Archaeological and Anthropological Sciences (2023) 15:22
https://doi.org/10.1007/s12520-023-01723-6

BRIEF REPORT

Personal adornments in West-Central Africa—the case study of a talc bead from the Kongo Kingdom (Mbanza Kongo, Angola)

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Received: 26 October 2022 / Accepted: 27 January 2023

Abstract
A mustard-gold-colored talc bead was recovered during the 2014 excavation campaign carried out in Lumbu (Mbanza Kongo, Angola) together with the nineteenth-century glass trade beads imported from Bohemia and Venice. Results from this multi-analytical and minimally invasive study suggest that this bead may have been brought to the kingdom's capital by means of an established intra-kingdom trade network or as an offering intended for the king or a member of the nobility. However, it was undoubtedly manufactured within the Kongo kingdom using talc sources known by the local population. As such, this talc bead constitutes the first evidence of local production of personal adornment objects in the Kongo kingdom and one of the first examples of craft specialization for personal adornment purposes in central and southern Africa since pre-historic times.

Keywords Talc bead · Personal adornment · Kongo kingdom · Trace elements · LA-ICP-MS

Introduction

Considered to be one of the hallmarks of modern humanity, the use of personal adornments has been widespread since at least 40 ka BP (Conard 2005). In all human societies, personal adornments are symbolic items, used to convey an individual's beliefs, gender, personal preferences, affiliation or kinship, and social-economic status (White and Beaudry 2009; Mattson 2021). The symbolism associated with the use of such objects may be recognized only by the user and by the group or community members to which the owner belongs and is important in the reconstruction of individual,

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regional, and national cultural and social identity (White and Beaudry 2009).

Pre-historic personal adornments were generally made of bone, teeth, stone, carved ivory, and perforated and/or decorated shells. Early evidences for the use of personal adornments were found in the Near East and North and sub-Saharan Africa, dating to around 82 ka BP (D'Errico et al. 2009). In all three regions, perforated marine shells from different species were found along with evidences pointing towards a conscious collection, transport, and modification of these objects (D'Errico et al. 2009). The shells recovered during the excavations carried out in the Blombos Cave (South Africa) exhibit, for instance, use-wear signs that are indicative of having been stung as beads and worn but may also have been painted using ochre as demonstrated by the presence of red pigments inside a number of shells (d'Errico et al. 2005; D'Errico and Vanhaeren 2009; Vanhaeren et al. 2013; Hatton et al. 2020). However, evidences from archaeological sites attributed to the Aterian culture and dating between 130 and 40 ka BP may correspond to the earliest use of personal adornment objects (McBrearty and Brooks 2000). The artifacts found in these contexts include not only shells, but also stone and bone pendants (McBrearty and Brooks 2000).

While there seems to be no evidences of the use of personal adornments between ca. 70 ka and 40 ka BP, by 40 ka BP, this practice had spread to all continents, excluding the Americas and Antarctica (D'Errico and Vanhaeren 2009; D'Errico et al. 2009). In Africa, ostrich eggshell beads seem to have taken a central role as personal adornment objects since their first appearance around 50 to 40 ka BP (Stewart et al. 2020). Found throughout Africa in Middle Stone Age (MSA) and Late Stone Age (LSA) contexts, recent studies point towards these beads having been exchanged as commodities, at least on a regional scale, in southern Africa (Stewart et al. 2020).

Testaments of the use of stone in the manufacture of personal adornment objects in sub-Saharan Africa, on the other hand, seem to be somewhat scarce even in modern times. While bored stones are widely found in southern African LSA archaeological sites, their use as adornment objects does not appear to be consensual, with interpretations ranging from weights for digging sticks to "arm-rings" (despite no satisfactory evidence for such a use) (Lombard 2002). Bored stones have also been reported in Pastoral Neolithic sites in West Kilimanjaro dated between the 4th millennium BP and the first millennium (Mturi 1986).

Semi-precious stone adornment pieces found in both East and West Africa are generally considered to be evidences of trans-Saharan, European, or Indian Ocean trade (Chami et al. 2002; Gijanto 2011), which may have been in place as early as the middle of the 1st millennium BC in East Africa (Chami et al. 2002). However, local or regional production should not be excluded, as evidenced by the extraction of jasper intended for bead production in Niger and reported by Posnansky (1981). Local and regional sources may also account for the stone and mineral beads found in the monumental cemeteries or "pillar sites" built by East Africa's first herders around 5000 to 4000 cal. BP near Lake Turkana (Hildebrand et al. 2018; Sawchuk et al. 2019) and for the stone beads found in the Neolithic Njoro River Cave site (Wandibba 1988), both in Kenya.

Despite the fact that talc is fairly common in Africa (e.g., Noack et al. 1989; Schlüter 2008), its use in the manufacture of personal adornment objects has rarely been reported in African archaeological contexts. Talc-schist, steatite, soapstone, or other talcose rocks are considered soft stones as they can be easily carved, drilled, and polished (Ige and Swanson 2008; Baron et al. 2016; Mini et al. 2016; Nitsche et al. 2022). The mineral talc, a crystalline hydrated magnesium phyllosilicate ($Mg_3Si_4O_{10}(OH)_2$), is the softest known mineral with a Mohs hardness of 1 out of 10 (Deer et al. 2013; Mini et al. 2016). Its color varies greatly from white to green, according to minor cation substitutions—i.e., the presence of Fe, Al, Ni, Mn, Cr, and Ti occupying different positions within the crystalline structure (Deer et al. 2013; Baron et al. 2016). However, while the physical and chemical properties of a talc source, such as color and purity, depend on the geological process from which it originated, its hardness can ultimately be modified by heating. According to Kenoyer (2003), by heating talc-schist or soapstone, its hardness can increase from 3 to 5 on the Mohs scale. When heated at temperatures ≥ 800 °C, talc suffers dehydroxylation and enstatite phases, and cristobalite or amorphous silica are formed (Deer et al. 2013; Mini et al. 2016; Baehre et al. 2019). At high temperatures, above 1000 °C, protoenstatite is formed instead of enstatite, also referred to as orthoenstatite (Baehre et al. 2019). The formation of enstatite can increase the hardness of steatite to 7 on the Mohs scale (Bar-Yosef Mayer et al. 2004). Moreover, the hardness of talcose rocks may also be higher than 1 on the Mohs scale due to the presence of accessory mineral phases (Vavro et al. 2015).

