

Full length article

## An early historic bleach-decorated carnelian bead from Sumhuram (Dhofar, Oman): Personal possession or traded commodity?

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## ARTICLE INFO

## Keywords:

Carnelian beads  
 Arabia  
 South Asia  
 Indian Ocean  
 Trade  
 Cosmopolitan encounters

## ABSTRACT

This paper presents the integrated study of a distinctive bleach-decorated (bleached or etched) carnelian bead (S3074) discovered at the South Arabian port of Sumhuram (Dhofar, Sultanate of Oman), a Hadrami trading outpost active within regional and transoceanic trade networks between 100 BCE and 400 CE. Originating from a technology developed in the Greater Indus Valley during the 3rd millennium BCE, bleached carnelian beads remained markers of long-distance trade in the Early Historic and Medieval periods. Stylistic comparisons and SEM-based drilling diagnostics revealed that the Sumhuram specimen, the first securely identified example of this bead type in South-western Arabia, is consistent with production in north-western India. Its discovery in an urban context rather than a funerary assemblage raises interpretive questions about its circulation and meaning. While it may reflect structured trade flows linking Gujarat with South-eastern Arabia, the possibility that it was the personal possession of a South Asian individual temporarily residing in Sumhuram is equally plausible. This case ultimately exemplifies the entanglement of material culture, mobility, and identity in a cosmopolitan port city. Beyond economic exchange, the bead provides insight into personal histories and cross-cultural interactions across the Western Indian Ocean during the Late Iron Age.

*Every time we create something new, we go from zero to one* — Peter Thiel

### 1. Introduction

Carnelian (originally ‘cornelian’ from Latin ‘cornum’, the cornel cherry, or ‘caro’ meaning ‘flesh’) is a translucent form of chalcedony with a homogeneous translucent colour ranging from amber to reddish-orange and a hardness of 7 on the Mohs scale. Among the varieties of chalcedony, carnelian differs from agate, which is banded, and from jasper, which is opaque, but can sometimes be confused with sard, which is a brownish to brownish-red translucent form of chalcedony (Friedman, 2025; Ralph and Ralph, 2025). Since ancient times, carnelian has often been heat-treated to darken and enhance its colour (Schumann, 2013: 142; Bhan et al., 2017). In antiquity, the most exploited source of carnelian in Eurasia was the deposits around

Ratanpur in south-eastern Gujarat, where nodules are of large size, with almost no cracking and exceptional translucency (Law, 2011: 277–278). Other sources of carnelian occur in northern Gujarat, central and eastern Iran, south-western Afghanistan, south-eastern Uzbekistan, Armenia, Yemen and western Saudi Arabia, the Emirate of Ras Al-Khaimah, and Thailand (Law, 2011: 278–283; Simpson, 2020: 526).

The technique used for decorating carnelian with permanent white designs was introduced by Indus (Harappan) master beadmakers in the second half of the third millennium BCE (Kenoyer, 2020).<sup>1</sup> Indus-style bleached (or etched) carnelian beads were widely valued across Western and Central Asia for their unique stylistic features and the skilled technique required to produce them (Frenez, 2023). They typically exhibit the characteristic orange to dark reddish hue of carnelian, with artificial white lines decorating their surface forming various patterns (Reade, 1979; Prabhakar, 2018; Kenoyer, 2020). Much rarer beads are whitish and decorated with black designs or reddish with black designs,

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<sup>1</sup> Initially misidentified as ‘etched’ due to post-depositional weathering effects (Beck, 1933; Mackay, 1933), these beads are better described as ‘bleached’ or ‘bleach-decorated’, as originally proposed by C. L. Woolley and recently reaffirmed by J. M. Kenoyer (Woolley, 1955: 127, 197; Kenoyer, 2020: 169–170).

<https://doi.org/10.1016/j.ara.2026.100702>

Received 17 August 2025; Received in revised form 25 December 2025; Accepted 28 February 2026

Available online 13 March 2026

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but these possibly result from failure in the heating process (Kenoyer, 2020: 174).

The production of such beads required a complex manufacturing process involving the procurement of specific raw materials and the skilful application of advanced techniques for shaping, polishing, and decorating them (Vidale, 2000: 40–58; Law, 2011: 83–85; Kenoyer, 2017a, 2017b, 2020). Although the genesis of this technique remains obscure, the manufacturing process employed to create artificial white designs on carnelian beads has now been established. Irregular white discolouration exhibited by numerous plain carnelian beads during the third millennium BCE is assumed to have resulted from long burial in alkaline sediments (Kenoyer, 2020, cf. Caux et al., 2018: 215). Ethnographic research has documented that such a phenomenon can also develop during the final heating process used to brighten the beads' red-orange colour (Kenoyer, 2020: 172). Indus craftspeople may have observed this transformation and experimented to produce intentional white patterns on carnelian. However, the analysis of archaeological and experimental beads indicated that the white-looking design on the carnelian surface does not result from actual discolouration of the stone, but from a dense network of very fine pores 0.5 µm in diameter that extend to a depth of 200–300 µm, which deflects light and makes the carnelian appear visually white (Kenoyer, 2020: 170; Holé et al., 2020). This effect was obtained by applying an alkaline solution made from plant ash produced by burning the *khar* shrub (*Salsola stocksi*), mixed in a glue made by boiling the tips of wild caper (*Capparis decidua* or *Capparis aphylla*) or fenugreek (*Trigonella foenum-graecum*) seeds. Once the surface had been painted and the solution dried, the beads were heated for a few minutes between 350 °C and 380 °C (for a summary of the bleaching technique, see Vidale, 2000: 57; Kenoyer, 2020; Holé et al., 2020).

## 2. Diachronic patterns of production, use, and circulation

From their emergence within the Harappan cultural sphere to their later diffusion across large parts of the Indian Ocean world, bleached carnelian beads underwent significant transformations in form, decoration, and social meaning. These changes were neither linear nor uniform, but unfolded through regionally specific trajectories shaped by technological practices, exchange networks, and shifting patterns of use. A diachronic perspective is therefore essential to situate individual regional traditions within a broader comparative framework and to eventually assess in detail the distribution and characteristics of bleached carnelian beads discovered in Southern Arabia.

### 2.1. Bronze age

During the Early Bronze Age (2600–1900 BCE) bleached carnelian beads exhibit a highly standardised morphological and decorative system rooted in the Harappan visual tradition. The principal forms comprise cylindrical, barrel-shaped, spherical, and lentoid and rectangular flattened beads. The decorative repertoire is dominated by linear bands and concentric circles (eye motifs) arranged in single, double, or triple configurations; other patterns include chevrons, figure-of-eight designs, and lattice networks with embedded circles (Dikshit, 1949; Reade, 1979; Prabhakar, 2018; Kenoyer, 2020). Within the Greater Indus Valley, bleached carnelian beads occur primarily in workshop-related assemblages and residential deposits, indicating their local production and use for social status display within the broader urban domestic and public fabric rather than ritual or funerary contexts (Mackay, 1943; Prabhakar, 2018; Kenoyer, 2020). In contrast, across Western and Central Asia, Indus-style bleached beads were found predominantly in higher-status funerary contexts, highlighting their transformation from urban social ornaments into ritualistic markers of elite identity (During Caspers, 1972; Reade, 1979; Possehl, 1996; Kenoyer, 2008; Frenez, 2023).

