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Indian Glass in Ancient Nubia

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Abstract
Even within Sudanese studies, Ancient Nubian glassware is an under-examined area of research. My work uses scientific analysis to identify raw materials and production techniques of Nubian-provenanced glassware from the Meroitic Period (c. 400 BCE–400 CE) and X-Group/Ballana Culture (c. 400–600 CE). This analysis has identified a type of glass indigenous to South East Asia—high-alumina mineral-soda glass—present at the site of Faras, Lower Nubia. My identification of the origin of this coloured glass begs the question how it might have travelled from India, possibly via Egypt, to end up in a child's grave in Nubia. It also leads us to ask what proportion of glass objects found in the Near East and the Mediterranean originated in India, what else (ideas, customs, traditions) might have travelled with such items, and what influence these interactions might have had not just at Faras but within the region as a whole.

Glass in the ancient world, as today, was made of silica and a flux, which might be either a mineral soda or potash.[1] As silica has a melting temperature of 1700° C, the flux is required to reduce this temperature to 1000°–1300° C.[2] Lime was added to this silica-soda mix to act as a network stabiliser which would reduce the weathering of the glass.[3] The potash (or plant-ash flux) for glass is derived from burning plants that grow in salt-rich environments where they accumulate sodium and potassium, which when burned form a considerable part of the resulting ash, reaching up to 25% of the weight of the ash.[4] It is this type of plant-ash glass that forms the basis of most Bronze Age glass from the Middle East and Iron Age, Roman Period, and Late Antiquity found to the east of the Euphrates.[5] Mineral-soda glass uses evaporate minerals as its flux instead of burnt plant matter, the most well known being from the Wadi Natrun in Lower Egypt, although other natron sources such as those in western Turkey are also known to have been exploited in antiquity.[6] It is from these three main components and their resulting natural contaminants, in particular alumina, lime, and iron oxide, that different glass groups have been identified.[7]

Studies of ancient glass have shown how far the material could travel in the Bronze Age, either as the result of direct or indirect trade. Examples of such trade include ingots found on the Uluburun shipwreck, showing trade between Egypt, Mesopotamia, and Mycenae,[8] and the discovery of glass beads of Egyptian and Mesopotamian manufacture in Danish Late-Bronze-Age context graves.[9] Examination of Roman glass from around the Mediterranean and Near East and the identification of glass groups[10] and possible production centres,[11] as well as the revision of glassmaking and distribution models,[12] have shown the extent to which glass was travelling. What is now just beginning to be identified, due to visual and chemical analysis, is not only how far Mediterranean-produced glass could travel beyond the Mediterranean world but also how glass from Asia was heading towards the Mediterranean world.

Roman Trade to India

Roman trade with India would build upon Ptolemaic activities in the Red Sea. Following Alexander the Great's death in 332 BCE, his general Ptolemy took control of Egypt, becoming Ptolemy I Soter (305–285 BCE).[13] Little is known of Soter's activities around the Red Sea, although the contemporary writer Theophrastus (370–c. 285 BCE)[14] and other contemporary extant papyri[15] indicate direct contact between Egypt and the kingdoms of South Arabia, and indirect contact with India via South Arabian and perhaps Nabataean Arab middlemen during the late 4th to early 3rd century BCE.[16] It has been suggested that this indirect contact between the Ptolemies and India can be seen in the errors in descriptions of the origins of some imported wares; for example Theophrastus believed erroneously that cinnamon came from Arabia although in fact it came from India.[17] A brief insight into Ptolemaic commerce in the Erythraean Sea comes from the reign of Sotar's successor, Ptolemy II Philadelphus (285–246 BCE).[18] Under Philadelphus, Ptolemaic commercial activity in the Red Sea was promoted with the construction of ports at Arisone (Clysma-Suez), Myos Hormos, Philoteras, and Berenike Trogodytica in Egypt.[19] The port of Ptolemais Theron, "Ptolemies of the Hunt[ing]s," located c. 80 km south of modern-day Port Sudan, served as the means to transport elephants and other trade goods from the early 260s BCE.[20] These ports were connected to Koptos and Apollonopolis Magna (Edfu) on the Nile.[21]