Talc, possibly collected with the intention to produce beads, has been found in the Iron Age stone-walled site of Thaba ya Batswana (Johannesburg, South Africa) (Mason 2002), while seemingly locally sourced micaceous talc-schist appears to have been used to produce beads and pendants found in the Early Iron Age Wosi site (KwaZulu-Natal, South Africa) (van Schalkwyk 1994). Talc (or soapstone, a talc-schist) was also used by the East Africa's first herders to produce beads and pendants (Hildebrand et al. 2018; Sawchuk et al. 2019). Outside Africa, the use of talc in the manufacture of personal adornments is also mostly limited to pre-history. Talc seems to have been used by Neolithic communities of the Near East as evidenced by the talc-schist ring beads found in Çatalhöyük (central Turkey) (Wright 2012) and the talc butterfly beads found in Abu Hureyra, Tell Aswad, Dja'de el-Mughara, and Tell Halula (Syria) (Alarashi 2016). Steatite beads have also been found in a Chalcolithic burial cave in Israel (Bar-Yosef Mayer et al. 2004). Disk-shaped talc beads were also found in the Arch Lake human burial site (eastern New Mexico, USA) dated to ca. 10.000 BP (Owsley et al. 2010), and talc beads and pendants, as well as evidences of their manufacture, have also been found in several Paleolithic Aurignacian sites in France (White 2007; White and Normand 2015). First Nations's groups also used steatite to produce beads and other objects since precontact times (Baron et al. 2016; Jones et al. 2018). Steatite objects are most commonly found in Iroquian sites in Eastern North America dating between the fifteenth and the sixteenth century (Jones et al. 2018). Talc bead production has been reported in the Indus Valley from the 5th millennium BC to the beginning of the 2nd millennium BC, but this traditional industry was still in place in modern times in Pakistan (Vidale 1995).

This study focuses on the chemical and mineralogical characterization of a broken mustard-gold-colored stone bead uncovered during the 2014 excavation campaign carried out in Lumbu (6° 15′ 55.61″ S, 14° 15′ 5.78″ E), an archaeological site in Mbanza Kongo (Angola), the capital of the Kongo kingdom. The Kongo kingdom, which at its height extended from northern Angola to te western Democratic Republic of the Congo, was an independent state between the thirteenth and the nineteenth century A.D. (Thornton 2001, 2018). The Kongo kingdom was characterized by a strong social stratification and a high degree of centralization even before the first contact with the Portuguese in 1483 (Thornton 2018). This contact had a significant impact on the Kongolese society, and the Portuguese were responsible for the introduction of Christianity, of several technological developments, and of various European products (Radulet 1992). The existing trade network based on specialized indigenous products was, therefore, supplemented by long-distance transatlantic trade (Tsoupra et al. 2022). The kingdom's capital, Mbanza Kongo, which appears to have been founded in the mid-fourteenth century based on archaeological finds (Clist et al. 2015) and is considered to be the oldest continuously occupied large settlement (*Mbanza* in Kikongo) in West Central Africa (Thornton 1977, 2000, 2018), was classified as a UNESCO World Heritage Site in 2017 (Costa et al. 2019c). Lumbu is thought to have been either the king's residence (Maret 2002) or a large courtyard used as the court of justice, where the king would resolve disputes and, simultaneously, a place to assemble for traditional and solemn ceremonies (Domingos 2013). The 3-month excavation campaign carried out in 2014 revealed evidence of a dry-stone building structure composed of irregularly cut blocks unevenly arranged causing the walls to have an irregular thickness (Clist et al. 2015). Charcoal finds in different sectors of the site were dated resulting in a two-sigma calibrated age of the context between 1637 and 1950 (Clist et al. 2015). The analysis of a stone bead, found in Lumbu along with five European trade beads (Costa et al. 2020), brings forth new information regarding local production and craft specialization of personal adornment objects in the Kongo kingdom.

Materials and methods

Materials

During the 2014 excavation campaign under the supervision of Sónia da Silva Domingos (CNIC, Angola), Maria da Conceição Lopes (University of Coimbra, Portugal), and Christophe Mbida and Raymond Assombang (University of Yaoundé I, Cameroon), an assortment of beads, locally produced ceramic vessels, Portuguese pottery, and clay pipe fragments were found in Lumbu. From the 53 beads found in Lumbu, almost all were glass beads (Costa et al. 2020). The exception, a broken mustard-gold-colored bead classified as type 44 (Fig. 1), appeared to be made of a softer material and was initially considered to be a clay bead. Type

Fig. 1 Stereomicroscope images of the type 44 bead found in Lumbu (Mbanza Kongo, Angola)

44 is a broken tubular bead with a width of 8.7 mm, a length of 9.0 mm, a maximum thickness of 8.9 mm, and a round perforation with a diameter of 5.6 mm. The unbroken edge is rounded which may be connected to bead-on-bead use wear or wear from stringing (McGloin, under review). Based on morphological features, the type 44 bead resembles that of the tubular monochrome glass-drawn beads known as Ia according to the glass bead classification devised by Kidd and Kidd (2012) and modified by Karklins (2012). This mustard-gold bead was found in stratigraphic unit 6 of survey H17 together with hexagonal blue glass beads (types 26 and 28), which were found to have been imported from Bohemia in the nineteenth century, and with blue and green beads (types 30, 42 and 43; Mbida et al. 2014) produced by the Venetian glass industry (Costa et al. 2020).

Methods

The type 44 bead was initially examined and documented using a Leica M205C stereomicroscope (with a zoom range of 7.8 × to 160 ×) equipped with a DFC295HD photo camera. It was then analyzed using a Hitachi™ S3700N scanning electron microscope coupled to a QUANTAX energy dispersive X-ray spectrometry microanalysis system equipped with a Bruker™ XFlash 5010 SDD EDS Detector®, a Bruker™ Optics SENTERRA dispersive Raman spectrometer coupled with a BX51 Olympus™ microscope, a Bruker™ D8 Discover® micro-X-ray diffraction (μ-XRD), and a CETAC LSX-213 G2 + laser ablation (LA) system coupled to an Agilent™ 8800 Triple Quad inductively coupled plasma mass spectrometer (ICP-MS).