### 2.2. Iron age and early historic period

The bleaching technique survived the socio-economic and political fragmentation of the Indus Civilization during the early second millennium BCE (Uesugi, 2018). As a result, in the Iron Age and Early Historic period (c. 600 BCE–300 CE), South Asia witnessed a resurgence and expansion in the production and exchange of bleached carnelian beads. While the characteristic constricted cylindrical drills of the Indus phase were replaced by solid copper drills with abrasives, and eventually by diamond drills (Kenoyer, 2017a: 138–148; Uesugi, 2018: 35), the bleaching technology was essentially transferred unaltered (Holé et al., 2020).

In this period, the northern and southern regions of the Subcontinent developed consistently distinctive traditions in bleached bead production but, in most cases, the decoration appears simpler in design and more cursory in execution than in the previous period (Simpson, 2020: 527). The northern tradition displays a markedly expanded morphological and decorative repertoire, reflecting a strong regional diversification of the earlier Harappan tradition (Beck, 1933; Dikshit, 1949; Uesugi, 2018: 175). Dominant bead forms include spherical, cylindrical, barrel-shaped, and oblate types, while the decorative system is characterised primarily by abstract geometric compositions, including pentagonal compartment networks with or without internal dots, parallel lines, grids, cross-based and eye motifs, alongside more cursory curvilinear designs. With the spread of cremation practices, bleached beads continued to occur exclusively in domestic contexts, as in earlier periods, still functioning mainly as ornaments embedded in everyday social life, rather than as ritual or mortuary symbols (Uesugi, 2018: 37).

Moving southwards, bleached beads from late South Megalithic and early Satavahana contexts exhibit a more restrained morphological and decorative system, dominated by spherical, barrel-shaped, and pendant forms (Beck, 1933; Dikshit, 1949; Uesugi, 2018: 175). The decorative grammar favours linear zoning, band-based designs, and zigzag motifs. A particular form of tabular disc and lozenge-shaped beads, characterised by radial marginal tick-mark decoration, has been tentatively interpreted as a formally standardised type with potential exchange-related functions (Kelly, 2017). While in the North beads were mainly tied to visual display and social status in urban environments, in the Southern Megalithic sphere they were structurally embedded in mortuary display and funerary ideology, a pattern that persisted into the Early Historic and Satavahana horizons (Uesugi, 2018: 39).

During this phase, from the core production centres in South Asia, the circulation of bleached carnelian beads expanded over a much wider geographical area, extending from Eastern Africa to Southeast Asia and from the Eurasian steppes to Southern Arabia. From the late first millennium BCE, bleached carnelian beads spread into mainland Southeast Asia, southern China, and island Southeast Asia, marking one of the clearest archaeological signatures of Indian Ocean trade (Glover and Bellina, 2001, 2003). This eastward expansion is characterised by a funerary-centred mode of adoption tied to long-distance circulation networks rather than workshop diffusion. A crucial aspect of this phenomenon is its selective nature. Only a narrow subset of the Indian decorative repertoire spread eastward, dominated by simple eye motifs and banded chevrons, with more complex North Indian geometries and Southern zonal grammars largely absent (Bellina, 2003).

From the mid-first millennium BCE onward, bleached carnelian beads occur sporadically across Iran, Mesopotamia, and the Eurasian steppe, where they appear as rare, high-value objects within elite and funerary contexts. Documented types in these regions consistently include cylindrical, barrel-shaped, lentoid, and spherical beads, decorated with radiating lines, diagonal curvilinear motifs, and banded or compartmented geometric designs deriving from both North and South Indian bead traditions (Simpson, 2020: 532–535). While some particularly large spherical beads from Sasanian contexts exhibit exceptionally fine and original scroll motifs, suggesting local production, the lack of secure workshop evidence indicates that bleached beads mainly

circulated as imported prestige goods, transmitted through long-distance exchange networks linking South Asia, the Iranian plateau, and the Inner Asian steppe, where they were recontextualised within indigenous elite ideologies.

This broader comparative framework provides the necessary context for examining the evidence from Southern Arabia, where bleached carnelian beads are documented within a regionally distinct and articulated archaeological and historical setting.

### 3. Bleached carnelian beads in southern Arabia

Against this wider background of continued long-distance circulation and social valuation, exceptional discoveries from various contexts attest to the importation of bleached carnelian beads also into South-eastern Arabia, encompassing the territories of the United Arab Emirates and northern Oman, from the mid-third millennium BCE onwards (De Waele and Haerinck, 2006). In contrast, prior to the present study, no bleached beads had been reported from South-western Arabia, encompassing the Dhofar Governorate in southern Oman and Yemen.<sup>2</sup>

#### 3.1. Bronze age, c. 2600–1300 BCE

Indus-style bleached carnelian beads have been consistently found at sites in all regions directly linked to Indus external trade, from Mesopotamia to South-eastern Iran and from Afghanistan to the Gulf and South-eastern Arabia (Frenez, 2023: 16–19). From these regions, they were occasionally traded far beyond, as far as the Nile Valley, the Saronic Gulf in the eastern Mediterranean, and the southern Caucasus (Abramishvili, 2010: 171, Fig. 2.5; Grajetzki, 2014: 160–161, Fig. 2; Reinholdt, 2003: 261/166.a).

In South-eastern Arabia, white-on-red bleached carnelian beads have been found at Early Bronze Age sites (2600–2000 BCE) mainly in the Emirates, both inland and along the northern shores, including Tombs I and II at Al-Sufouh (Dubai), Tomb II at Umm an-Nar (Abu Dhabi), Tombs A, B and N at Hili (Abu Dhabi), Tomb B at Mowaihat (Ajman), Tomb Sh 222 at Shimal (Ras Al-Khaimah), and Grave TA 2106 at Tell Abraq (Umm Al-Quwain) (De Waele and Haerinck, 2006: 34–35, table 2). More recently, examples have also emerged in interior Oman from Tomb 401, burial pit A-Inst. 0025, and Tower 1156 at Bat (Ad Dhahirah), and from unknown contexts at Bidbid (Ad Dakhiliyah) (Kenoyer and Frenez, 2018, 2020; cf. Böhme and Al-Sabri, 2011: 149, fig. 22/160; Schmidt and Döpfer, 2014: 209, fig. 11/g; Mortimer, 2016: 142, Fig. 6.37). With the sole exception of the bead from the upper fill deposits of the inner ditch of Tower 1156 at Bat (Mortimer, 2016), all other specimens derive from Umm an-Nar funerary contexts (see also Williams, 2023: table A10).

At present, no bleached carnelian beads are securely documented from primary Middle (Wadi Suq) or Late Bronze Age contexts (2000–1300 BCE) in Southern Arabia. In fact, the few bleached beads reported from Wadi Suq tombs at Qattarah (Abu Dhabi) and Dhayah (Ras Al-Khaimah) derive from funerary structures heavily affected by reuses, and the beads are interpreted as secondary intrusions linked to later PIR-period burials (De Waele and Haerinck, 2006: 35–37). This absence is particularly significant in light of the large bead assemblages documented from Wadi Suq cemeteries (Righetti, 2015: 307), which attest to the continued importance of personal ornamentation in funerary contexts during the second millennium BCE. The available data indicate a clear discontinuity in the circulation of bleached carnelian beads between the Early Bronze Age and the Middle Bronze Age, most probably consequent to the interruption of most trade links with the

Indus region (Frenez, 2019: 29–31).

