Commercial and social significance of glass beads in migration-period Italy: The cemetery of Campo Marchione

Cristina Boschetti, Bernard Gratuze, Nadine Schibille

CRISTINA BOSCHETTI, BERNARD GRATUZE AND NADINE SCHIBILLE

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Summary. *Migration-period glass beads from Italy are an overlooked source of evidence. This investigation discusses the provenance, economic value and social significance of glass beads from the cemetery of Campo Marchione, northern Italy (c.570 to the end of the seventh century AD). The different chemical compositions and specific forming technologies have identified European, Egyptian, Mesopotamian and Asian specimens. The wider contextualization of the beads in association with other grave goods and the sex and age of the deceased has yielded important insights into the economic, social and cultural significance beads held in Italy, acting as markers of long-distance exchange*.

INTRODUCTION

The literature on Migration-period Italy traditionally has an ethnic slant, in its desire to determine the ethnic identity of the peoples who moved across Europe, and to attribute an ethnic assessment to its material culture (Von Hessen 1968; 1976; 1978). The circulation of goods is thus mostly seen as a direct consequence of migrations (Koch 2001). These theories originated and spread in Europe during the second half of the nineteenth century and were further developed in Germany during the first decades of the twentieth century (Kossinna 1911). The German school (Werner 1950) was embraced in the 1960s by the first generation of scholars who promoted the study of Italian medieval antiquities (von Hessen 1968), a topic that had suffered from neglect during the fascist years (Giardina and Vauchez 2000). Even though this approach has since been criticized (Barbiera 2012, 93–130; Gasparri 2012, with previous references; Possenti 2014; Harland in press), it remains popular, especially for the study of weapons and body ornaments that are interpreted as elements of the *Tracht* (traditional costume) and thus material expressions of ethnicity (Barbiera 2012, 61–5, with previous references).

Despite their ubiquity in Italian sixth to seventh-centuries cemeteries (Giostra 2012), the scholarly literature systematically excludes beads, as they have the repute of being bad ethnic indicators and chronological markers (von Hessen 1978; Giostra 2012). With few exceptions, they have thus been mostly overlooked (Corrado and Verità 2012; Giostra 2012; Verità 2012). Recently,

in the catalogue of the last major exhibition dedicated to the Lombards, beads were even omitted from the distribution maps of grave goods in Italian cemeteries (Brogiolo 2017, 76–113).

This reluctance to study beads is not limited to post-World War II Italy. In fact, it is a reaction to the recent colonial past, whence the bead-trade obtained a negative connotation (Burgmann 2004, 1–2), an attitude that can be traced back to the beginning of the twentieth century (Kisa 1908, 110). Furthermore, medieval beads were at times considered female ornaments devoid of meaning and significance, and so not worthy of further consideration (O'Sullivan 2015). A renewed interest in beads and their socio-economic meaning surfaced only in the 1970s (Callmer 1977; Koch 1977; Guido 1999; Spaer 2001; Francis 2002).

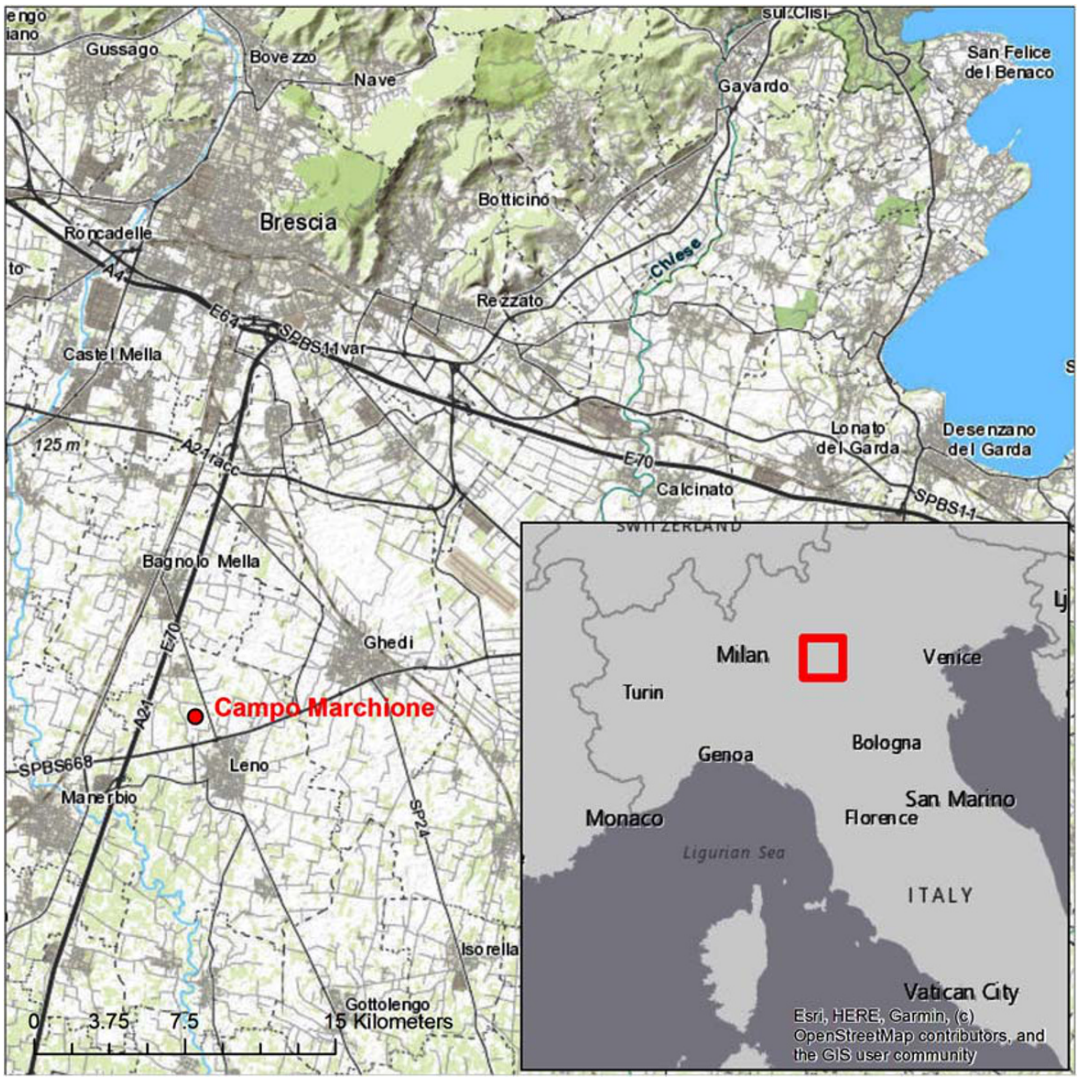

Figure 1
Map showing site of Campo Marchione.