Variable pressure scanning electron microscope coupled with energy dispersive X-ray spectrometry (VP-SEM–EDS), μ-XRD, and micro-Raman spectroscopy measurement conditions and processing followed previous studies (Coccato et al. 2017; Costa et al. 2019b, a, d, 2020, 2021). LA-ICP-MS acquisition conditions, the isotopes analyzed, and their respective dwell time can be found in Costa et al. (2020) along with ICP-MS calibration, performance monitoring, and analysis post-processing procedures.

Results and discussion

Under the stereomicroscope, the broken mustard-gold-colored bead classified as type 44 revealed a fine granular texture with the occasional presence of white and black or dark brown mineral inclusions (Fig. 1). The softness of the type 44 bead can be easily observed given the large number of scratches clearly visible under the stereomicroscope (Fig. 1). In fact, based on accidental scratching with fingernails during the bead's manipulation, its hardness is estimated to be about 2.5 on the Mohs scale, which could suggest heat treatment was employed in its production (Wright 2012). However, as previously mentioned, the presence of accessory mineral phases may increase the hardness of talcose rocks (Vavro et al. 2015).

Micro-XRD and micro-Raman spectroscopy were used in order to quickly access the composition of the type 44 bead. XRD is considered, by many authors, to be the fastest, cheapest, and most reliable technique for the identification of crystalline phases in all types of materials, including metals, ceramics, and pigments (Artioli 2010). However, difficulties can arise when using XRD to differentiate between minerals included in the pyrophyllite-talc group (Zelazny et al. 2018). As seen in Fig. 2, both μ-XRD and micro-Raman spectroscopy indicate that the type 44 bead is composed almost exclusively of talc, with minor amounts of quartz. The Raman bands at 113, 194, 228, 290, 361, 432, 468, 677, and 1051 cm^{-1} are indicative of talc, with the < 250 cm^{-1} bands reflecting the rigid translation and rotation of this phyllosilicate's TOT (tetrahedra-octahedra-tetrahedra) modules, while the bands between 250 and 650 cm^{-1} can be attributed to the lattice modes of the Mg-O bonds and tetrahedral bending, and the bending and stretching modes of the siloxane bands can explain the 677 cm^{-1} band, as well as those above 1000 cm^{-1} (Reynard et al. 2015). The presence of a band at 464 cm^{-1} attributed to quartz (Frezzotti et al. 2012) in

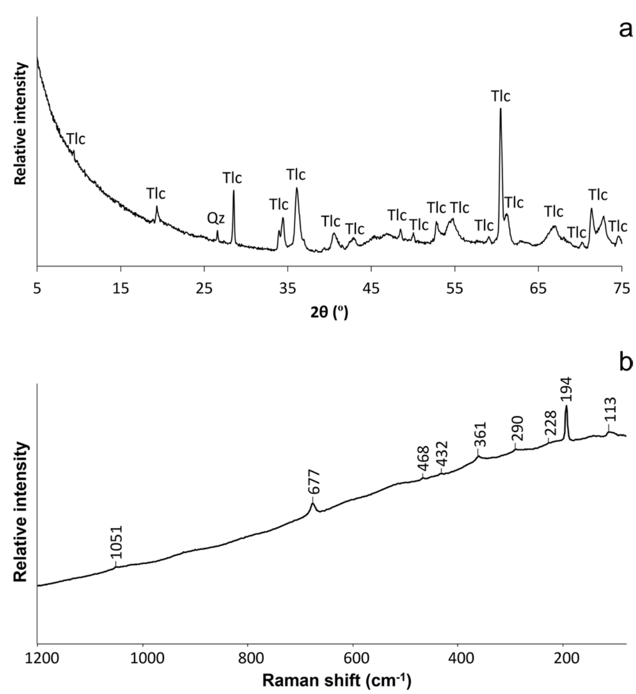

Fig. 2 Results of the μ-XRD and micro-Raman spectroscopy analysis of the type 44 bead found in Lumbu (Mbanza Kongo, Angola). **a** diffractogram identifying talc (Tlc) and quartz (Qz) as main constituents. **b** Raman spectra with marked Raman bands that are attributable to talc

only one of the Raman spectra acquired (data not shown), confirms the results from μ-XRD.

The fine-grained structure of the type 44 bead was once again observed by VP-SEM–EDS along with its occasional heterogeneous composition and lack of discernible foliation. While magnesium silicate (talc) platy grains, occasionally slightly bended or folded and with a maximum size of 10 μm, dominate the micro-structure of the bead (Fig. 3a), several mineral inclusions with sizes ranging from less than 5 to 30 μm can also be observed. These mineral inclusions are generally composed of zirconium (most likely zircon) and iron or iron and titanium, suggesting both Fe and Fe-Ti oxides such as ilmenite are present (Fig. 3 b and c).

The results obtained by LA-ICP-MS can be found in Table 1. Trace elements and rare earth element (REE) patterns, in particular, have been used to distinguish hydrothermal from non-hydrothermal Mg-phyllosilicates (Cai et al. 2019), but also do distinguish and differentiate talc deriving from ultramafic rocks from talc associated with carbonate rocks (Baron et al. 2016). Mg-phyllosilicates which precipitate from seawater enriched in silica maintain the signature of the seawater, and therefore, their REE patterns are characterized by an enrichment of heavy REE when compared to light REE, negative Ce-anomalies and positive La-anomalies; while hydrothermal Mg-phyllosilicates present an inverted "U" shaped REE pattern and high-Eu anomalies (Cai et al. 2019). On the other hand, talc deriving from ultramafic rocks are enriched in metals such as Cr and Ni, with the latter two occurring in concentrations around 2000 ppm, while talc associated with carbonate rocks has low Cr and Ni values (Baron et al. 2016).

As seen in Fig. 4, the PAAS-normalized REE pattern of the type 44 talc bead displays an enrichment in heavy REE, a strong negative Ce-anomaly (Ce/Ce* = 0.1), and a positive La-anomaly (La/La* = 1.3–1.5). As previously mentioned, these characteristics are indicative of Mg-phyllosilicates which precipitated from seawater. The slightly jagged appearance of the medium and heavy REE seen in Fig. 4 can be either the combined effect of the low abundance of these elements and the short dwell times used during the LA-ICP-MS analysis (Baldwin et al. 2011) or the result of detrital input, as REE patterns of palustrine, alluvial, and mudflat Mg-phyllosilicates exhibit this feature (Cai et al. 2019). Moreover, the average boron value of 5.48 (±0.79) ppm detected in the type 44 bead (Table 1) is consistent with the boron average concentration in seawater. The boron concentration in the type 44 bead, along with the low Cr and Ni values (< 10 ppm; Table 1), also suggests a source deriving from carbonate rocks (Baron et al. 2016). The correlation between Zr, Hf, and Th and the total REE concentration (Fig. 5) confirms the occurrence of a small detrital contribution, likely below 2% given the similarities of the REE patterns of the type 44 bead and that of seawater (Cai et al. 2019).