#### 3.2. Iron age, c. 1300 BCE–CE 500

The evidence for the discovery of bleached carnelian beads in South-eastern Arabia during the Early Iron Age (1300–300 BCE) is limited and discontinuous, and largely derives from isolated or chronologically ambiguous settings, including mixed contexts and later reuses (Yule, 2001: 396, pl. 531/1.6; De Waele and Haerinck, 2006: 36). However, when visual information is available, as in the case of Tomb LCG-1 at Daba Al-Bayah (Musandam) in northern Oman (Genchi, 2013: fig. 63), the bleached beads appear to represent mainly cases of reuse and curation of earlier Indus-style beads. This pattern mirrors the evidence observed in an early 6th-century BCE tomb at Jubaji in the Khuzestan province of western Iran (Simpson, 2020: 534, fig. 13), suggesting a possible episodic re-introduction of curated Indus beads into long-distance exchange networks either locally or in the Indus region.

Approximately thirty bleached carnelian beads have been documented from Late pre-Islamic and Samad Late Iron Age contexts (300 BCE–500 CE), occurring predominantly in funerary structures and only sporadically in domestic assemblages, with a marked concentration at sites along both the inner and southern shores of the United Arab Emirates and rare attestations in the interior of the Sultanate of Oman (Fig. 1).

At Dibba Al-Hisn (Sharjah), a coherent group of six bleached carnelian beads derives from tombs dated to the 1st century CE (Jasim, 2006: 228–229, figs. 62, 63/17–22; for the dating see Jasim, 2006: 234). The assemblage consists exclusively of hemispherical beads, all decorated with stylistically consistent white-on-red geometric motifs combining horizontal and diagonal lines, in several cases associated with dotted elements. In addition to the funerary contexts, nine bleached carnelian beads are documented at Dibba Al-Hisn in rooms within the port settlement (Level III), dated between the late 1st century BCE and the 1st century CE (Jasim and Yousif, 2014: 74, fig. 54/59–60, 69, 71–76; for the dating see Jasim and Yousif, 2014: 50). The assemblage includes a variety of shapes, dominated by large spherical beads, all decorated with white-on-red geometric motifs combining horizontal and diagonal lines, in several cases organised into networks with embedded dots, whereas others feature coarser motifs with wavy lines and arcs. Compared to the funerary assemblage, which shows a restricted typological range in terms of shape but a certain variability in the organisation of the geometric motifs, the settlement material exhibits a broader range of forms and decorative patterns, while remaining fully consistent with the same craft and visual tradition.

Three additional red-on-white bleached carnelian beads have been reported from the Emirate of Sharjah in funerary contexts broadly dated between the 1st and 3rd centuries CE, two from Mleiha (Haerinck et al., 2021: 70, cf. Jasim, 2006: 229) and one from Kalba (De Waele and Haerinck, 2006: 37). Unfortunately, the available published record does not provide specific information on the context or the shape and decorative motifs of these finds.

At Ed-Dur (Umm Al-Quwain), six bleached carnelian beads are documented mainly from funerary contexts broadly dated to the last centuries BCE and the early centuries CE (Haerinck, 2001: pl. 245/3–4; De Waele and Haerinck, 2006: 37, Fig. 5.2/a–f; Haerinck et al., 2021: fig. 51, 52/27–28). In particular, a globular bead decorated with white-on-red dotted circles and dots derives from Tomb 10, a simple pit burial of a child, where it was found strung in a necklace together with stone, glass and shell beads, and a central bronze bell. In addition, two roughly spherical beads decorated with networked dots, one executed in white-on-red and the other in red-on-white, and a teardrop-shaped pendant featuring white-on-red coarse horizontal and oblique lines, were recovered from tombs independently dated to the 2nd and 3rd centuries CE. The assemblage further includes two surface finds, both barrel-shaped beads with white-on-red geometric decoration combining

<sup>2</sup> The present paper adopts the geographical subdivision of Southern Arabia into a South-eastern region, encompassing the United Arab Emirates and northern Oman, and a South-western region, comprising southern Oman and Yemen, proposed by P. Magee (2014: 14–32, Figs. 2.2 and 2.13).



Fig. 1. Map of Southern Arabia showing the Late Iron Age sites mentioned in the text with indication of the presence of bleached carnelian beads (map by the authors on a QGIS platform).

horizontal and oblique lines with dotted elements.

Three other bleached carnelian beads are documented from sites in the Emirate of Ras Al-Khaimah. At Dayah, two specimens derive from Tomb 1, a Wadi Suq funerary structure reused for a secondary PIR burial (De Waele and Haerinck, 2006: 37, Fig. 5.3/a–b). Both the lentoid and the barrel-shaped beads are decorated with cursorily executed red-on-white geometric motifs, featuring respectively crossing lines and circles, and undulating lines and dots. At Wadi Al-Qawr, a single bleached carnelian bead derives from a PIR burial dated to the 1st–2nd centuries CE (Haerinck et al., 2021: 70; De Waele and Haerinck, 2006: 38).

Moving southward, the occurrence of bleached carnelian beads decreases drastically, with only four specimens recovered from tombs in the interior of central Oman. Two have been found at Samad Ash-Shan (Ash Sharqiyah North), including a barrel-shaped bead decorated with white-on-red horizontal lines from Tomb S10718, and a large spherical

bead decorated with a fine white-on-red scroll motif, possibly of Sasanian production, from Tomb S3018 (Yule, 2001: 358, pl. 450; Yule, 2001: 253, pl. 99/2.12; De Waele and Haerinck, 2006: 38, Fig. 5.4/a–b; Yule and Mauro, 2025: Fig. 3.8/j–k). Following a reassessment of the associated grave goods, both tombs are now attributed by the excavators to the Samad Late Iron Age, between 300 BCE and 300 CE (Yule and Mauro, 2025). At Al-Muqatta (Ash Sharqiyah North), two short cylindrical carnelian beads decorated with white-on-red geometric motifs featuring networked dots are documented from Tomb Mu1, an Early Iron Age funerary structure whose burial assemblage attests to reuse in the Samad Late Iron Age (Yule, 2001: 396, pl. 531/1.6; De Waele and Haerinck, 2006: 36, Fig. 5.1/a–b; Yule and Mauro, 2025: Fig. 3.8/l–m).

Despite the existence and exploitation in antiquity of high-quality sources of carnelian in Yemen (Mackay, 1933: 145; Gwinnett and Gorlick, 1991), there is no evidence in the published record for either the

local production or the importation of bleached beads in South-western Arabia, namely Yemen and the Dhofar Governorate of Oman, with the sole exception of the specimen from Sumhuram presented here.

#### 4. The Hadrami port of Sumhuram (Khor Rori, Sultanate of Oman)

The Hadrami (Ancient South Arabian) trading outpost of Sumhuram is located on the eastern bank of Wadi Darbat in the area of Khor Rori (Dhofar Governorate, Sultanate of Oman). First reported by Theodor Bent at the end of the nineteenth century (Bent and Bent, 1900), it was later tentatively identified with the port of Moscha Limén mentioned in the *Periplus Maris Erythraei* (Groom, 1995; Avanzini, 2008a; Seland, 2008). After the first excavations carried out by the American Foundation for the Study of Man in 1952 (Albright, 1982), Sumhuram was extensively excavated by the Italian Mission to Oman of the University of Pisa between 2000 and 2019 (Avanzini, 2002, 2008b, 2019; Pavan, 2017; Buffa, 2019a, 2019b; Lischi) (Fig. 2).