The present paper explores for the first time the economic and cultural role of glass beads in sixth to seventh-centuries Italy by combining archaeological, typological, technological and analytical data. We investigate beads as markers of short, medium and long-distance trade, and assess their value as social indicators. Based on the finds from the cemetery of Campo Marchione, in north-west Italy, that presents a typical example of a sixth to seventh-centuries burial site, we argue that glass beads provide an important and regularly overlooked source of evidence for commercial and cultural exchange in early medieval Italy more generally.

The Migration period in Italy and the cemetery of Campo Marchione (Leno)

The Migration period in Italy is marked by the arrival of peoples from northern Europe, who settled in the peninsula at the end of the Graeco-Gothic wars (AD 535–553), establishing the Lombard Kingdom in AD 568 (Brogiolo 2017). The reasons underlying the migration are not fully understood, but a combination of factors seems to have been involved, certainly including environmental changes (Rottoli 2017; Squatriti 2017). Rather than representing a single and well-defined population group, the immigrants were likely a heterogeneous combination (Gasparri 2012), who moved only gradually southwards and arrived in Italy after spending approximately two generations in present-day Hungary (Vida 2017). Only at the end of the seventh century were these people identified as the Lombards in the written sources (the *Historia Langobardorum* and *the Origo Gentis Langobardorum*) that were probably created at their Royal court and that served to construct a unified cultural identity (Pohl 2002, 228–9). After the collapse of the system based on the Roman rural villas, in the sixth century, the presence of the immigrants was crucial for shaping new territorial holdings in the Po valley: here a network of new settlements systematically re-occupied the existing centurial grid (De Marchi 1995; Breda and De Marchi 2000). The cemeteries serving these communities were large burial sites, hosting adults of both sexes and children and are well documented in the archaeological record (Giostra 2017, with previous references). Despite the high research potential offered by these large graveyards, the traditional literature has focussed on the small cemeteries reserved for high-ranking individuals (Paroli 1996; Paroli and Ricci 2007; Breda 2010; Giostra and Lusuardi Siena 2012; Possenti 2014).

Campo Marchione, the cemetery selected for this study, is a typical example of a large rural cemetery of sixth to seventh-centuries Italy (Giostra 2017). The site is located in present-day Lombardy, 20 kilometres south of Brescia, ducal capital during the last phase of the Lombard Kingdom (Fig. 1). The first generation of immigrants settling the site established their cemetery, which a rescue excavation in 1994–1995 has partially investigated (Fig. 2). The portion excavated includes 247 tombs, of which 156 had grave goods. This sector is estimated to correspond approximately to two-thirds of the total necropolis (Giostra 2017). The funerary space is organized in clusters, with the graves oriented E-W and arranged in irregular rows. This articulation is common in high-medieval Italy and combines the customs of the Roman and Germanic funerary traditions (Barbiera 2012, 42–6). The demographic and social studies conducted on the cemetery have divided the site into three chronological phases and attributed the portion investigated to a community of seventy to eighty individuals (Giostra 2011; 2017). The first phase (Phase I) starts around AD 570 and extends to the beginning of the seventh century. The second phase (Phase II) covers the first half of the seventh century, and the third phase (Phase III) dates to the second half of the seventh century. The demographic analysis yielded a picture of moderate, but constant growth over the three phases (Giostra 2017, 85). This positive trend is in line with the demographic model proposed for

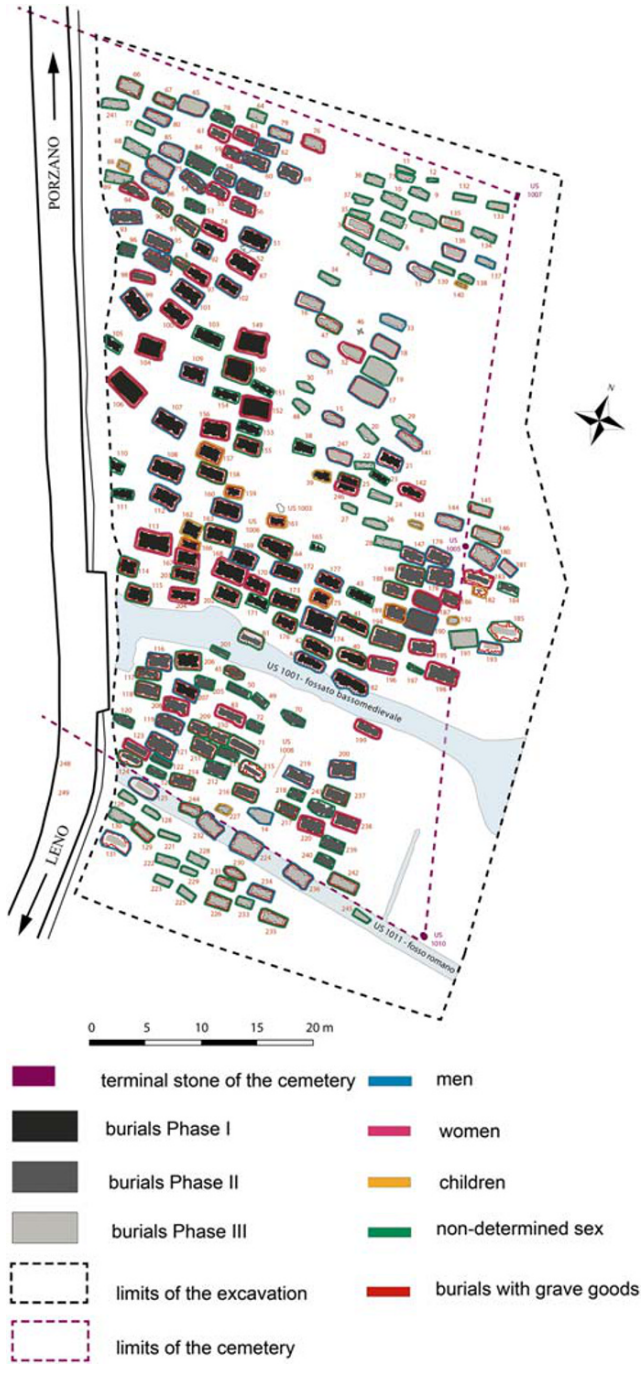

Figure 2
Plan of the cemetery of Campo Marchione, with identification of the three phases. (Plan Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia, edited by Cristina Boschetti).

northern Italy during the High Middle Ages (Barbiera and Dalla Zuanna 2007). The frequency and distribution of luxury goods deposited in the burials reflects an average level of wealth, matching the image already established from other contemporary large cemeteries of northern Italy (Giostra 2017). This typical character of Campo Marchione and its chronological span enable us to observe the consumption of glass beads across a broad sample of the population, and for the whole period between the arrival of the first migrants to the end of the Lombard kingdom. The analysis of the forming technology and the chemical characterization of the beads are crucial to understand the economic meaning of these artefacts, establishing their provenance and their degree of technological complexity.