Moving on to the beginning of the Roman Period in Egypt, trade in the Red Sea region expanded rapidly during the reigns of Augustus and his successors, building upon the Ptolemaic ports.[22] Looking towards the Indian Ocean, there is also the recorded arrival of an embassy from Taprobane (Sri Lanka) to see Claudius,[23] while use of the major trade networks of the east by merchants from the Roman Empire reached their peak under Trajan.[24] The best route to India was by sea, with such trading ventures managed by Alexandrian merchants.[25] It is the *Periplus Marius Erythraei*, a unique non-literary narrative work from the Greek and Roman world,[26] that provides a great deal of the available information about Roman Egypt's trade with Africa, Arabia, and India. Opinion is divided on the dating of the *Periplus,* ranging from 40 CE to 120 CE.[27] The *Periplus* describes two major lines of trade, both beginning at the Red Sea ports of Egypt, one which followed the coast of Africa, the other heading eastward to India, with many instances of Egypt being mentioned specifically as the point of departure (*Periplus* 6:3.5, 14:5.7, 49:16.31, 58:18.28–29).[28] It also provides details of sailing times, weather, distances, and names of all the ports on the routes, and gives lists of the items each imported or exported.[29] Because almost half of the *Periplus* is devoted to this trade route, it has been argued that Roman Egypt's trade with India was more important than that with Africa and Arabia.[30] The mechanisms for trade with India (also Africa and Arabia) involved using Nile boats to take goods upriver to Koptos, where they were then transferred to donkey and camel trains, in order to cross the Eastern Desert to "Myos Hormos and beyond it, after a sail of 1800 stades to the right, Berenicê. The ports of both are bays of the Red Sea on the edge of Egypt" (*Periplus* 1:1.2–4).[31] Thus it is these Egyptian Red Sea ports and Alexandria that saw much of Rome's maritime trade with South India, South Arabia, and Sri Lanka.[32] While Egypt was one of the major regions for Roman trade, the other was the route from Palmyra.[33] The participation of Palmyrenes in trade with India is demonstrated by an honorific inscription from Palmyra, addressed "[t]o Marcus Ulpius son of Hairan, son of Abgar, the patriot, the merchants who have returned from Scythia [India][34] on the ship of Honainu son of Hahudan son of …"[35] Images of ships in Palmyrene funerary sculpture also attest to merchants and shipowners involved in trade to India.[36] The presence of Palmyrenes in the Gulf is further attested by the discovery of a Palmyrene tomb on the island of Kharg.[37]

The *Periplus* claims that India's west coast contained two zones, each served by two major ports—the northwest ports of Barbarikon (near the modern city of Karachi) and Barygaza (the Graeco-Roman name given to the city of Bharuch), and the southwest ports of Muziris and Nelkynda.[38] When it comes to the details of glass trade in the *Periplus*, it is the ports of Barbarikon and Barygaza that show something of interest.[39] The *Periplus* provides details of the glass that was favoured at these ports. At Barbarikon, it was ὑαλᾶ σχενὴ "glassware" (39:13.9)[40] that was preferred, while Barygaza imported ὕελος ἀργή "raw glass" (49:16.23).[41] In addition to the account in the *Periplus* there is archaeological evidence showing the trade of glass. Archaeological evidence for the trade in glassware comes from numerous finds of a distinct Mediterranean vessel type: the ribbed bowl.[42] The site of Barbarikon is mentioned in the *Periplus*, and ribbed bowls have also been found upriver from there at Taxila and Begram.[43] Three ribbed bowls were also found at Arikamedu (Podouke in ancient sources), located on the southeastern coast of India.[44] Additionally, at the port of Arikamedu a fragment of a Hellenistic glass vessel was found.[45] When analysed by Brill it was found to be made of a natron type of soda-lime glass, a characteristically Mediterranean glass recipe.[46] These types of vessels have a similar date range to those suggested for the *Periplus*, 1st century BCE to 1st century CE.[47] Evidence for trade in unprocessed glass into India is not solely reliant on the written record but also supported by the discovery of two unprocessed glass blocks on a path towards the Red Sea at Maximianon in Egypt.[48] This indicates, as with the Mediterranean glass trade, that there was a market for both the finished objects and glass as a raw material in India. Indeed, recent excavations on the eastern coast of Africa may also indicate a trading connection between India and Africa that facilitated the movement of glass (see below).