Founded by the Kingdom of Hadramawt between the late 2nd and the early 1st centuries BCE, and inhabited until the 4th century CE (Lischi forthcoming), Sumhuram covers an area of approximately 1 ha and was surrounded by a massive fortification wall with a monumental gate, encompassing residential, productive, commercial, and cultic

districts (Avanzini, 2008b; Buffa, 2019a). In Khor Rori, the Hadrami port coexisted, in an evolving strategy of fluctuating interactions, with a semi-nomadic indigenous population settled along the coast (Lischi, 2019, 2020a, 2021, 2023; Lischi, 2022; Lischi forthcoming; Crippa et al., 2023; Hilbert and Lischi, 2020; Vangeli et al., 2023). After a first phase of constructive coexistence, which allowed Sumhuram to be established and the Hadramis to adapt to a completely new coastal environment, a conflictual period is marked by the abandonment of the indigenous settlement on the Inqitat Plateau (Lischi, 2023; Lischi, 2022; Lischi forthcoming).

The material culture recovered at Sumhuram depicts a thriving port dedicated to channelling the frankincense (*Boswellia sacra*) harvested in the mountains of Dhofar into the vast and intricate network of commercial exchanges that linked Dhofar to Yemen, the Red Sea, the Mediterranean, the Persian Gulf, Persia, and South Asia (Lischi, 2015; Pavan, 2017; Buffa, 2019b; Lischi et al., 2020; Zampierin et al., 2024). In addition to a wide range of pottery and coins imported from different regions (Sedov, 2008a; Sedov and Aydrūs, 1992; Pavan, 2017; Buffa, 2019b), personal ornaments such as beads and pendants also played an important role in defining the social status of Sumhuram's inhabitants (Lischi and Pavan, 2012; Lischi, 2018). The bead assemblage of Sumhuram included different short and long shapes (spheres, discs, cylinders, bicones, barrels, cones, cubes, pyramids, etc.) produced from a variety of local and exotic materials such as marine shell, fish bone, stone (soft-stone, agate, carnelian, quartz, amethyst, amazonite, obsidian, heat-treated steatite, etc.), copper-bronze, and vitreous material (glass, frit, and faience) (Lischi, 2018). Most beads were found in the residential quarter (Area A: 38%) and in the cultic area (Area F: 33%).

#### 5. Bleach-decorated carnelian bead S3074

S3074 represents a small fragment of what appears to have been originally a spherical (?) bleached bead made from a bright red-orange carnelian, coarsely decorated with white short curved arcs and dots (Fig. 3). The surviving roughly plano-convex flake measures approximately  $10.8 \times 8.2 \times 6.2$  mm. Based on scanning electron microscopy (SEM) images of impressions of the bead perforation made with a low-viscosity vinyl polysiloxane silicone (*Zhermack® Hydorise™ Light Body*), S3074 appears to have been perforated using a double (twin) diamond drilling technology. The cylindrical perforation (2.4 mm in diameter) shows, in fact, the sharp, consistently deep and regularly spiralling striations typical of double diamond drilling (Gwinnett and Gorelick, 1991: 191–194; Kenoyer, 2017b: 163; Kenoyer, 2017c: 421–429, fig. 17) (Fig. 4). This perforation technique was introduced in western India in the 6th century BCE and became widespread by the 3rd century BCE, enabling faster and more efficient drilling although reducing the overall value of hard stone beads (Kenoyer, 2003: 17–18; Kenoyer, 2017a: 138–140).

S3074 was found in March 2018 in the accumulation layer (US443) over the floor (US425) of an open-air courtyard (A291) in Area F, some 25 m to the south-east of the *intra-muros* temple dedicated to the god Sin (IMTO, 2018a: 12; Sedov, 2008b) (Fig. 2). As evidenced by the numerous remains of pit-kilns and tuyeres, and the large amounts of ash, iron slag, and iron fragments, in this period A291 was dedicated to iron smelting activities (IMTO, 2018a: 12; Degli Esposti and Pavan, 2020: 183). In addition to the bleached bead fragment, eleven Indo-Pacific turquoise glass beads were collected in the area along with bronze and iron objects such as chisels, needles and nails, several soft-stone vessels mostly belonging to Type II.4 (Buffa, 2008), and six coins yet to be studied (IMTO, 2018a: 12; IMTO, 2018b: 8).

The pottery assemblage includes kitchen and table wares of both South Arabian (hemispherical bowls and wavy rim bowls) and Indian (cooking pots and jars with inside grooves) origin, plus a fragment of Parthian greenish/goldish-glazed jar from southern Mesopotamia, and several fragments of South Arabian vegetal-tempered ovoid jars and

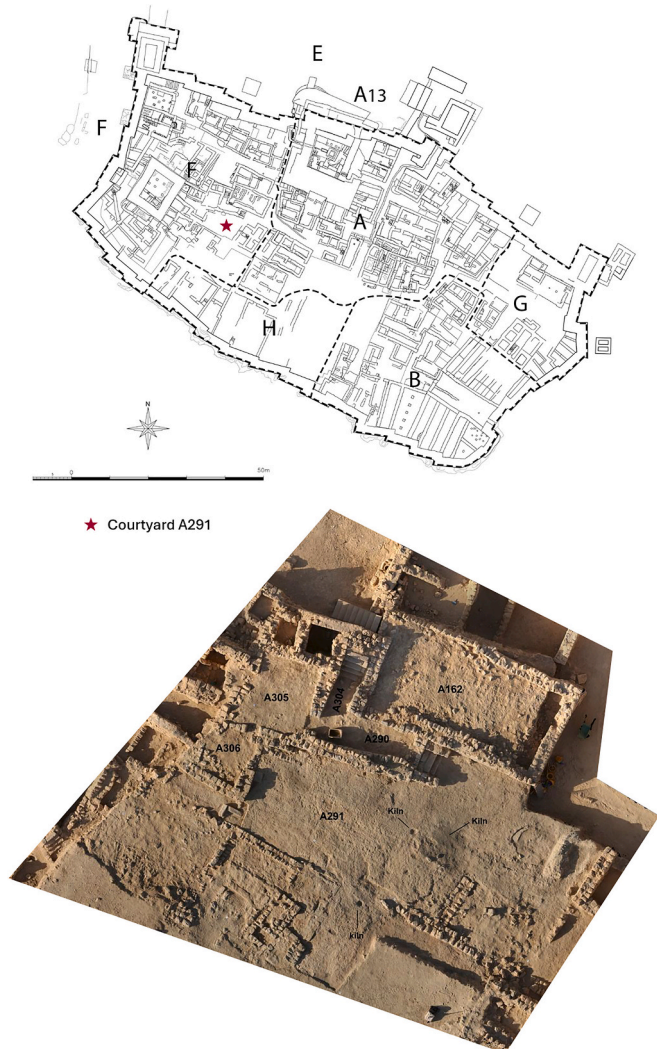


Fig. 2. Plan of Sumhuram with indication of the open courtyard for iron smelting (A291) where the bleached carnelian bead S3074 has been found (map from Buffa, 2019; aerial photograph from IMTO, 2018 A: fig. 18).