GLASS BEADS AT CAMPO MARCHIONE: DISTRIBUTION AND CHRONOLOGY

The excavation at Campo Marchione retrieved a total of 384 glass beads, deposited in only 22 burials (9% of the total, and 14% of the tombs with grave goods). The graves are attributed to eighteen adult females (10 in Phase I and eight in Phase II), one child (Phase II), one individual of undefined sex and age (Phase II) and two adult males (Phase III) (Fig. 3, Table 1). The interpretation of the quantitative data for the beads at Campo Marchione is problematic, because the literature lacks comprehensive quantitative data for beads in European cemeteries to act as comparanda. Hungary is the only region where data for the deposition of beads in Migration-period graves are available. Here glass beads have been found in 70% of the burials (Bóna and Horváth 2009), a figure that might appear at first glance to be in striking contrast with what is seen at Campo Marchione, but most likely reflects the quality of the sample analysed. Unlike Campo Marchione, most of the published Hungarian records concern high-ranking cemeteries. An analysis conducted on a broader and more socially-variegated sample of cemeteries would very likely change the current picture.

Not surprisingly, at Campo Marchione beads were deposited nearly exclusively in female burials, worn by the deceased strung in necklaces or bracelets. The presence of one single bead in a child burial (T 183) is consistent with the practice of burying children with a reduced number of grave goods (Giostra 2017, 56–7). The third Phase marks a change in funerary practices and a decline in grave goods, following a trend common to the whole of Lombardic Italy (Barbiera 2012, 21–5; Giostra 2017). This phase at Campo Marchione sees the disappearance of beads from female burials, but offers a unique glimpse of their deposition in male graves. This phenomenon, never documented before in Italy, finds parallels in northern-European contexts (O'Sullivan 2015). The two male burials in Phase III (T 18; T 235) included a single bead each, most likely used as amulets rather than proper items of jewellery. Interestingly, one of these two burials (T 235) is one of the most important burials of the latest period. It was the grave of a smith, identified as such thanks to the presence of an anvil, and associated with an important set of weapons (La Salvia 2017, 32). The significance of this prestigious burial has to be understood according to the prominent social role metalworkers enjoyed during the Migration period in Italy and, more generally too in northern Europe (Carlisle 2013; La Salvia 2017).

MATERIALS AND METHODS

The forming technology, which can be easily identified by visual examination, is the principal criterion considered for creating the typology of beads from Campo Marchione.

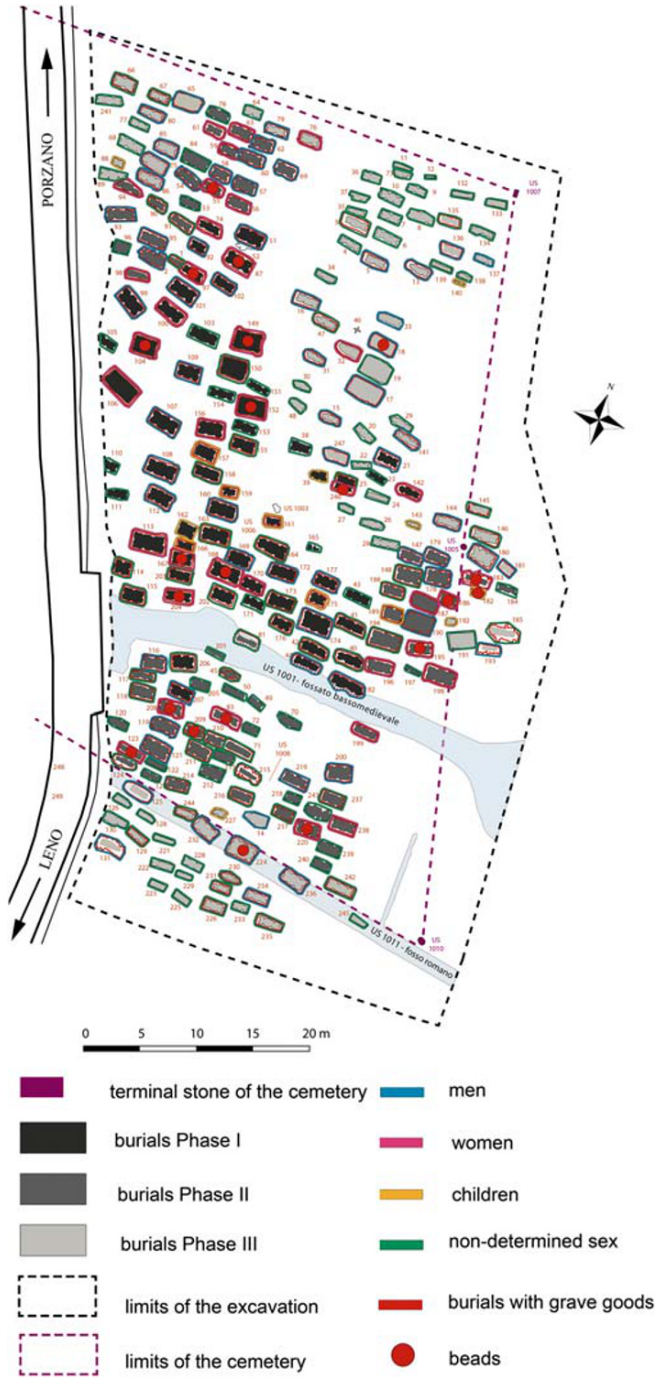

Figure 3
Distribution of glass beads in the cemetery of Campo Marchione (Plan Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia, edited by Cristina Boschetti).