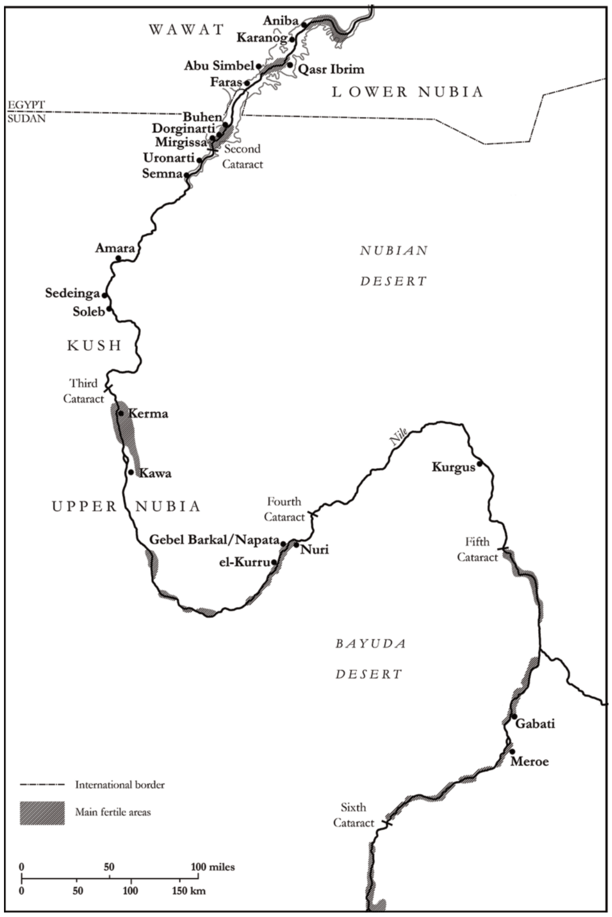

Figure 1: Map of Nubia.

Case Study: An Indian Source for Glass from Faras, Nubia

The provenance of the material that forms the basis of this case study (British Museum Accession number EA51716)[49] is the Lower Nubian site of Faras, located on the modern border between Egypt and Sudan at the Wadi Halfa Salient, now covered by Lake Nasser (Fig. 1).

EA51716 came from Grave 23 in Cemetery 1 of the Meroitic cemetery at Faras.[50] Griffith characterised this grave as "D,", giving it a date of late/end of Meroitic Period–X-Group (Ballana Culture),[51] based on his dating of the pottery found in the graves at the site. This gives EA51716 a deposition date of c. 400–600 CE. The glass samples from Grave 23 are ring-shaped opaque orange glass beads (**Fig. 2**).

Chemical analysis of the major and minor elements of EA51716.1-10 was done on the JEOL JSM-IT300 scanning electron microscope (SEM) equipped with a Thermo System 7 energy dispersive spectrometry (EDS) detector in the Professor Elizabeth Slater Archaeology Laboratories at the University of Liverpool. The instrument was operated at an accelerating voltage of 20kV, with a probe current (PC) of 50nA, working distance (WD) of 10 mm, for 60 seconds. The samples were mounted in resin and polished to 0.25 μm and then carbon coated. This analysis was performed three times for each sample and then a mean calculated. Only totals of 97–103 wt% were considered acceptable for the production of comparable normalised values. These normalised results can be found in Table 2. Corning A and B were used as the standard reference material (SRM); see Table 1.

The results for the main components show silica levels of 58–64 wt%, alkali levels of 8–12 wt%, and lime of 1–2 wt%, slightly lower than emerged from