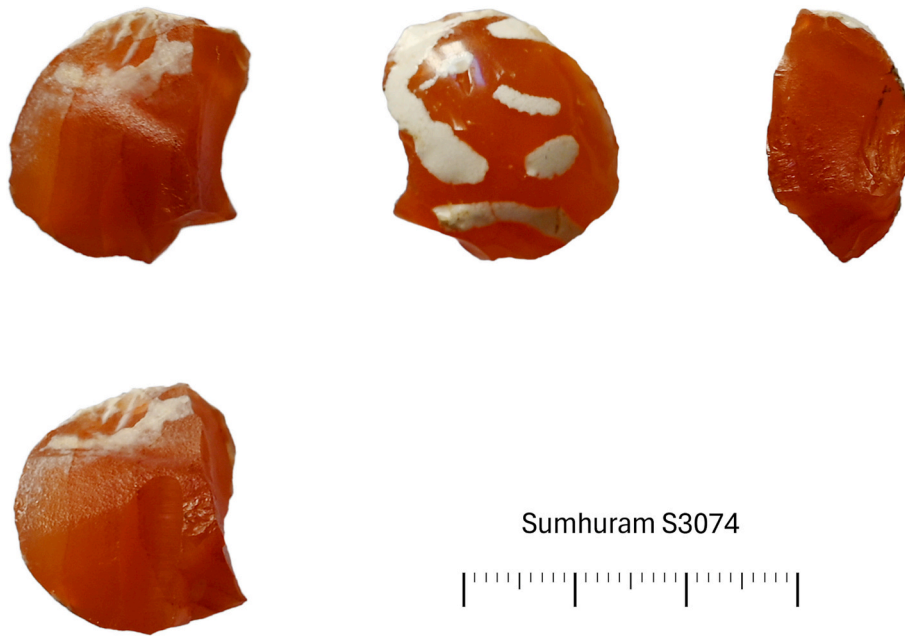


Fig. 3. Bleached carnelian bead fragment S3074 (image by the authors).

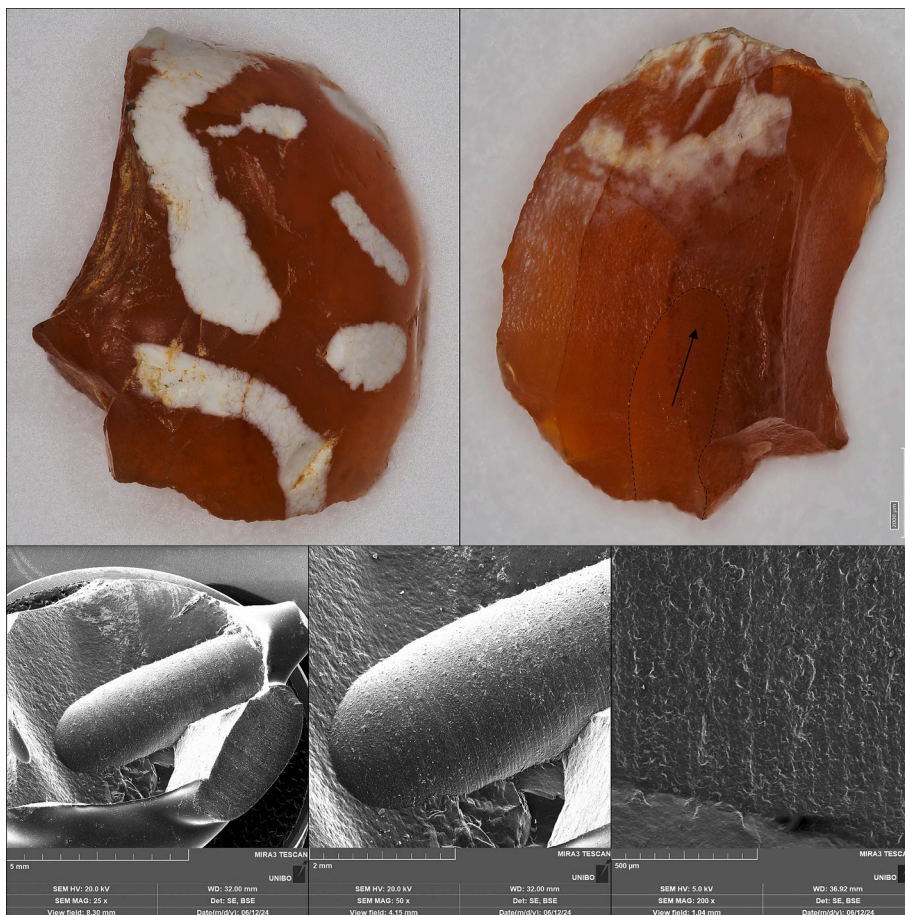


Fig. 4. Details of bleached carnelian bead fragment S3074 with indication of the remaining drill hole (images by Vittoria Bianchi, BonesLab, University of Bologna) and SEM images of the drill hole silicone impression revealing the sharp parallel striations characteristic of a double-diamond drill (SEM images by Enrico Sassoni, Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna).



Fig. 5. Bleached beads from South Asia showing decorative patterns comparable with S3074: White-on-black agate beads from Taxila Bhir Mound (a-c), Taxila Sirkap (d-e), and Ahichchhatra (f); Black-on-red carnelian bead from Barikot (g); White-on-red carnelian beads from Taxila Bhir Mound (h-l), Taxila Sirkap (m-n), and Atranjikhhera (o); Bleached beads from South-eastern Arabia: White-on-red carnelian beads from Al-Muqatta (p-q), and Ed-Dur (r-w) (beads not in scale, redrawn by the authors after Beck, 1941: pl. II; Dikshit, 1952: Fig. 1.9; Rabbani, 2020: Fig. 5; Uesugi, 2018: fig. 8.32; Gaur, 1983: fig. 117.1; De Waele and Haerinck, 2006: Fig. 5).

Roman amphorae Dressel 2–4 from the Mediterranean (IMTO, 2018b: 8). The discovery of the Dressel 2–4 amphorae (Tomber, 2017: 323, 328), the Indian cooking pots (Pavan, 2017: 38–39, type I.1.1.1), and the greenish/goldish glazed jar (Pavan, 2017: 106, type II.1.33, cf. Mouton, 2008: 95, fig. 63/7) appear to be consistent with a dating of the context to the first two centuries CE. The presence of fragments of South Arabian hemispherical bowls and wavy rim bowls, which are typically associated with the earliest occupation levels at Sumhuram (last two centuries BCE) (Pavan, 2017: 50, 112–113, types I.2.4.5 and II.6.1), can in fact be considered an intrusion related to the excavation of pits associated with metallurgical processing in the area. In addition to the pottery, the Indo-Pacific beads represent an independent chronological marker confirming that the open courtyard A291 (US443/US425) was operational for iron smelting during the 1st and 2nd centuries CE (Lischi, 2018: 16).

In terms of manufacturing technology, morphology and decorative motifs (Fig. 5), S3074 finds close parallels within the assemblages of bleach-decorated carnelian and black agate beads from domestic contexts at Taxila in Punjab and Barikot in the Khyber Pakhtunkhwa, northern Pakistan, broadly dated between the 4th century BCE and the 1st century CE (Beck, 1941: 2–3, pl. II/2, 4–6, 8–11, 19, 21, 23–24, 28; Rabbani, 2020: 11, Figs. 4/a and 5), as well as from Atranjikhhera and Ahichchhatra in Uttar Pradesh, northern India, which broadly date to the late 1st millennium BCE (Gaur, 1983: 406–408, fig. 117/1; Dikshit, 1952: 34, Fig. 1/9).