Insights into the possible provenance of the type 44 bead raw material

Mbanza Kongo lies on the geological unit known as the Schisto-Calcaire sub-group. Dated to ca. 575 to 550 Ma

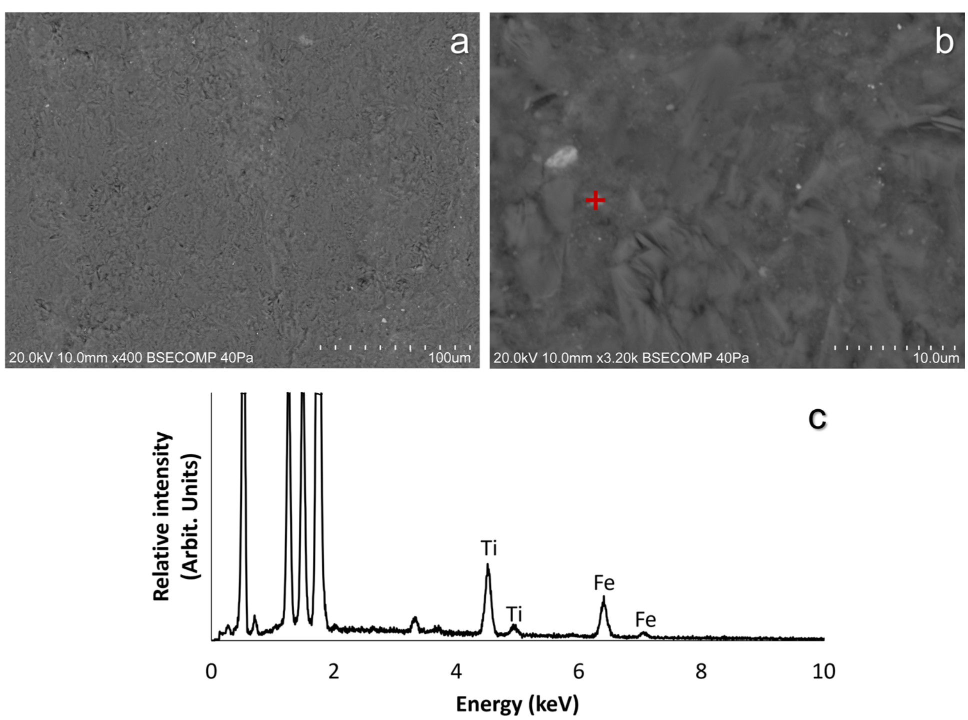

Fig. 3 **a** VP-SEM image showing the heterogeneous granular nature of the type 44 bead. VP-SEM image (**b**) and respective point measurement (**c**) of an ilmenite inclusion

Table 1 Chemical analyses of major and minor elements (oxides wt.%) and trace elements (ppm) obtained by LA-ICP-MS in the 3 distinct locations analyzed

	Type 44		
	01	02	03
wt.%			
Na_2O	0.16	0.16	0.16
MgO	37.11	38.19	38.68
Al_2O_3	1.38	1.26	1.08
SiO_2	60.64	59.87	59.54
K_2O	0.28	0.27	0.29
FeO	0.27	0.16	0.15
ppm			
B	6.09	5.76	4.58
P	75.02	48.72	46.71
Ca	203.86	222.08	231.11
Sc	3.07	2.89	2.50
Ti	546.21	238.48	215.36
V	38.97	33.93	27.81
Cr	7.16	6.88	5.52
Mn	24.37	12.69	10.91
Co	0.56	0.38	0.29
Ni	3.00	3.41	2.75
Cu	4.65	3.36	4.77
Zn	21.53	19.02	23.01
As	1.61	<D.L	<D.L
Rb	13.02	12.55	12.28
Sr	1.09	1.01	1.04
Y	18.33	18.72	8.20
Zr	6.34	6.59	2.65
Nb	1.50	1.23	0.46
Ag	0.05	0.06	0.07
Sn	0.65	0.57	0.50
Sb	0.12	<D.L	<D.L
Cs	0.48	0.46	0.35
Ba	7.37	7.61	3.27
La	5.21	3.76	2.22
Ce	1.33	0.95	0.64
Pr	1.87	1.29	0.84
Nd	9.49	6.77	4.69
Sm	2.39	1.76	0.99
Eu	0.61	0.45	0.25
Gd	3.22	2.68	1.46
Tb	0.48	0.37	0.20
Dy	3.29	2.54	1.30
Ho	0.72	0.60	0.34
Er	2.29	1.87	0.91
Tm	0.28	0.25	0.12
Yb	1.79	1.69	0.92
Lu	0.30	0.26	0.12
Hf	0.19	0.15	0.08
Ta	0.12	0.08	0.04
Au	0.10	<D.L	<D.L
Pb	6.79	6.93	14.53
Bi	0.03	0.02	0.03
Th	1.52	0.69	0.37
U	0.49	0.45	0.24

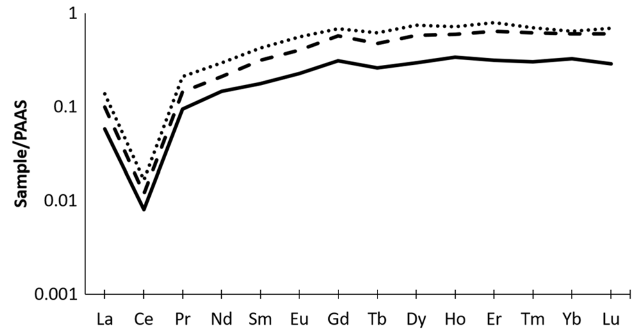

Fig. 4 PAAS-normalized REE pattern of the three measurements performed on the type 44 bead found in Lumbu (Mbanza Kongo, Angola). Significant Ce anomaly should be noted