TABLE 1

Archaeological context of the glass beads from Campo Marchione, with indication of the chronological phase, sex and age of the deceased, and association with other grave goods. The tombs marked by an asterisk were identified by the excavators as looted in antiquity, thus part of the grave goods might be missing

TOMB	PHASE	SEX	GLASS BEADS				ROMAN ORNAMENTS			STONE BEADS			
			WOUND	MOSAIC	DRAWN (segmented)	DRAWN (cold-cut, hot polished)	GLASS BEADS	FAIENCE BEADS	GLASS BANGLES	AMBER	AMETHYST	ROCK CRYSTAL	AGATE
T. 87	**I**	**F**	**X**	**X**	**X**								
T. 97*		**F**	**X**	**X**									
T. 104		**F**	**X**	**X**		**X**			**X**	**X**	**X**	**X**	**X**
T. 106*		**F**	**X**							**X**			
T. 149		**F**	**X**								**X**		
T. 152		**F**	**X**	**X**	**X**					**X**			
T. 167		**F**	**X**		**X**								
T. 168		**F**	**X**	**X**	**X**								
T. 204		**F**	**X**		**X**					**X**			
T. 246		**F**	**X**		**X**								
T. 55*	**II**	**F**	**X**										
T. 83*		**F**	**X**										
T. 123		**F**	**X**		**X**		**X**						
T. 182		**C**	**X**										
T. 183		**F**	**X**		**X**								
T. 186		**F**	**X**										
T. 195		**F**	**X**		**X**	**X**				**X**			
T. 208		**F**	**X**										
T. 209		**ND**	**X**		**X**								
T. 220		**F**	**X**										
T. 18	**III**	**M**					**X**						
T. 224		**M**						**X**					

TABLE 1
(Continued)

TOMB	STONE BEADS	BODY ORNAMENTS											GLASS VESSELS
	BERYL	BONE	SHELL	PIERCED COINS (Bronze)	LEAD	IRON	BRONZE	GILDED BRONZE	SILVER	GILDED SILVER	GILDED SILVER WITH GARNETS	GOLD	
T. 87						X	X	X	X	X	X		
T. 97*							X						X
T. 104	X						X						
T. 106*							X						
T. 149						X	X						
T. 152							X		X		X	X	
T. 167							X						
T. 168				X	X		X			X			
T. 204							X						
T. 246						X	X		X	X			
T. 55*				X		X							
T. 83*				X									
T. 123				X			X						
T. 182													
T. 183				X			X						
T. 186													
T. 195			X	X			X		X				
T. 208		X		X		X	X		X				
T. 209				X			X						
T. 220				X									
T. 18							X						
T. 224						X	X						

Figures 4
The specimens from Campo Marchione, with indication of tomb (T), sample number, forming technique, base glass type and antimony or tin-based opacifiers (images Cristina Boschetti, with permission of Soprintendenza Archaeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia).

Figure 5
The specimens from Campo Marchione, with indication of tomb (T), sample number, forming technique, base glass type and antimony or tin-based opacifiers (images Cristina Boschetti, with permission of Soprintendenza Archaeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia).

Seventy-six beads, representing almost the entire typological range attested in the cemetery (with the exception of four types, not considered for reasons of access to the materials) and covering its entire chronological span, were selected for chemical analysis. Most of the beads are composed of multiple colours, and each colour is considered separately (n = 142). The set of samples includes also the foot of a goblet, which was the only glass vessel found in the cemetery, as well as a fragment of a glass bangle, also the only example of its kind recovered from Campo Marchione (Figs. 4 and 5).

The cleaned samples were analysed by LA-ICP-MS (laser ablation coupled with inductive plasma mass spectrometry) at IRAMAT-CEB in Orleans (France). This method does not require any preparation and allows for the separate analysis of the different colours and the determination of virtually all the elements expected in ancient glasses. The instrument set-up consists of a Resonetics M50E excimer 193 nm laser and a Thermo Fischer Scientific ELEMENT XR mass spectrometer. The standard working conditions are a 5 mJ energy, 10 Hz pulse frequency and a beam diameter that ranges from 30 μm to 100 μm (Gratuze 2013) (Table 1 in the Supporting Information).

Forming technologies

The corpus of glass beads (n = 384) from Campo Marchione represents all four forming techniques known in medieval Europe: winding, mosaic, drawing with segmentation, and drawing with cold-cutting and hot-polishing. The typology of beads from Campo Marchione therefore corresponds perfectly with the evidence from other European regions (Callmer 1977; 1997; Koch 1977; 1997; Guido 1999).

Figure 6
Close-up details of wound beads (not to scale). From top-left, clockwise: (marked by the arrow) impression left by the tool used for detaching the bead from the mandrel; the junction resulting from folding soft glass; detail of a combed decoration; spiral-working (images Cristina Boschetti, with permission of Soprintendenza Archaeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia).

Wound beads are the largest group (n = 353) and are attested during the entire life-cycle of the cemetery. Winding is a simple process, involving the wrapping of some softened glass around an iron rod, the mandrel (Fig. 6). This operation can be done both by collecting the glass with the mandrel directly from the crucible or by a two-step process. In the latter case, the glass is first prepared in rods by stretching a mass of glass. To form the beads, the tip of the rod is re-heated on a flame and coiled around the mandrel. The final products of the two processes are identical in their outward appearance, but the infrastructures required differ significantly. In the first variation of manufacture, the furnace must have a firing chamber suitable to hold the crucibles, and an opening to allow access to the hot glass. Ethnographic evidence of this type of furnace, with several working stations to allow for the simultaneous production of large quantities of beads, are known, for example, from Nazarkoy, Turkey (Küçükermann 1988), and Purdapur, India (Kanungo 2004, 100–1). In contrast, the furnace for cane-winding can be very simple indeed: a fire-pit with raised walls and a single opening at the top. This type of furnace is used by the bead and bangle-makers of Bida, Nigeria (Gardi 1970, 87–102). Similar furnaces are likely to have been widespread in antiquity, but are rarely identified, because they leave little archaeological traces. Winding is attested at all European medieval sites where bead-making has been documented, including Scandinavia (Callmer and Henderson 1991; Sode 2004; Karlsson 2017) the Netherlands (Sablerolles *et al.* 1997), Belgium (Pion 2014), and the Balkans (Bezborodov 1959). The only evidence of bead-making in Italy, as postulated by Cavalieri and Giumlia-Mair (2009), is currently under re-assessment (Boschetti, in preparation).