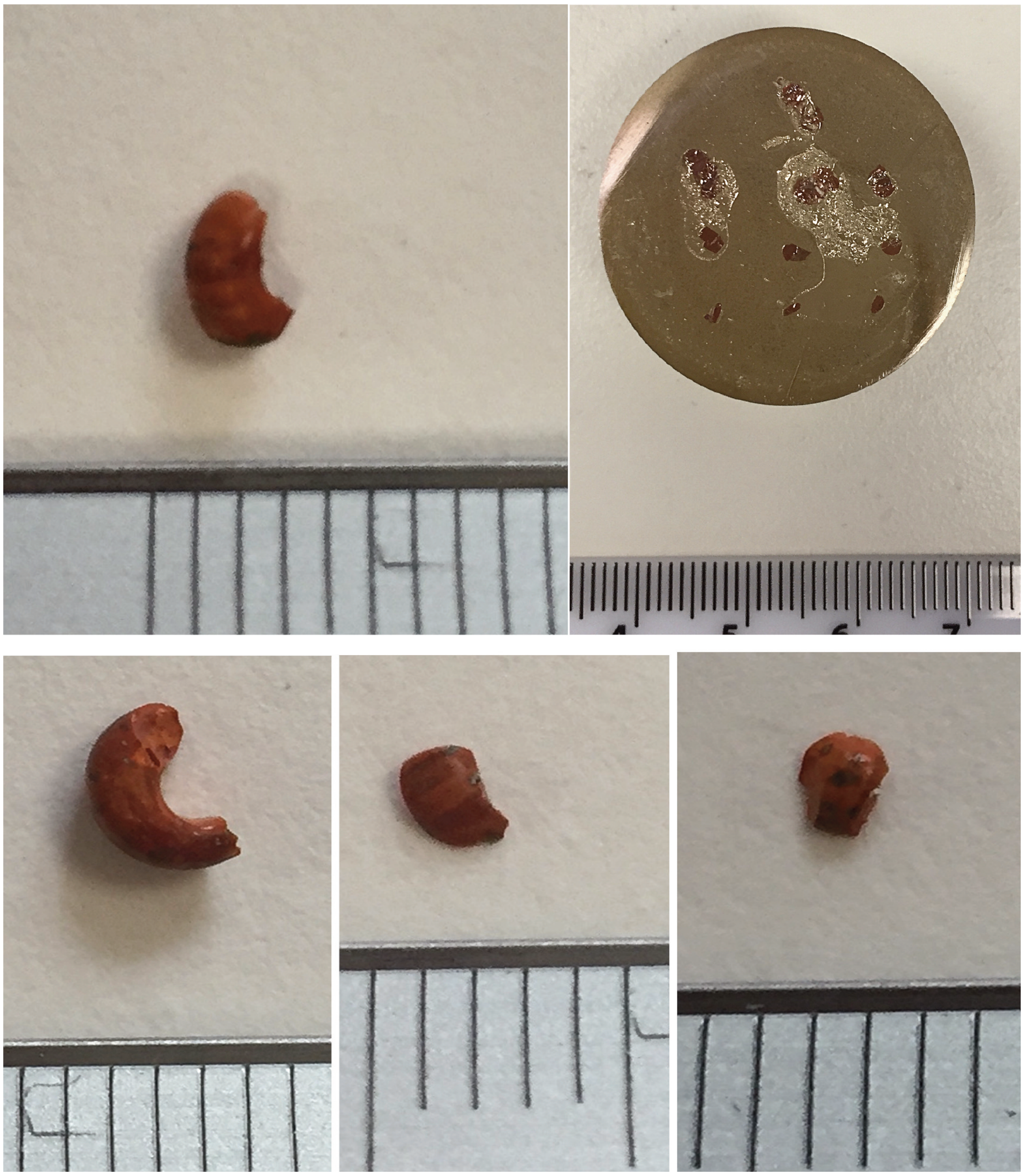

FIGURE 2: Images of EA51716 samples (top left and bottom, images of samples; top right, samples set in resin for analysis).

the analysis of other material from Faras and glasses from the sites of Gabati, Meroe, and Qasr Ibrim, as well as other material from around the Mediterranean.[52] Furthermore, of particular interest were the very high levels of the natural contaminants alumina (Al_2O_3—8.40–10.56 wt%), and iron II oxide (Fe_2O_3—1.80–2.66 wt%) when compared to the other material. Sand would have been the common source for the silica resulting in natural impurities, such as alumina and iron, being transferred in varying amounts to the glass.[53] It is from the levels of these natural impurities that the origins of

Table 1: Average wt%, precision, and error for the SEM-EDS as compiled from accepted wt% for Corning Standards A and B (Adlington 2017, 5)

	Corning A				**Corning B**			
Oxides	**Average wt%**	**Accepted wt%**	**Precision %**	**%Error**	**Average wt%**	**Accepted wt%**	**Precision %**	**%Error**
SiO_2	68.24	66.56	±0.12	±2.52	62.84	61.55	±0.14	±2.10
Na_2O	14.43	14.30	±0.01	±0.91	16.69	17.00	±0.03	±1.82
K_2O	2.89	2.87	±0.00	±0.70	0.98	1.00	±0.00	±2.00
CaO	5.14	5.03	±0.01	±2.19	8.46	8.56	±0.01	±1.17
MgO	2.38	2.66	±0.02	±10.53	0.95	1.03	±0.01	±7.77
Al_2O_3	1.01	1.00	±0.00	±1.00	3.77	4.36	±0.07	±13.53
P_2O_5	0.13	0.08	±0.00	±62.50	1.17	0.82	±0.04	±42.68
PbO	0.25	0.07	±0.01	±257.14	0.40	0.61	±0.02	±34.43
Ti_2O	1.15	0.79	±0.03	±45.57	0.12	0.08	±0.00	±50.00
Fe_2O_3	1.12	1.09	±0.00	±2.75	0.35	0.34	±0.00	±2.94
MnO	1.12	1.00	±0.01	±12.00	0.24	0.25	±0.00	±4.00
Sb_2O_5	1.35	1.75	±0.03	±22.86	0.46	0.46	±0.00	±0.00
Cu_2O	1.10	1.17	±0.01	±75.98	2.70	2.66	±0.01	±1.50
CoO	0.19	0.17	±0.00	±11.76	0.03	0.04	±0.00	±25.00