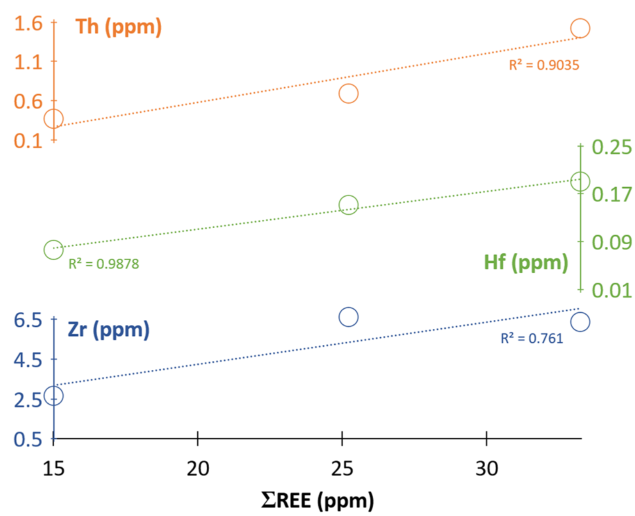

Fig. 5 Th-, Hf-, and Zr-ΣREE concentrations of the three measurements performed on the type 44 bead found in Lumbu (Mbanza Kongo, Angola). The positive correlation between the total REE concentration and that of Th, Hf, and Zr should be noted

(post-Marinoan, Neoproterozoic) (Cailteux et al. 2015), this sub-group consists of limestones, dolostones, siltstones, and shales with rare intercalations of sandstones, cherts, and evaporites (Cailteux et al. 2015; Affaton et al. 2016). The Schisto-Calcaire sub-group also contains two types of talc deposits: (1) talc occurring as oolites (and possibly minor veins) in centimeter-thick silica-rich layers within dolomite, the most important of which is the so-called "Pseudo-Oolithe de Kisantu", and (2) an authigenic hydrothermal talc associated with Cu and Pb–Zn mineralization (Noack et al. 1989). The lithologies present within the "Pseudo-Oolithe de Kisantu" geological sequence are indicative of sedimentation in shallow marine and lagoonal environments (Noack et al. 1989; Cailteux et al. 2015). However, the oolitic talc appears to have been formed by a diagenetic low-temperature process that allowed the recrystallization of Mg-clays (Noack et al. 1989).

The low Cr and Ni values (< 10 ppm) of the type 44 bead exclude the authigenic hydrothermal talc associated with Cu and Pb–Zn mineralization of the Schisto-Calcaire sub-group as a possible source of the raw material used in the production of this bead, as well as the ultramafic hosted talc schist deposits located within the Schist Belt of Nigeria (Noack et al. 1989; Ige and Swanson 2008; Olobaniyi and Mücke 2011). On the other hand, the REE patterns (Fig. 4) and the average boron concentration of the type 44 bead, which are consistent with seawater, may suggest the formation of Mg-phyllosilicates in the shallow marine environments that are thought to have originated the "Pseudo-Oolithe de Kisantu" sequence. However, it must be pointed out that the Noack et al. reports that the talc spheroids of the "Pseudo- Oolithe de Kisantu" have very low aluminum and iron contents (Al_2O_3 and FeO < 0.05%), much lower than the values determined for the type 44 bead and reported in Table 1. A previous study by Guenot, on the other hand, reporting the chemical and mineralogical characterization of a mixed layer talc-saponite from the Bangu unit, which includes the "Pseudo-Oolithe de Kisantu," presents much higher aluminum values (Guenot 1970). It is therefore clear that further field studies are needed to better characterize the diagenetic talcose sources of the Schisto-Calcaire sub-group.

Facies corresponding to the Bangu unit can be found in the Democratic Republic of the Congo, in the vicinity of the Congo River near Luozi, but also near Inkisi and Kisantu and in the southeast near the border with Angola (Cailteux et al. 2015). While the Schisto-Calcaire sub-group dominates a large section of northern Angola, including the area surrounding Mbanza Kongo, the units in this region have not yet been differentiated (Cailteux et al. 2015) making it difficult to identify outcrops that could have been used as raw materials in the production of the type 44 bead recovered in Lumbu. The identification of a manganoan ilmenite (Figure S1—supplementary information), a mineral used as an indicator for potential diamond-bearing kimberlites (Kaminsky and Belousova 2009), may limit the production location to regions in which kimberlite dykes cut the rocks from the Schisto-Calcaire sub-group, as in the Bas-Congo Kimpangu Kimberlite Field (de Wit and Jelsma 2015). However, given the uniqueness of this find in approximately thirty iron and iron–titanium oxides analyzed by VP-SEM–EDS, the use of other talc sources appears to be more credible. Moreover, the recent study of pottery produced in the Kongo kingdom (Tsoupra et al. 2022) suggests that talc sources were well-known and exploited by locals even before the first contact with Portuguese merchants in 1483. In fact, this study showed that talc-rich pottery seems to have been locally produced in the provinces of Nsundi, Mbata, and Mpemba, the latter being home to the kingdom's capital (Tsoupra et al. 2022). It is also important to highlight that prestigious objects manufactured from talcose rocks have additionally been found in other African contexts that are contemporary of the Kongo kingdom, such as the tripod cooking pots of the Rasikajy (Madagascar) produced by specialized craftsman using regional sources (Nitsche et al. 2022); the soapstone statues of Esie (southwestern Nigeria), likely carved from local ultramafic rocks (Ige and Swanson 2008); and the soapstone birds and decorated bowls of Great Zimbabwe (southeaster Zimbabwe) found in the vicinity of evidences of local stone-working (Chirikure and Pikirayi 2008).

Conclusions

The talc bead studied appears to be the first evidence of local production of personal adornment objects in the Kongo kingdom and one of the first examples of craft specialization for personal adornment purposes in central and southern Africa since pre-historic times.