Judging by their typology, two wound beads (LEMA 1 and 25) are likely to be reused-Roman pieces. LEMA 1, black, with polychrome mottled decorations, represents a common type in medieval Europe (Koch 1997), as well as in Late Antique Egypt (Spaer 2001, 127). LEMA 25, a large black bead with a double perforation and sculpted ribs, can be identified as a *Trilobitenperle*, common during the third to fourth centuries AD (Spaer 2001, 127). Similarly, while glass bracelets were widespread during the Iron Age and the Roman Empire, they were not used in early medieval Europe (Spaer 2001, 193–6). The fragment of a blue glass bracelet (LEMA 17) can therefore be assumed to be a reused ornament, too. The deposition of ancient objects in burials of the Migration period is well documented across Europe and is considered to be linked to symbolic and ritual practices (Sherlock 2016).

Winding is also involved in the production of mosaic beads, which requires a high level of technical expertise. Three different types of mosaic beads can be distinguished among a total of thirteen specimens retrieved at Campo Marchione, all in Phase I burials. These types are popular in Europe during the Migration period (Giostra 2012, with previous references), but are documented also in Egypt (Brunton 1930, 27). The mosaic technique originated in Hellenistic Egypt (Bianchi 1983; Nenna 1993; Boschetti 2018) and is based on the principle of creating a design by fusing together sections of separate canes. For bead-making, the polychrome canes are so wound around a mandrel (Fig. 7). There is no archaeological evidence of the production of mosaic beads in Europe during the Middle Ages, with the exception of Ireland (Henderson 1988) and eighth-century Scandinavia (Callmer 1997). These mosaic canes, however, all involve but simple patterns and are technically inferior to the virtuoso mosaic work known from Egypt.

Four different types, from a total of 15 beads from Phases I and II, are made by the segmentation technique. This forming technique involves a two-step process. Firstly, soft glass gathered at the end of an iron rod is tooled to form an open cylinder; this was then elongated to the desired size and thickness of the cane by attaching a second iron rod to the free end of the cylinder and drawing it out. The hollow canes can be manufactured also by attaching molten glass

Figure 7
Close-up view of two mosaic beads (not to scale). The sections of the canes are clearly visible (images Cristina Boschetti, with permission of Soprintendenza Archaeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia).

to a blowing-pipe and blowing an air bubble inside the hot glass, before pulling out the cane in the same manner as above. This latter process was most likely adopted after the invention of glass blowing, a skill developed around the middle of the first century BC (Stern 1999). To prevent the perforation from closing in the drawing out process, an iron rod was inserted into the hollow of the cane. Once the cane had reached the desired size, it was pressed into and rotated in a ribbed stone mould, so as to produce the desired indentations at regular intervals, thus dividing the cane into its segments (Fig. 8). The earliest occurrence of this technique, used also for a variant of sandwich-gold (or silver) glass beads, is currently attributed to Hellenistic Rhodes (Weimberg 1983). Segmented bead-making workshops have furthermore been identified at Alexandria and Fustat (Egypt), dating to the fourth to sixth, and eighth to tenth centuries AD, respectively (Spaer 2001, 130–5 with previous references).

Figure 8
Close-up view of drawn beads (not to scale). Both the beads show the lines formed by pulling out the cane. The drawn-segmented bead (left) has constricted ends, while the drawn cold-cut, hot-polished bead is rounded in profile (images Cristina Boschetti, with permission of Soprintendenza Archaeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia).

Drawn, cold-cut and hot-polished beads make up the smallest group of beads from Campo Marchione. Of the three beads, two types have been recovered from Phases I and II. This laborious forming technique produces extremely tiny beads suitable for jewellery, as well as embroidery (Giordani 2010, 83–4; Juwig 2010). Drawn beads are still produced in India by a complex process, involving a peculiar type of infrastructure: a furnace with a double opening that allows the hollow canes to be shaped and pulled. An iron tool (the *lada*) is used for trapping an air bubble inside a mass of hot glass, before pulling it into a hollow cane (Francis 1991, 29). The canes produced can be extremely thin; they are then cold-cut with a blade into segments. These segments are again heated in iron pans to give them a rounded shape (Fig. 8). For preventing the perforation from closing at this point, the segments were previously soaked in a mix of water and clay, which ensures that the interiors are filled. At the end of the process, the beads are cleaned, including washing out the clay, and strung, before being put on the market. The *lada*-method has been used in India and in several Asian locations, including Sri Lanka and Java, at least since the second century AD (Francis 1991; Lankton and Dussubieux 2006; Dussubieux *et al*. 2008). The production of hollow canes by blowing is not documented in India (Kanungo 2004).

Asian drawn and hot-polished beads have thus far not been documented in Italy, but are quite common in fifth to sixth-centuries burials in Belgium and France (Pion and Gratuze 2016). Drawn cold-cut (not hot-polished) beads, made from Mesopotamian glass, have been identified among tenth-century finds from Albania, but the provenance of these beads is unclear (Neri *et al*. 2018). The discovery of Asian beads in Nubian graves (Then-Obłuska and Wagner 2019) suggests that they may have arrived in Europe via the route described in the first-century *Periplus Maris Erythraei* (Belfiore 2004): that is by crossing the Indian Ocean, the Red Sea, and up the Nile valley. A comprehensive investigation of the evidence of Asian beads in Egypt would be helpful to elucidate the role of Egypt and of the port of Alexandria in this commerce.

Chemical composition: base glass

Ancient glasses can be categorized into distinct primary production groups according to the raw materials used, particularly the nature of the fluxing agent and the silica source (Table 2 in Supplementary Information). The vitreous material from Campo Marchione analysed within this study falls into four compositional groups: mineral soda-lime-silica glass, plant-ash soda-lime-silica glass, silica-lime-lead glass, and mineral soda-silica-alumina glass. There is a strong correlation between the composition of the base glass and the bead-forming technique. The large majority of the glasses used for the beads (n = 115) are mineral soda-lime-silica glasses with low MgO and K_2O (< 2% wt) (Fig. 9a) and low P_2O_5 (< 0.5% wt) contents. These values reflect the use of natron, the predominant fluxing agent in Mediterranean glass-making from the Hellenistic period through to the eighth century AD (Sayre and Smith 1961; 1974; Gratuze and Barrandon 1990; Shortland *et al*. 2006). One small red wound bead (LEMA 75) stands out by its higher K_2O (2.52% wt), but low MgO (0.87% wt), in its reduced composition. This points to the addition of wood ash to facilitate the precipitation of cuprous oxide or metallic copper crystals in the glass melt (Barber *et al*. 2009). Some samples have elevated contents of potassium oxide ($1.5 < K_2O < 2.0$), higher phosphorus oxide ($0.5 < P_2O_5 < 0.7$), and lower chlorine (< 1% wt), indicative of pollution presumably due to recycling (Schibille and Freestone 2013; Jackson and Paynter 2015).