As discussed above, in South-eastern Arabia, technologically and stylistically comparable bleached carnelian beads have been documented at Late pre-Islamic and Samad Late Iron Age sites in the northern region, mainly from funerary structures but also from domestic contexts, within a chronological range extending from the late 1st century BCE to the 3rd century CE. The largest concentrations derive from Dibba Al-Hisn, on the coast of the Sharjah Emirate facing the Sea of Oman,

where six specimens derive from tombs dated to the 1st century CE and nine from rooms in the port settlement dated between the late 1st century BCE and the 1st century CE (Jasim, 2006; Jasim and Yousif, 2014). Another significant assemblage of six specimens originates from tombs at Ed-Dur, on the Gulf coast of Umm Al-Quwain (Haerinck et al., 2021), while smaller clusters or isolated finds have been recorded at other sites in the United Arab Emirates and in the interior of the Sultanate of Oman (De Waele and Haerinck, 2006).

Comparable white-on-red bleached carnelian beads have also been documented in north-western Iran, three in the Partho-Sasanian fortress of Qasr-i Abu Nasr in Fars and one in the Hassani Mahale graveyard in Gilan (Yule and Mauro, 2025: 124, Fig. 3.8/e–l, cf. Whitcomb, 1985: 177, fig. 69/a–c; Sono and Fukai, 1968), supporting the interpretation of sites around the Strait of Hormuz as redistribution hubs for high-status commodities originating from the Indian subcontinent.

## 6. Personal possession?

As previously discussed, bleached carnelian beads have consistently remained rare finds in South-eastern Arabia from the Early Bronze Age onwards. Within this framework, the first and hitherto sole documented discovery of a bleach-decorated carnelian bead in South-western Arabia, at a settlement that remains largely isolated from other contemporaneous sites yielding similar ornaments, may provide a valuable basis for discussing the circulation of individuals and high-status exotic objects across the Western Indian Ocean during the Late Iron Age and Late pre-Islamic period.

While the significance of this discovery for reconstructing preferential trade routes linking north-western India with the Hormuz region and extending along the shores of Southern Arabia will be discussed in detail below, it is first necessary to consider the role of seasonal maritime mobility and temporary residence of foreign individuals at Sumhuram.

In fact, a substantial corpus of textual and archaeological evidence indicates that Indian ships from both North and South India, in addition to temporarily mooring at Sumhuram, also routinely overwintered there owing to monsoon constraints, with their crews — including sailors, merchants, and possibly craftspeople — residing temporarily within the city (Seland, 2008). Moreover, the potential establishment of small Indian communities settled in the city on a more permanent basis has also been proposed (Lischi, 2015; Pavan, 2015, 2016).

The *Periplus Maris Erythraei*, a 1st-century CE Greco-Roman navigational and commercial logbook, provides key textual evidence for Indian maritime shipping activity at the port of Moscha Limén, identified with the site of Sumhuram (Groom, 1995; Avanzini, 2008a). The text describes Moscha Limén as a formally designated harbour for the loading of frankincense, but also as a refuge for vessels sailing from the Malabar Coast and Gujarat (par. 32, Casson, 1989: 71). According to E.H. Seland (2008), overwintering by Indian ship crews at Sumhuram should not be understood as an exceptional occurrence, but rather as a recurrent and structurally embedded feature of Indian Ocean navigation.

When considered alongside the textual evidence, the archaeological record provides a coherent framework for interpreting Indian-style material culture at Sumhuram not merely as the result of episodic

commercial exchange, but as the material expression of sustained human presence. The ceramic assemblage comprises multiple categories of pottery typically associated with household use, documenting sustained contacts with the Indian subcontinent (Pavan, 2017). An earlier phase, spanning the last two centuries BCE, is characterised by South Indian wares, including local imitations and repaired specimens indicating their prolonged use and curation (Lischi, 2015: 233; Pavan, 2016: 4–5; Pavan, 2017: 28–29, 113–114). The subsequent phase, emerging in the 1st century CE, is instead dominated by North-western Indian wares, suggesting a reorientation of Sumhuram's commercial connections (Pavan, 2015: 133; Pavan, 2016: 6). The dominance of cooking pots (60% of the Indian pottery corpus) indicates the domestic character of ceramic imports from the Subcontinent (Pavan, 2015: 128). However, the spatial distribution of the various Indian pottery types across different areas of the settlement does not support the identification of a segregated Indian enclave (Pavan, 2017).

Ceramic fragments also bear graffiti and painted inscriptions in Indian scripts and languages. A Tamil-Brahmi graffito scratched on the shoulder of a Dressel 2–4 amphora fragment dating to the 1st century CE, reused locally as a lid for a cooking pot, is to be read [ṇ]antai kīraṇ, a form that comprises an honorific suffix to an elderly person and a male



Fig. 6. Indian-style acephalous bronze figurine from Sumhuram, Oman, representing a *Śālabhañjikā* (courtesy National Museum of Asian Art, Smithsonian Institution, gift of The American Foundation for the Study of Man, Wendell and Marilyn Phillips Collection, S2013.2.378) and comparable figure in a railing pillar from Mathura, India, c. 125–50 CE (courtesy Cleveland Museum of Art, Cleveland OH); Indian-style bronze head from Sumhuram (Oman) depicting a princely ascetic, a bodhisattva, or a Shaivite devotee (courtesy Italian Mission to Oman).

personal name characteristic of the Tamil Sangam period between the third century BCE and third century CE (Subramanian, 2021, cf. Pavan, 2016). Single Tamil-Brahmi letters are also found scratched on bowls imitating the rouletted ware (Pavan, 2017: 114). Finally, a painted Prakrit inscription on a pottery sherd identifies an individual connected with wheeled transport, either a coachman or a charioteer (Bukharin, 2002).

Two Indian bronze coins are reported from Sumhuram, one issued by the Kushan king Kanishka I (r. 127–150 CE) and the other by the Western Kshatrapa ruler Bhumaka (r. early 1st century CE) (Lischi, 2015: 231; Pavan, 2016: 5). Since such bronze coins were not originally used in international trade, the Sumhuram specimens likely had a symbolic, ornamental function (Sedov and Aydrus, 1992: 126).

Particularly significant in this context are two Indian-style figurines, representing portable cult images or decorative objects of elite taste (Lischi, 2015: 230–231; Pavan, 2016: 4–5) (Fig. 6). The first is a partially preserved bronze figurine representing a *Śalabhānjikā*, a female spirit embodying ideals of fertility, beauty, and auspiciousness (Rāya, 1979). The iconographic features of this figurine associate it with the Western Kshatrapas sculptural traditions of the early 3rd century CE (Goetz, 1963; Autiero, 2019: 409–412). The second bronze figurine, discovered at the entrance of a 3rd-century CE building close to the storage quarter, is represented by the head of a richly adorned male figure, probably a princely ascetic, a bodhisattva, or a Shaivite devotee (Autiero, in press: 10–14).