This bead, recovered during the 2014 excavation campaign carried out in Lumbu (Mbanza Kongo, Angola) and found together with imported glass trade beads, was analyzed using a multi-analytical minimally invasive methodology, including stereomicroscopy, micro-X-ray diffraction (μ-XRD), micro-Raman spectroscopy, variable pressure scanning electron microscope coupled with energy dispersive X-ray spectrometry (VP-SEM–EDS), and laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). Results indicate that this bead was manufactured within the Kongo kingdom using talc sources known by the local population. A heat treatment may have been applied to increase the hardness of the bead, but the possibility of an increased hardness due to the presence of accessory mineral phases in the raw material source cannot be excluded. Given the presence of talc-rich outcrops throughout the Kongo kingdom, it is not possible to unequivocally determine if this mustard-gold-colored bead was brought to the kingdom's capital by means of an established intra-kingdom trade network or as an offering intended for the king or a member of the nobility. The resemblance between this mustard-gold bead and the tubular monochrome glass-drawn beads produced in Europe and introduced to the Kongo kingdom via the oceanic trade routes since the end of the sixteenth century A.D. should be noted. This suggests that while the knowledge of glass-making was not present in the kingdom, the use of similar adornment objects was incorporated into the fashion practices by the local population.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12520-023-01723-6.

Acknowledgements This study was conducted with permission from the Angolan Ministry of Culture that holds the rights to the archaeological site of Lumbu. The authors would like to thank the Angolan Government for funding the archaeological excavations carried out in the city of Mbanza Kongo during 2014 and the preliminary archaeological laboratory work conducted in 2015, in the framework of the application for the recognition of Mbanza Kongo as part of the UNESCO World Heritage List. The financial support provided by a Concerted Research Action of Ghent University (B/13340/02) and by the Special Research Fund of Ghent University is also acknowledged. The authors would also like to acknowledge the anonymous reviewers that, due to their insightful comments and suggestions, greatly improved the quality of this manuscript.

Author contribution Conceptualization: M.C., P.B., M.C.L., J.B., M.P.J., S.S.D., P.V., and J.M. Methodology: M.C., P.B., P.V., and J.M. Validation: M.C. and P.B. Investigation: M.C. and P.B. Formal Analysis: M.C. Visualization: M.C. Resources: M.C.L., J.B., M.P.J., S.S.D., and J.M. Project administration: M.P.J., S.S.D., and J.M. Funding Acquisition: M.P.J., S.S.D., P.V., and J.M. Supervision: P.V. and J.M. Writing, original draft: M.C. Writing, review and editing: P.B., P.V., and J.M. All authors reviewed the manuscript.

Funding Open access funding provided by FCT|FCCN (b-on). This study was funded by the Angolan Ministry of Culture; Fundação para a Ciência e para a Tecnologia and by the European Regional Development Fund and the European Social Fund (projects UIDB/04449/2020 and UIDP/04449/2020, and Ph.D. Fellowship SFRH/BD/128889/2017); and by a Concerted Research Action of Ghent University (B/13340/02).

Data availability The data that support the findings of this study, which are not included in the manuscript are available from the corresponding author upon reasonable request.

Code availability Not applicable.

Declarations

Competing interests The authors declare no competing interests.

Ethics approval Not applicable.

Consent to participate Not applicable.

Consent for publication Not applicable.

Conflict of interest The authors declare no competing interests.

References

Affaton P, Kalsbeek F, Boudzoumou F et al (2016) The Pan-African West Congo belt in the Republic of Congo (Congo Brazzaville): stratigraphy of the Mayombe and West Congo Supergroups studied by detrital zircon geochronology. Precambrian Res 272:185–202. https://doi.org/10.1016/j.precamres.2015.10.020

Alarashi H (2016) Butterfly beads in the Neolithic Near East: evolution, technology and socio-cultural implications. Camb Archaeol J 26:493–512. https://doi.org/10.1017/S0959774316000342

Artioli G (2010) Scientific Methods and Cultural Heritage: an introduction to the application of materials science to archaeometry and conservation science. Oxford University Press, Oxford

Baehre O, Kloess G, Raue D et al (2019) From talc to enstatite: archaeometric investigations on an ancient Egyptian whitish bead. Archaeol Anthropol Sci 11:1621–1629. https://doi.org/10.1007/s12520-019-00785-9

Baldwin GJ, Thurston PC, Kamber BS (2011) High-precision rare earth element, nickel, and chromium chemistry of chert microbands prescreened with in-situ analysis. Chem Geol 285:133–143. https://doi.org/10.1016/j.chemgeo.2011.03.019

Baron A, Burke AL, Gratuze B, Chapdelaine C (2016) Characterization and origin of steatite beads made by Northern Iroquoians in the St. Lawrence Valley during the 15th and 16th centuries. J Archaeol Sci Rep 8:323–334. https://doi.org/10.1016/j.jasrep.2016.06.011

Bar-Yosef Mayer DE, Porat N, Gal Z et al (2004) Steatite beads at Peqi'in: long distance trade and pyro-technology during the Chalcolithic of the Levant. J Archaeol Sci 31:493–502. https://doi.org/10.1016/j.jas.2003.10.007

Cai Z, Li J, Chen H et al (2019) Genesis of Mg-phyllosilicate occurrences in the Middle Permian marine successions of South China. Appl Clay Sci 181:105242. https://doi.org/10.1016/j.clay.2019.105242

Cailteux JLH, Delpomdor FRA, Ndobani JPN (2015) The neoproterozoic west-congo "Schisto-Calcaire" sedimentary succession from the bas-congo region (Democratic republic of the Congo) in the frame of regional tentative correlations. Geol Belg 18:126–146

Chami FA, le Guennec-Coppens F, Mery S (2002) East Africa and the Middle East relationship from the first millennium BC to about 1500 AD. J Afr 72:21–37. https://doi.org/10.3406/jafr.2002.1304

Chirikure S, Pikirayi I (2008) Inside and outside the dry stone walls: revisiting the material culture of Great Zimbabwe. Antiquity 82:976–993. https://doi.org/10.1017/S0003598X00097726

Clist B-O, Lopes M da C, Barreira J, et al (2015) Mission d'expertise archéologique: Ville de Mbanza Kongo, République d'Angola, 8–20

Coccato A, Costa M, Rousaki A et al (2017) Micro-Raman spectroscopy and complementary techniques (hXRF, VP-SEM-EDS, μ-FTIR and Py-GC/MS) applied to the study of beads from the Kongo Kingdom (Democratic Republic of the Congo). J Raman Spectrosc 48:1468–1478. https://doi.org/10.1002/jrs.5106

Conard NJ (2005) An overview of the patterns of behavioural change in Africa and Eurasia during the Middle and Late Pleistocene. Wits University Press