The origin of natron glasses can be better assessed by comparing the ratios of TiO_2/Al_2O_3 and Al_2O_3/SiO_2 reflecting the feldspars and heavy minerals in relation to the silica source (Freestone

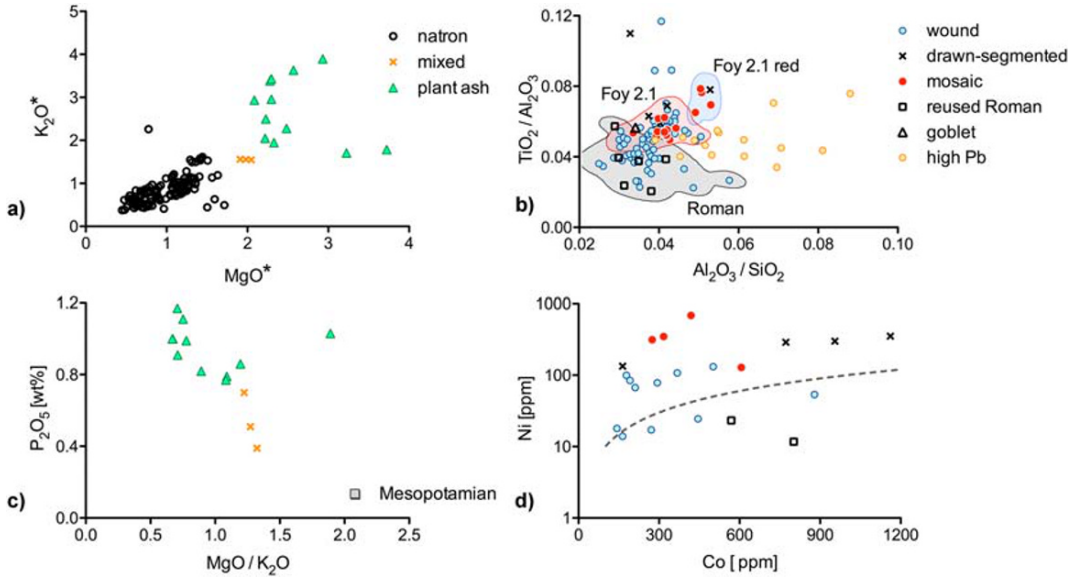

Figure 9

a. Magnesium and potassium oxide concentrations discriminate the plant-ash and natron glasses (*reduced compositions). b. Al_2O_3/SiO_2 and TiO_2/Al_2O_3 ratios establish different base-glass groups for the natron samples. c. Phosphorus oxide concentration and MgO/K_2O discriminate between plant-ash beads and the Mesopotamian plant ash sample. d. Two different correlations of Co versus Ni in the cobalt blue samples indicate the use of two different cobalt sources. The dotted line indicates Co/Ni = 10. [Colour figure can be viewed at wileyonlinelibrary.com]

et al. 2018). According to these ratios, the glasses can be divided into three main groups (Fig. 9 b). A first group (n = 36) exhibits the ratios typical of glass made and circulating during the Roman Empire (Silvestri *et al*. 2008). All the members of this group are wound beads and include the two Roman reused beads (LEMA 1, 25) and the bangle (LEMA 17). Hence, the majority of these beads are likely to have been made by recycling Roman glass cullet and/or mosaic tesserae, a practice attested at least since the fourth century AD (Boschetti *et al*. 2016), and documented in medieval Europe (Schibille and Freestone 2013). A second group of samples (n = 58) includes wound (n = 38), mosaic (n = 11), and drawn-segmented beads (n = 8), as well as the foot of the goblet. This group has higher TiO_2 to Al_2O_3 ratios coupled with higher magnesium, zirconium, vanadium, chromium and lanthanum contents. These characteristics are associated with the so-called Foy 2.1 group, believed to be of Egyptian origin and widespread in Europe and in North Africa from the second half of the fifth to the seventh centuries AD (Foy *et al*. 2003; De Juan Ares *et al*. 2019). Interestingly, the mosaic and drawn-segmented beads cluster together. This could indicate a common origin, which is further supported by the fact that they share the same complex bead-making techniques. The Foy 2.1 red glass used for both the mosaic beads (n = 5) and one drawn-segmented bead (LEMA 47) is enriched in titanium oxide, probably as a result of the addition of iron as part of the colouring process. The trace elements of the segmented and mosaic beads fit well with published data for Foy 2.1 (Foy *et al*. 2003), pointing to the use of new glass. The wound beads, by contrast, show variable levels of vanadium, chromium and lanthanum that are not always consistent with typical Foy 2.1 glass. This is likely an effect of recycling and mixing of Foy 2.1 and Roman cullet. A small group (n = 4) consisting of one drawn-segmented and three wound beads are

made from HIMT (high-iron, manganese and titanium) glass. HIMT is likewise of an Egyptian provenance and dates generally to the fourth and fifth centuries AD (Foy *et al*. 2003; Freestone *et al*. 2018).

Eleven samples with MgO and K_2O close to or in excess of 2% are made from plant-ash glasses (Fig. 9c). These include red, orange and colourless glass used for wound beads, red in one drawn-segmented bead, and the green glass of one drawn, cold-cut and hot-polished bead. An intermediate group (n = 3), including one purple and two orange glasses used for wound beads, may be the result of the mixing and recycling of natron and plant ash glass. The trace element pattern of these beads suggests that they were made by adding some plant ashes to Roman and Foy 2.1 cullet. The drawn, cold-cut, hot-polished green bead (LEMA 64, Phase II) can be clearly distinguished from the other samples, due to higher magnesia (3.8% wt), lower phosphorus oxide (0.13% wt) and somewhat elevated lithium (21 ppm) and chromium levels (80 ppm) (Table 2 in Supplementary Information; Fig. 9c). These compositional features are reminiscent of glass produced in Mesopotamia, and more specifically Sasanian glass of the third to seventh centuries AD (Mirti *et al*. 2009; Schibille *et al*. 2018).