Personal ornaments represent a significant category of material evidence for evaluating the intensity and the nature of contacts between

Sumhuram and the Indian subcontinent (Lischi, 2015: 234–235; Lischi, 2018). Indo-Pacific glass beads account for 19% of the total bead assemblage, providing substantial evidence for connections with the Indian Ocean exchange networks. Agate and carnelian beads represent 46% of the stone beads. Although geological sources of agate and carnelian are also attested in Yemen, comparative evidence indicates that the beads from Sumhuram were imported from Gujarat (Lischi, 2018). The archaeological record also includes material indicators of bead-working activities, suggesting that at least part of the bead production sequence may have been performed at the site by individuals familiar with Indian bead-making techniques (Lischi, 2015, 2018).

A final element relevant to assessing the possible presence of individuals of Indian origin at Sumhuram is a plaster fragment from the outer city wall, which depicts a scene including a two-masted ship (Avanzini, 2008a: 615–616, Fig. 5). The careful rendering of the vessel's structural elements allows for a close comparison with representations on Satavahana coins, suggesting its execution by an individual familiar with Indian iconography and maritime traditions (Lischi, 2015: 231–232, Fig. 3).

Altogether, the textual, iconographic, and material evidence indicate the importance of the transit and seasonal overstay of sailing crews, merchants, and craftspeople from the Indian subcontinent in Sumhuram's socio-economic and cultural setting. Less clear is whether the cumulative effects of such seasonal mobility may have led to the establishment of more stable groups of individuals of Indian origin maintaining strong elements of their cultural identity. However, the recurrent and often prolonged presence at Sumhuram of individuals

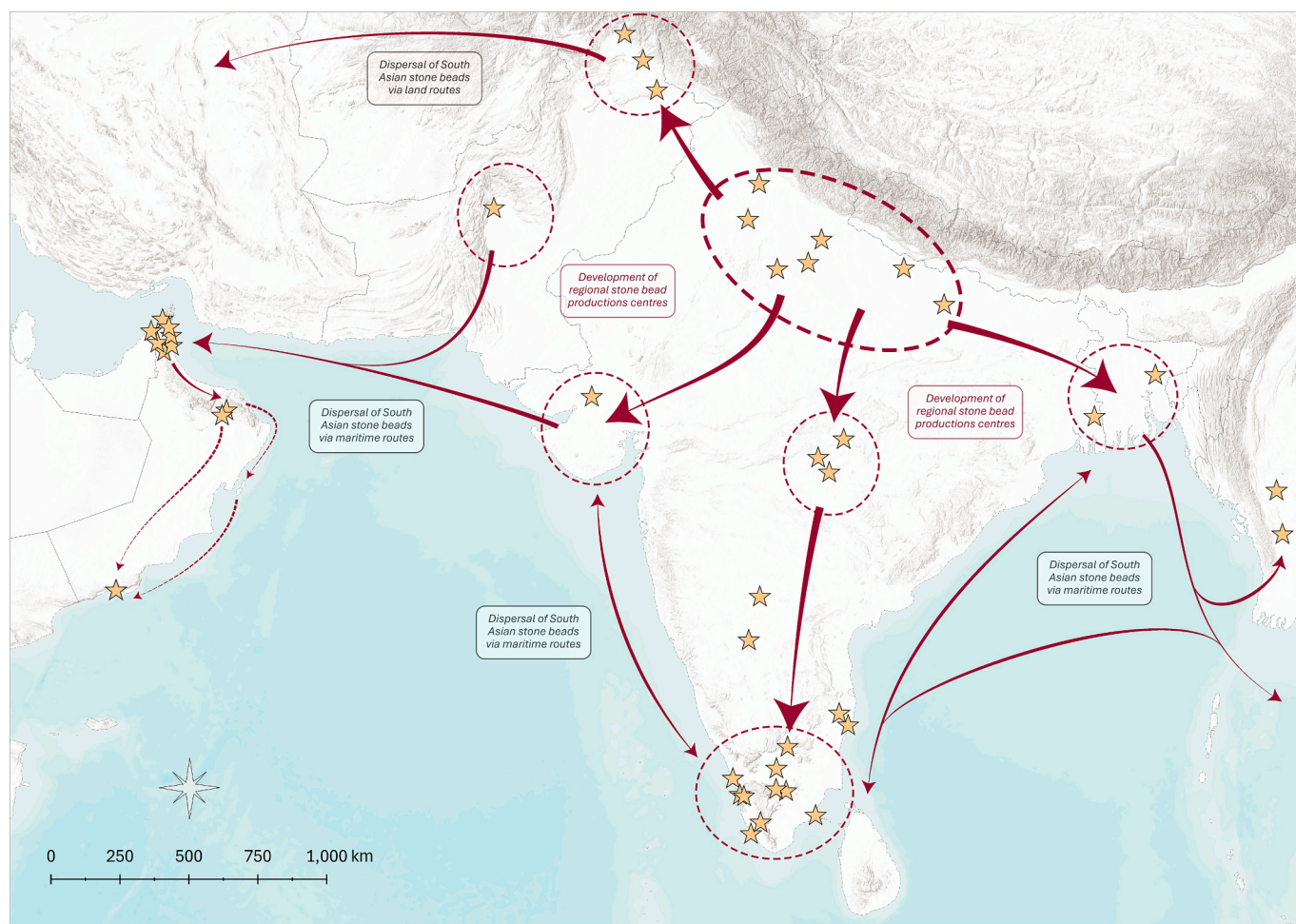


Fig. 7. Distribution and diffusion of bleached carnelian beads in South Asia and Southern Arabia during the Iron Age and Early Historic Period (map redrawn and updated by the authors after Uesugi, 2018: fig. 21).

from South Asia may easily have resulted in the occasional loss or deliberate disposal of personal properties, including prized symbols of socio-economic status and cultural identity such as beads, ornamental coins, and votive figurines. While the bleached carnelian bead may have reached Sumhuram through structured exchange mechanisms, it is equally plausible that it constituted the possession of a South Asian individual overwintering in the city or possibly a member of a more long-term diasporic community. In this perspective, the bead should be understood not merely as an indicator of economic exchange, but as a material trace of individual biography and cultural entanglement within the dynamic social environment of a cosmopolitan port.

## 7. Or traded commodity?

When considered on a macro-regional and quasi-global scale, the available data on the retrieval of bleached carnelian beads in Southern Arabia also highlight distribution patterns possibly indicating the existence of preferential trade routes and directions with South Asia during the last centuries BCE and the first centuries CE. In this phase, bleached carnelian beads continue to concentrate at sites in the north of the Oman Peninsula, i.e. modern United Arab Emirates, becoming much rarer moving southward, until they are only represented by an isolated find in Dhofar, and eventually disappeared in Yemen and south-western Saudi Arabia.

During this period, ports such as Dibba Al-Hisn and Ed-Dur in the north were equivalent in economic significance to the Hadrami ports of Sumhuram and Qani on the south-western coast, respectively supplying mostly pearls and frankincense to the international maritime commercial network linking the Mediterranean to South and Southeast Asia (Jasim, 2006: 236; Jasim and Yousif, 2014: 78; Haerincx et al., 2021; Avanzini, 2008b; Salles and Sedov, 2010). Considered in a broader perspective involving the location of production and marketing centres in the Indian subcontinent (Uesugi, 2018: 35–37, fig. 21) (Fig. 7), the unbalanced distribution of a traditionally highly prized trade item such as the bleached carnelian beads may indicate the existence of at least two autonomous or loosely connected trade networks linking the east and west of Southern Arabia with South Asia. In fact, the bleached carnelian beads found in Southern Arabia seem all stylistically and technologically linked with production centres in Pakistan and northern India, such as Taxila, Atranjikhra and Ahichchhara, while for some reason no specimens linked with production centres in South India have yet been discovered.