Costa M, Arruda AM, Barbosa R et al (2019) A micro-analytical study of the scarabs of the necropolis of Vinha das Caliças (Portugal). Microsc Microanal 25:214–220. https://doi.org/10.1017/S143192761801560X

Costa M, Arruda AM, Dias L et al (2019) The combined use of Raman and micro-X-ray diffraction analysis in the study of archaeological glass beads. J Raman Spectrosc 50:250–261. https://doi.org/10.1002/jrs.5446

Costa M, Barrulas P, Arruda AM et al (2021) An insight into the provenance of the Phoenician-Punic glass beads of the necropolis

of Vinha das Caliças (Beja, Portugal). Archaeol Anthropol Sci 13:149. https://doi.org/10.1007/s12520-021-01390-5
Costa M, Barrulas P, Dias L et al (2019) Multi-analytical approach to the study of the European glass beads found in the tombs of Kulumbimbi (Mbanza Kongo, Angola). Microchemical Journal 149:103990. https://doi.org/10.1016/j.microc.2019.103990
Costa M, Barrulas P, Dias L et al (2020) Determining the provenance of the European glass beads of Lumbu (Mbanza Kongo, Angola). Microchemical Journal 154:104531. https://doi.org/10.1016/j.microc.2019.104531
Costa M, Barrulas P, Dias L et al (2019) Multi-analytical approach to the study of the European glass beads found in the tombs of Kulumbimbi (Mbanza Kongo, Angola). Microchemical Journal 149:103990. https://doi.org/10.1016/j.microc.2019.103990
de Wit MCJ, Jelsma HA (2015) A review of the kimberlites of the Democratic Republic of Congo. Geology and Resource Potential of the Congo Basin. Springer, Berlin Heidelberg, Berlin, Heidelberg, pp 361–369
Deer WA, Howie RA, Zussman J (2013) An introduction to the rock-forming minerals. The Mineralogical Society
d'Errico F, Henshilwood C, Vanhaeren M, van Niekerk K (2005) Nassarius kraussianus shell beads from Blombos Cave: Evidence for symbolic behaviour in the Middle Stone Age. J Hum Evol 48:3–24. https://doi.org/10.1016/j.jhevol.2004.09.002
D'Errico F, Vanhaeren M (2009) Earliest personal ornaments and their significance for the origin of language debate. In: Botha R, Knight C (eds) The Cradle of Human Language. Oxford University Press, Oxford, UK, pp 16–40
D'Errico F, Vanhaeren M, Henshilwood C, et al (2009) From the origin of language to the diversification of languages: what can archaeology and palaeoanthropology say? In: D'Errico F, Hombert J-M (eds) Becoming Eloquent: Advances in the emergence of language, human cognition, and modern cultures. John Benjamins Publishing Company, pp 13–68
Domingos Z (2013) Preservação e Valorização do Património Arqueológico Angolano no Contexto Nacional e Mundial: Caso do Sítio de Mbanza Kongo (Candidato a Património da Humanidade). Tecnologia e Ambiente 19:262–275
Frezzotti ML, Tecce F, Casagli A (2012) Raman spectroscopy for fluid inclusion analysis. J Geochem Explor 112:1–20. https://doi.org/10.1016/j.gexplo.2011.09.009
Gijanto L (2011) Personal adornment and expressions of status: beads and the Gambia river's Atlantic Trade. Int J Hist Archaeol 15:637–668. https://doi.org/10.1007/s10761-011-0162-x
Guenot B (1970) Etude d'un minéral argileux de type interstratifié talc-saponite trouvé dans le Précambrien du Congo-Kinshasa. Bulletin Du Groupe Français Des Argiles 22:97–104. https://doi.org/10.3406/argil.1970.1123
Hatton A, Schoville BJ, Wilkins J (2020) A quantitative analysis of wear distributions on Middle Stone Age marine shell beads from Blombos Cave. South Africa. J Archaeol Sci Rep 29:102137. https://doi.org/10.1016/j.jasrep.2019.102137
Hildebrand EA, Grillo KM, Sawchuk EA et al (2018) A monumental cemetery built by eastern Africa's first herders near Lake Turkana, Kenya. Proc Natl Acad Sci U S A 115:8942–8947. https://doi.org/10.1073/pnas.1721975115
Ige OA, Swanson SE (2008) Provenance studies of Esie sculptural soapstone from southwestern Nigeria. J Archaeol Sci 35:1553–1565. https://doi.org/10.1016/j.jas.2007.11.001
Jones TW, Birch J, Williamson RF et al (2018) Steatite characterization using X-ray fluorescence and insights into Northern Iroquoian interregional interaction. J Archaeol Sci Rep 20:506–515. https://doi.org/10.1016/j.jasrep.2018.05.018
Kaminsky FV, Belousova EA (2009) Manganoan ilmenite as kimberlite/diamond indicator mineral. Russian Geology and Geophysics 50:1212–1220. https://doi.org/10.1016/j.rgg.2009.11.019
Karklins K (2012) Guide to the Description and Classification of Glass Beads Found in the Americas. BEADS: Journal of the Society of Bead Researchers 24:62–90
Kenoyer JM (2003) Stone beads and pendant making techniques. In: A Bead Timeline. VOLUME I: Prehistory to 1200 CE. A Resource for Identification, Classification and Dating. pp 14–19
Kidd KE, Kidd MA (2012) A classification system for glass beads for the use of field archaeologists. BEADS: Journal of the Society of Bead Researchers 24:39–61
Lombard M (2002) Bored stones lithic rings and the concept of Bored stones, lithic rings and the concept of holes in San Shamanism. Anthropology South Africa 25:18–27
Maret P de (2002) Urban origins in central Africa: the case of Kongo. In: The Development of Urbanism from a Global Perspective. Afrikansk och jämförande arkeologi, Uppsala, pp 1–13
Mason RJ (2002) A Moment in the Past of Thaba ya Batswana
Mattson HV (2021) Personal adornment and the construction of identity: a global archaeological perspective. Oxbow Books, Oxford
Mbida C, Asombang R, Lopes M da C (2014) Rapport de la mission du 11 avril au 8 juillet à Mbanza Kongo
McBrearty S, Brooks AS (2000) The revolution that wasn't: a new interpretation of the origin of modern human behavior. J Hum Evol 39:453–563. https://doi.org/10.1006/jhev.2000.0435
McGloin J (under review). Of beads and burials: a microwear and experimental study of early medieval glass and amber beads from the Merovingian site of Lent-Lentseveld. J Archaeol Sci. McGloin, Jemma, Of beads and burials: a microwear and experimental study of early medieval glass and amber beads from the Merovingian Site of Lent-Lentseveld. Available at SSRN: https://ssrn.com/abstract=3907930
Mini FM, Santi P, Renzulli A et al (2016) Representative archaeological finds of pietra ollare from Comacchio (Italy): identifying provenance and high-T mineral breakdown reactions hindering lithotype classification. Archaeol Anthropol Sci 8:135–148. https://doi.org/10.1007/s12520-014-0220-5
Mturi AA (1986) The Pastoral Neolithic of West Kilimanjaro. Azania: archaeological research in Africa 21:53–63. https://doi.org/10.1080/00672708609511367
Nitsche C, Schreurs G, Serneels V (2022) The enigmatic softstone vessels of Northern Madagascar: petrological investigations of a Medieval Quarry. J Field Archaeol 0:1–18. https://doi.org/10.1080/00934690.2022.2092689
Noack Y, Decarreau A, Boudzoumou F, Trompette R (1989) Low-temperature oolitic talc in Upper Proterozoic rocks, Congo. J Sediment Petrol 59:717–723. https://doi.org/10.1306/212F9057-2B24-11D7-8648000102C1865D
Olobaniyi SB, Mücke A (2011) Chemical composition of chromite and intergrown chlorite in metamorphosed ultramafic rocks (serpentinite and talc schist) of the Egbe-Isanlu schist belt, southwest Nigeria: genetic implications. J Min Geol 47:115–134
Owsley DW, Jodry MA, Stafford TW, et al (2010) Arch lake woman: Physical anthropology and geoarchaeology. Arch Lake Woman: Physical Anthropology and Geoarchaeology 1–93
Posnansky M (1981) The East African coast and its role in maritime trade. In: Mokhtar G (ed) General history of Africa, II: Ancient civilizations of Africa. United Nations Educational, Scientific and Cultural Organization, pp 551–567
Radulet CM (1992) O cronista Rui de Pina e a "Relação do reino do Congo": manuscrito inédito do "Códice Riccardiano 1910." Casa da Moeda
Reynard B, Bezacier L, Caracas R (2015) Serpentines, talc, chlorites, and their high-pressure phase transitions: a Raman spectroscopic study. Phys Chem Miner 42:641–649. https://doi.org/10.1007/s00269-015-0750-0
Sawchuk EA, Pfeiffer S, Klehm CE et al (2019) The bioarchaeology of mid-Holocene pastoralist cemeteries west of Lake Turkana, Kenya.