A group of yellow natron glasses (n = 14) used for wound beads are very high in lead oxide (PbO $>$ 20%) and tend to have higher Al_2O_3 to SiO_2 ratios (Fig. 9b). Yellow glass of similar composition is quite common amongst beads and was detected in glass crucibles excavated at Maastricht, the Netherlands (Sablerolles *et al*. 1997), at Schleitheim, Switzerland (Heck *et al*. 2003) and at Dunminsk, Ireland (Henderson 1988). High-lead yellow beads were also found in seventh-century burials in Albania (Neri *et al*. 2018). The glasses of this group are very similar both to the Roman and the Foy 2.1 group. As argued in the above cited literature, these yellow glasses were likely made by mixing cullet and pure lead stannate. According to the high content in lead oxide (PbO = 35.39% wt) and the elevated alumina, we attribute the red wound bead (LEMA 75) to a separated high-lead compositional group.

The glass of two translucent green beads, both drawn cold-cut and hot-polished, found in the same Phase I burial (T 106) exhibit exceptionally high-alumina and low-calcium compositions similar to glasses originating from the Asian subcontinent (Pion and Gratuze 2016) (Table 2 in Supplementary Information). The composition fits with the group m-Na–Al 1, for which the archaeological evidence suggests a fourth to fifth-centuries production in Sri Lanka (Lankton and Dussubieux 2006; Dussubieux *et al*. 2008).

Colour technology and chronological trends

The beads from Campo Marchione offer an overview of the colouring and opacification technologies from the Roman period to the early Middle Ages. Three colour groups are particularly interesting for identifying the use of new or recycled glasses: white (including opaque cold shades), opaque yellow and green, and cobalt blue. As is well established in the literature, the whites owe their colour and opacity to white crystals dispersed in the glass matrix. The same principle underlies yellow and green samples, where the opacity and colour are conferred by yellow crystals. Until the fourth century, antimony-based compounds, either calcium or lead antimonate, were mostly used (Tite *et al*. 2008). Antimony was replaced by tin-based opacifiers (cassiterite, lead stannate) occasionally since the second, and more systematically since the fourth century (Verità *et al*. 2013).

With the exception of two specimens, antimony-based opacifiers are used in the Roman base glass group, both pure and mixed with tin-based compounds. Conversely, antimony-opacifier

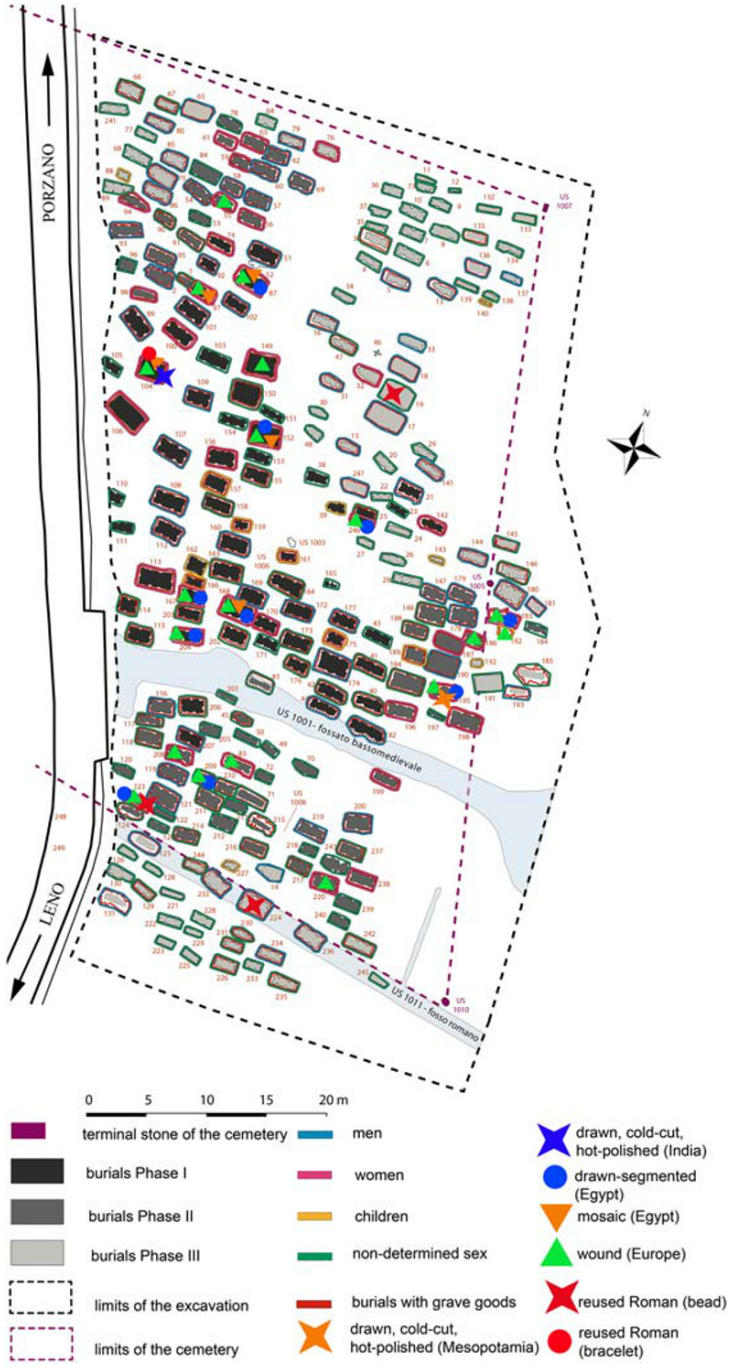

Figure 10
Distribution of glass beads at Campo Marchione, with identification of the forming technique and provenance (Plan Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di Bergamo e Brescia, edited by Cristina Boschetti).

alone is present in only one Foy 2.1 sample, while tin-based opacifiers, occasionally mixed with antimony compounds, underlie all the other Foy 2.1 samples and one HIMT glass. All the glasses with a mixed antimony and tin composition were part of wound beads, confirming the practice of recycling. All the glasses used for the mosaic beads are opacified by pure tin-based compounds, thus pointing to the use of new glass. The same can be said of the yellow and green glasses, opacified by lead antimonate or lead stannate. Lead antimonate is used in the Roman base glass group, while lead stannate prevails in the Foy 2.1 group (Figs. 3–4; Table 2 in the Supplementary Information).

