study are dated between the end of the first millennium AD and the beginning of the second millennium AD. This period is consistent with the radiocarbon dating from Tätär Gur. The glass beads were mostly obtained from the Middle East and Egypt. Some of them (m-Na-Al glass beads) are clear evidence of connection with the Indian Ocean trade network. Interestingly, many of the beads that could be associated with the Indo-Pacific region, based on their typology (Fauvelle-Aymar & Poissonnier, 2016, p. 67–70), are actually of Middle-Eastern origin based on their composition. This is not unique (see Wood et al., 2022), as physical attributes of glass beads are not the best indices for understanding the origin of glass. More work is needed to understand where bead production centers were located in Eastern Africa. Recently, Rødland (2022) has suggested the possibility of a bead-making workshop in northern Zanzibar, Tanzania, during the early second millennium AD. The provenance of the Shay beads coincides with the eastern commercial catchment area of the Islamic world at the time, which means that there were active and intense networks between the Shay and the Muslims in the region (Fauvelle-Aymar, 2013; Fauvelle-Aymar & Poissonnier, 2016).

Trade Networks and Pagan Resistance

Between the tenth and fourteenth centuries AD, the Shay were surrounded by expansionist Christian and Muslim kingdoms that were pushing southward and westward, aiming at controlling the eastern fringe of Ethiopia's central plateau (see Fig. 1). However, the Shay did not convert to Christianity until the fourteenth century AD, as shown at Ketetiya (Fauvelle-Aymar & Poissonnier, 2012, p. 129–140), when their culture was subsumed or disappeared (Fauvelle-Aymar & Poissonnier, 2016, p. 71–72). Before the fourteenth century, the Shay survived the rivalry between Christian and Muslim polities and between different Muslim kingdoms (Krebs, 2021, p. 230). They successfully confronted the increasing pressure of religious conversion and political expansionism (Fauvelle-Aymar & Poissonnier, 2016, p. 64). At the same time, and precisely because of their in-between location, the Shay benefited from economic exchanges, especially from the Islamic global trade networks and connections that facilitated their beads' acquisition (Fauvelle-Aymar, 2017, 2020; Fauvelle-Aymar & Poissonnier, 2016). Beyond the trade connections, the Shay used exotic glass beads to embody their collective identity, sending a powerful signal of Shay's resistance to foreign religions.

Glass beads, and probably the agate and carnelian beads, likely functioned as a currency. Indeed, glass beads were used in other regions of Africa during the same period as "currency for negotiating political power, economic relations, and cultural/spiritual values" (Ogundiran & Ige, 2015, p. 769–770; see also Babalola, 2017, p. 521–522). Glass beads, both locally produced and acquired through the trans-Saharan trade routes, enacted hierarchies in medieval West Africa. In medieval Yorubaland, glass beads played a significant part in the formation of a new political system (Ogundiran, 2002, p. 433). Perhaps, the Shay went through a similar political process, as indicated by the individuals buried in a central position at both Tätär Gur and Məsḥalä Māryām. One of the individuals buried at Tätär Gur wore a silver-beaded cloak with a colorful beaded garment below, a silver torc, and beaded and metal bracelets and thus was distinguishable from the rest of the individuals buried in the tomb. Due to the poor preservation of the bones, the sex of the human remains could not be identified. The grave goods show that the deceased's family claimed their social and political status, and thus their societal legitimation, during the burial ceremony and beyond.

Grave goods and funerary rituals indicate that many members of the Shay communities had access to the Islamic-traded glass beads. So far, archaeologists have uncovered several clusters of beads associated with other bodies within the collective tomb. The fact that beads were always located next to the skulls and teeth and in connection with metal bracelets, anklets, and rings also reveals that they were used as hair embellishments and as clothing and body adornment by a wider group. Thus, glass beads were not restricted to the ruler among the Shay. However, the poor preservation of the bones does not allow for investigating gender and age differences among the Shay or at least among the members of the society who had the right to be buried in these communal gravesites. The lack of household contexts prevents further interpretations in that regard. Beads were, in any case, part of Shay's body, affirming their individual and collective identity. They became an essential part of the Shay, embodying cultural, social, and economic notions that distinguished individuals from the rest of the community/family and the community itself from other groups in the region, especially Christians and Muslims.

Beads, Bodies, and the Sensorial Experience

Beads and body adornment were inserted into a broader system of meanings among the Shay. The architecture of the tombs varied—tumuli, dolmens, and hypogea—but the dead were always accompanied by the same type of ceramics and presumably similar food and body adornment. Pottery, and most importantly, its contents and corporeal ornamentation, was thus crucial among the Shay for affirming and performing an individual and a collective identity. This identity performance was not only operated as part of their death rituals as embodied in their grave goods but functioned as a powerful vehicle for upholding community traditions among those who staged those rites and were alive.