Archaeol Anthropol Sci 11:6221–6241. https://doi.org/10.1007/s12520-019-00914-4

Schlüter T (2008) Geological Atlas of Africa

Stewart BA, Zhao Y, Mitchell PJ et al (2020) Ostrich eggshell bead strontium isotopes reveal persistent macroscale social networking across late Quaternary southern Africa. Proc Natl Acad Sci U S A 117:6453–6462. https://doi.org/10.1073/pnas.1921037117

Thornton J (2001) The Origins and Early History of the Kingdom of Kongo, c. 1350–1550. Int J Afr Hist Stud 34:89–120

Thornton J (1977) Demography and History in the Kingdom of Kongo, 1550–1750. Cambridge University Press 18:507–530

Thornton JK (2018) The Origins of Kongo: A Revised Vision. In: Bostoen K, Brinkman I (eds) The Kongo Kingdom: The Origins, Dynamics and Cosmopolitan Culture of an African Polity, 1st edn. Cambridge University Press, Cambridge, UK, pp 17–41

Thornton JK (2000) Mbanza Kongo/São Salvador: Kongo's Holy City. In: Anderson D, Rathbone RJAR, Rathbone R (eds) Africa's Urban Past. James Currey Ltd., Oxford, UK, pp 67–84

Tsoupra A, Clist B, da Conceição LM et al (2022) A multi-analytical characterization of fourteenth to eighteenth century pottery from the Kongo kingdom. Central Africa Sci Rep 12:9943. https://doi.org/10.1038/s41598-022-14089-x

van Schalkwyk L (1994) Wosi: an Early Iron Age village in the lower Thukela Basin, Natal. Natal Museum Journal of Humanities 6:65–117

Vanhaeren M, D'Errico F, van Niekerk KL et al (2013) Thinking strings: Additional evidence for personal ornament use in the Middle Stone Age at Blombos Cave, South Africa. J Hum Evol 64:500–517. https://doi.org/10.1016/j.jhevol.2013.02.001

Vavro M, Gajda J, Přikryl R, Siegl P (2015) Soapstone as a locally used and limited sculptural material in remote area of Northern Moravia (Czech Republic). Environ Earth Sci 73:4557–4571. https://doi.org/10.1007/s12665-014-3742-3

Vidale M (1995) Early beadmakers of the Indus tradition: the manufacturing sequence fo talc beads at Mehrgarh in the 5th millennium B.C. East and West 45:45–80

Wandibba S (1988) Prehistoric Beads in Kenya. Kenya Past and Present 17–20

White CL, Beaudry MC (2009) Artifacts and personal identity. International Handbook of Historical Archaeology. Springer, New York, New York, NY, pp 209–225

White R (2007) Systems of personal ornamentation in the Early Upper Palaeolithic: methodological challenges and new observations. Rethinking the Human Revolution: New Beahavioural and Biological Perspectives on the Origin and Dispersal of Modern Humans 287–302

White R, Normand C (2015) Early and Archaic Aurignacian Personal Ornaments from Isturitz Cave: Technological and Regional Perspectives. Palethnologie. https://doi.org/10.4000/palethnologie.789

Wright KI (2012) Beads and the body: ornament technologies of the BACH Area Buildings. In: Last House on the Hill: BACH Area Reports from Catalhoyuk, Turkey. Cotsen Institute of Archaeology Press, pp 423–444

Zelazny LW, Thomas PJ, Lawrence CL (2018) Pyrophyllite-talc minerals. Soil Mineralogy with Environmental Applications 7:415–430. https://doi.org/10.2136/sssabookser7.c13