Although the nature of the cobalt sources used in ancient glass-colouring is unclear, a change has recently been identified in the fourth century, when CoO/NiO ratios shift from higher to lower values (Gratuze *et al*. 2018). The beads from Leno show two different ratios, which are consistent with the chronology of the base glass (Fig. 9d). The Roman base glasses exhibit the highest ratios, typical of the Roman period. The Foy 2.1. glasses are characterized by lower ratios, confirming their affiliation with a later source.

THE PROVENANCE AND ECONOMY OF BEADS

The different base glasses used to make the beads and their relation with the forming technologies enable us to understand their level of complexity and point to at least four different origins, exemplifying the international character of the bead trade in sixth and seventh-centuries Italy. The context of deposition of the beads, classified according to their provenance and forming technique, provides a chronology to the different variants attested in the cemetery (Fig. 10, Table 1). All the wound beads can be identified as European products made from recycled glass, using a simple forming technology. The archaeological evidence for bead-making in early medieval Europe supports this interpretation. The popularity of wound beads is reflected by their presence at Campo Marchione in all the burials containing beads, both in the first and in the second Phases. Both segmentation and mosaic-glass are complex techniques deeply rooted in the Egyptian tradition and both HIMT and Foy 2.1 glass are most likely Egyptian. It is therefore feasible to conclude that mosaic and drawn-segmented beads were Egyptian imports, made with new glass and coloured according to the contemporary technological customs. Mosaic beads are attested only in burials of the first Phase (Table 1) and are associated with prestigious objects. These include the only golden jewels of the whole cemetery (T 152), brooches with set garnets (T 87, 152) and the only burial with a goblet (T 97), a vessel-type considered an index of prestige (Roffia 2010). The chronological limit for Egyptian mosaic beads at Campo Marchione is set at the end of the sixth century. Egyptian imports appear to continue during the first half of the seventh century, in the form of beads in four burials of the second Phase (T 123, 183, 195, 209), but with a possible change in the dynamics of distribution of Egyptian products. The effects of this change can be observed by considering the provenance of the beads manufactured with the complex technique involving drawing, cold-cutting and hot polishing. According to their base glass composition, the three drawn, cold-cut and hot-polished beads can be assigned to two different provenances. The two soda-silica-alumina beads deposited in one first Phase grave (T 104) are Asian, presumably from South India or Sri Lanka and were deposited in association with Egyptian mosaic and possibly Asian stone beads (one agate and one beryl). This unique assemblage of Asian and Egyptian imports may provide further support to Egypt's role in the trade in and distribution of Asian products (Wood 2015). The lack of Asian beads in the second Phase is in line with the chronology assigned to Asian beads in Merovingian cemeteries (Pion and Gratuze 2016) and Indian garnets in Migration-period jewellery (Calligaro

and Perin 2013). These data require further investigation, but are likely to represent an interruption in the supply of exotic products to Egypt through the Red Sea. The provenance for the plant-ash drawn, cold-cut and hot-polished bead deposited in one grave of the second Phase (T195) remains uncertain, due to the lack of archaeological evidence for bead-making in Mesopotamia. Beads of the same type and comparable composition were previously documented in Italy, in seventh-century graves at Trezzo sull'Adda, and interpreted as Roman reused beads (Verità 2012). Since the drawing, cold-cut and hot-polishing process was not practised in the Roman Mediterranean, and a substantial number of drawn cold-cut Mesopotamian beads was found in tenth-century Albania (Neri *et al*. 2018), this bead is most certainly medieval, possibly manufactured in Mesopotamia. Finally, both beads of the third Phase are reused Roman pieces, one glass bead (LEMA 01, T18) and one faience melon bead (T 224, not analysed). This supports the identification of the two beads as objects charged with prophylactic value (Sherlock 2016).

CONCLUSION

Our study can be considered a first step towards an economic interpretation of glass beads in Migration-period Italy. The typological correspondence with beads from other European regions suggests a common European trade. This international exchange may very well include an element of a non-monetary economy (Skre 2008), and the use of glass beads as currency. Despite the lack of archaeological evidence in this respect, the modern era offers countless parallels (Pallaver 2009). Not surprisingly, the quantitative data observed for beads at Campo Marchione differ from other published European evidence, highlighting the differences between an average community and the high-rank burial sites traditionally focussed on by scholars.

The direct relation between the technological complexity of beads and the distances covered in their trafficking is a new element in the understanding of the phenomenon of long-distance trade in medieval Europe. The dynamics of circulations of exotic products are still little investigated, but Egypt seems to have played a key-role as centre of both production and distribution of luxury items. The identification of Asian beads in Italy points to a commercial model comparable to the one postulated for Belgium, with glass beads accompanying garnets and other precious stones from Asia (Pion and Gratuze 2016).

Interestingly, after the Arab conquest of Mesopotamia, Mesopotamian plant-ash mosaic and drawn cold-cut beads appear on the Mediterranean market (Neri *et al*. 2018). These beads might represent a new Mesopotamian bead industry, where forming technologies like mosaic and drawing had been introduced, thanks to the movement of artisans. The mosaic technique was likely imported from Egypt, but the arrival of drawing and cold-cutting is more difficult to explain. It is hard to imagine that the hollow canes were manufactured in Mesopotamia following the adoption of the *lada* method, which requires a peculiar type of furnace that has never been documented either in Mesopotamia or in the Mediterranean. More likely, the process of making cold-cut, hot-polished beads was imported from Asia and adapted to the Mediterranean tradition, specifically that of the Egyptian-segmentation technique and possibly by forming the hollow canes by blowing. Intriguingly, drawn cold-cut and hot-polished beads made exactly in this way will appear in Venice at the end of the twelfth century (Bettoni 2017, 55–8, with previous references). This specialized production, protected and regulated by a strict legislation (Bettoni 2017, 81–6) might represent a relic and the final end of a technological transfer started five centuries earlier.

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(CB, NS, BG) IRAMAT-CEB, UMR5060, CNRS/université d'Orléans, 3D, rue de la Férollerie 45071, Orléanscedex 2FRANCE
(Corresponding author) E-mail: cristina.boschetti@cnrs-orleans.fr

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

Table S1. Average LA-ICP-MS data of glass standards in comparison with published values for Corning standards A, B, C, D and NIST 612

Table S2 LA-ICP-MS data of the Campo Marchione samples. Major and minor oxides [wt %], including chlorine, and trace elements [ppm]; n.i. not identified