According to Lischi et al. (2020: 76–77, fig. 8), from the 3rd century BCE to the 3rd century CE, the so-called torpedo jars were transported from southern Mesopotamia through the Strait of Hormuz, where an eastern route reached the coasts of Gujarat and eventually southern India, while a southern route reached the coasts of Dhofar and continued towards the south-west. Based on the limited available records, during this period, bleached carnelian beads were transported in the opposite direction, from the coast of Gujarat to Hormuz, before possibly entering the Gulf and reaching Mesopotamia. In this regard, data from Bahrain indicate a total of 47 bleached beads from the Tylos Period (300 BCE–300 CE) (Al-Sadeqi, 2013: 376), suggesting a final destination for these items further north. However, these may apparently also include specimens that were not actually bleached, but underwent natural discolouration resulting from post-depositional modification caused by their contact with alkaline soils (Kenoyer, 2020: 172, Fig. 5). In fact, W. Al-Sadeqi (2013: 370, pl. IV) erroneously equated this natural weathering process with an intentional technique, which he termed ‘wholesale etching’, intended to coarsely whiten the entire surface or almost the entire surface of the beads. According to Al-Sadeqi (2013: 371, pl. IV), this supposed technique characterises most of the bleached beads in the Bahrain sample, rendering his count unreliable and evidently lower than 47 specimens. Even more problematic is the extant evidence for the presence of bleached carnelian beads in southern Mesopotamia during the Persian period, as these are frequently misidentified in the original

reports (Simpson, 2020: 535, cf. Woolley, 1962: 105–130, pls. 22–24).

At the current stage of research, this evidentiary deficiency makes it therefore difficult to determine whether, for some reason, South-eastern Arabia was the final market for these particular beads or an intermediary redistribution hub within the trade network leading to Mesopotamia. Indeed, the trade routes reconstructed for the distribution of torpedo jars indicate that no technical or logistical constraints would have prevented bleached carnelian beads from reaching also ports along the coasts of Dhofar and Yemen. A more pragmatic explanation for their distribution may relate to the apparently limited volume of bleached beads traded from South Asia during this period, which may have been largely absorbed at the first ports of arrival on the western side of the Arabian Sea, such as Ed-Dur and Dibba Al-Hisn. However, the possibility that bleached carnelian beads were prized mainly in South-eastern Arabia, either for aesthetic or symbolic reasons rather than a mere commercial opportunity, cannot be entirely ruled out. In fact, there is substantial evidence indicating that Iron Age communities located south of Hormuz possessed a deep cross-cultural understanding of the surrounding cultures, which led to the selective adoption of specific objects and motifs from overseas regions according to their contextual uses (Frenez et al., 2021). During the Early Iron Age (c. 1000–300 BCE), in this region, exotic artefacts were deliberately selected to accompany the deceased based on their supposed ability to offer magical and supernatural protection against disease, in accordance with beliefs rooted in their original cultural traditions (Frenez et al., 2021: 7, 18). From this perspective, the highly standardised and repetitive motifs depicted on the bleached carnelian beads from the Early Bronze Age onwards seem to have conveyed ideologically significant messages within a framework of shared beliefs and practices (Kelly, 2013: 163). According to St John Simpson (2020: 542), ‘The ideological meaning of a given motif [on the bleached carnelian beads] is unlikely to have been the same across the huge distances and languages of India and Eurasia, but the significance as cultural markers or amulets of a particular meaning should not be under-estimated.’ However, while Simpson mainly referred to the possible significance of bleached carnelian beads discovered in distant areas of Central Asia, in the case of South-eastern Arabia, the closest proximity to the production areas in South Asia, the customary informed use of exotic artefacts, and the traditional presence of South Asian communities in the region, suggest that these beads may have held particular significance for the local communities, possibly creating a regional market that was potentially more interested in bleached beads than the Gulf, Mesopotamia, and possibly Dhofar/Yemen.

## 8. Conclusion

Although Ancient South Arabian (ASA) graveyards and tombs have not been extensively excavated or systematically published, introducing a significant gap in the archaeological record (for examples and discussion of this issue, see Caton-Thompson, 1944; Breton et al., 1998; Crassard and Hitgen, 2007; Mouton et al., 2011), bleached carnelian beads appear to have held little or no cultural or economic significance within the ASA society. In fact, although the procurement of the bleached carnelian beads produced in the northern regions of the Indian subcontinent may have been influenced by the organisation of maritime trade routes, there appears to be no reason why those produced in southern India were not in demand. In this general scenario, the fragment of bleached carnelian bead found at Sumhuram (S3074) is most likely to reflect trade links between Dhofar and the north of the Oman Peninsula rather than direct contacts with production centres in South Asia.

In this regard, it is also significant to note that the material assemblage recovered at Sumhuram displays distinctive features when compared to those from ASA centres in present-day Yemen. In fact, Sumhuram has yielded a significant number of artefacts that are entirely absent from other ASA sites but relatively common in South-eastern Arabia, such as the so-called shell bosses or discs (Caputo and Genchi,

2016; Weeks et al., 2019; Lischi, 2020b). Furthermore, whereas in the north ornaments such as beads and shell bosses are primarily associated with funerary contexts, at Sumhuram they are instead attested within an urban context. While this interpretation may evolve as excavations of ASA burial sites progress and findings are published in detail, this unique find offers new insights into the regional dynamics of Western Indian Ocean trade during the Late Iron Age and Late pre-Islamic period, suggesting the existence of different and only partially overlapping interaction spheres.

From an alternative perspective, this bleached bead may have been transported to Sumhuram not as merchandise, but rather as a personal adornment of a South Asian individual who transited through the city or formed part of a possible resident diasporic community. This perspective challenges strictly economic interpretations and foregrounds the importance of cosmopolitan encounters in interpreting Sumhuram's archaeological record. The site emerges not only as a node in exchange networks, but also as a vibrant, multicultural hub where material culture reflected and shaped complex social identities.

Regardless of the particular actions leading to its arrival in Dhofar, the bleached carnelian bead from Sumhuram exemplifies the entanglement of luxury consumption, mobility, and intercultural presence in the Western Indian Ocean during the early first millennium CE (Seland, 2014). In fact, as P. Beaujard (2010) argued, the movement of prestige items played a crucial role in negotiating identity, power, and connectivity across culturally diverse zones within the broader logic of an emerging Afro-Eurasian world-system.

#### CRedit authorship contribution statement

**Dennys Frenez:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Investigation, Conceptualization. **Silvia Lischi:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization.

#### Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

#### Acknowledgements

The authors would like to express their gratitude to the Ministry of Heritage and Tourism of the Sultanate of Oman, under whose auspices the DHOMIAP Project operates, and to the Museum of the Frankincense Land in Salalah. Thanks are also due to J. Mark Kenoyer (Department of Anthropology, University of Wisconsin–Madison) and Akinori Uesugi (Department of Cultural Properties, Tsurumi University) for their valuable comments, and to Eugenio Bortolini (Department of Cultural Heritage, University of Bologna) and Enrico Sassoni (Department of Civil, Chemical, Environmental and Materials Engineering, University of Bologna) for facilitating and producing SEM images of the silicone impressions of the bead drill hole. Special thanks to *Zhermack SpA* for providing the impression material and the associated instruments.

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