Further, food and body adornment offer important insights into the understanding of the Shay's "social self" (sensu Fulbrook & Rublack, 2010). They speak of a network of social relations and systems of meaning maintained by different Shay families/groups for about five centuries, as demonstrated by the persistence of these burial practices across time. The adornment of the bodies recovered from the tombs also indicates that the Shay, as a community, placed a high value on durable, colorful, and shiny objects. Their value for "imperishable" objects is shown by the combination of metals—iron, copper, and silver—and beaded adornments—both gemstone and glass-made.

The arrangement of metal, stone, and glass adornments did not only produce a beautiful esthetic experience; their patterned designs probably spoke of specific preferences and social differences and also of fashions. As objects placed on the body, jewelry was enlivened by the Shay's skin and movement and became part of them, efficiently embodying and performing their collective identity. Metals and beads created a meaningful array of sheens, colors, and materials, and the combination of beaded and metal necklaces, bracelets, and anklets animated the body of the wearer with their tinkling sound. Contrary to metal adornments, glass beads do not suffer alterations and are more durable. Because of their translucent properties, they capture light and color in a way that stone and metal ornaments cannot (Turgeon, 2005, p. 80–81). Glass and stone beads, as an affective and embodied assemblage, served as percussive elements against the metal ornaments, which would have vibrated whenever the wearer was moving.

As Turgeon's study of glass beads demonstrates, the tinkling sound originates from the body of the wearer when dancing or simply moving around (Turgeon, 2004, p. 37). The wearer and the body adornment become a trans-corporeal landscape (Hamilakis, 2014, p. 115–116). The jingling sound also creates a particular kinesthetic experience for the wearer, who senses the position and movement of those clinging adornments on the body. The sensorial landscape does not end there. The reflective nature of metals, semi-precious stones, and glass creates a sophisticated visual impression.

In the tomb's darkness, this array of ornaments would have made a unique visual impression. The enclosed darkness of the funerary architecture heightened the sensorial dimension (Hamilakis, 2002, p. 128, 2014, p. 132–138; Thomas, 2006, p. 55–56). The deceased is carried by family or community members along the passage of the tomb into the chamber that was only minimally illuminated by handheld torches. The torches create light and shadow effects that body adornments intermittently reflect. The olfactory, haptic, and auditory experiences were definitely stronger, allowing the participants of the funerary rituals to sense the odor of the decomposing bodies. The smell of humidity inside the tomb, the taste of feasting foods and offerings, the sound of voices/chants as part of the rites, the steps of the participants, and the tinkling sound of all participants' (including the deceased) hair and body adornments acted as guiding aid through the corridor of the tomb toward the chamber.

Discussion: Like Beads on a String

Beads and body adornment played a crucial role in the Shay understanding of the body, death, and the world around them. This form of bead culture is very different from that of their Muslim and Christian neighbors. The "unconverted" Shay were actively connected with other Christian and Muslim communities around them and perhaps also far away. They participated in the global Islamic trading networks through which they acquired their wealth in glass beads.

Glass beads were, however, more than "prestige goods" coming from distant and mysterious places. Indeed, as Diana DiPaolo Loren remarked, "the definition of glass beads as a trade good … is a colonial category. Of course, glass beads were traded, but it was their lives beyond that moment of exchange that provides deeper insights into lived experience" (2013, p. 159). Moreover, the colonial idea that Africans were naïve when accepting goods of supposedly no value—such as beads—in exchange for ivory and enslaved people only speaks of the level of Eurocentrism among many scholars. Ogundiran (2002) and Pallaver (2016) have discussed the changing and complex meaning of local and imported glass beads among African societies. Coveted glass beads entered the Shay world and became an indissoluble part of it until the fourteenth century AD, not because they were trade or prestige goods but because they embodied the Shay social self and trans-corporeal landscape.

The use of these tombs for decades, perhaps centuries, and the sensorial engagement with imported and local objects deposited in them, made the funerary sites places of multi-temporal reality (Hamilakis, 2014, p. 136). Light, color, haptics, sound, and kinesthetic experiences were behind the Shay desire for global glass beads, an affective and embodied assemblage staged in daylight and darkness. Thus, it is only possible to understand the allure of glass beads among the Shay by looking at the local context in which such sought-after objects coming from India, Sri Lanka, the Middle East, and Egypt were incorporated. In life and death, body adornments were crucial in fleshing out the senses.

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Data Availability The authors confirm that the data supporting the findings of this study are available within the article.

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