Table 2: Normalised results of the SEM-EDS analysis of samples EA51716.1–10 in wt%. b.d. = below detection.

Accession No. and Object No.	Provenance	Date	Colour	Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	K_2O	CaO	TiO_2	MnO	Fe_2O_3	CoO	Cu_2O	Sb_2O_5	PbO	Total
BMEA51716.1	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	12.69	0.98	9.89	58.42	0.23	1.53	2.32	0.98	0.11	2.55	0.12	7.82	b.d.	2.38	100
BMEA51716.2	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	8.43	0.83	9.73	59.49	0.56	1.74	2.3	0.97	0.13	2.68	0.12	8.96	b.d.	2.77	100
BMEA51716.3	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	11.31	0.72	8.4	63.96	0.54	1.42	2.04	0.77	b.d.	2.17	0.02	6.47	0.18	2.03	100
BMEA51716.4	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	11.88	0.96	9.11	64.29	0.3	1.27	1.83	0.65	0.07	2.04	0.07	5.5	b.d.	2.06	100
BMEA51716.5	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	11.39	0.91	9.34	58.96	0.53	1.63	2.63	0.84	0.1	2.36	0.16	9.02	b.d.	2.13	100
BMEA51716.6	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	10.24	0.76	9.87	59.44	0.15	1.53	2.19	0.86	0.03	2.64	b.d.	8.03	0.02	2.38	100
BMEA51716.7	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	12.04	1.21	8.96	63.2	0.2	1.24	1.83	0.58	0.1	1.8	0.09	5.98	0.11	2.67	100
BMEA51716.8	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	12.43	0.91	9.61	59.43	0.66	1.51	2.39	0.82	0.05	2.72	b.d.	7.45	b.d.	2.02	100
BMEA51716.9	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	10.95	0.8	10.56	63.6	0.71	1.87	1.72	1.05	0.12	2.46	b.d.	4.13	b.d.	2.03	100
BMEA51716.10	Faras Cemetery 1 Grave 23	X-Group/ Ballana Culture	Orange	11.99	0.91	8.66	62.86	0.29	1.39	1.87	0.81	0.09	2.25	b.d.	6.94	b.d.	1.94	100

glassmaking sand can sometimes be identified.[54]

Initially, values of alumina and iron II oxide for EA51716 were compared to a selection of glasses found at sites around the Mediterranean. The boxplots in Figures 3 and 4 illustrate the difference in the alumina and iron II oxide levels when compared to levels from Bubastis (Egypt), Pergamon (Turkey), Butrint (Albania), and Bologna and Spina (Italy).[55]

The observed differences between the levels of alumina and iron of silica sources for the high-aluminium glasses when compared to those around the Mediterranean meant it was necessary to look farther afield for a probable origin of the glassmaking sand used. A possible origin to investigate for these glasses is India.[56]

Glassmaking sites are very difficult to identify in the archaeological record due in part to the absence of a durable slag, such as might be found at a metalworking site.[57] Instead, only the finished

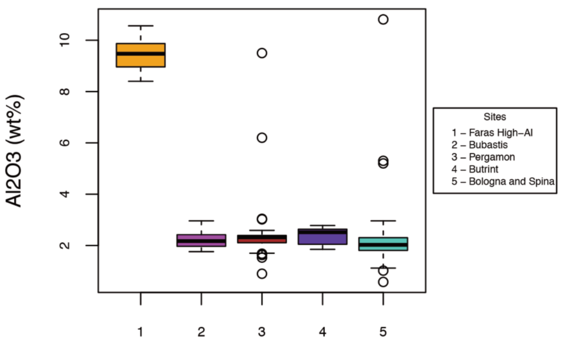

Figure 3: Boxplot of Al_2O_3 levels for Faras high-aluminium, Bubastis, Pergamon, Butrint, and Bologna and Spina glasses.

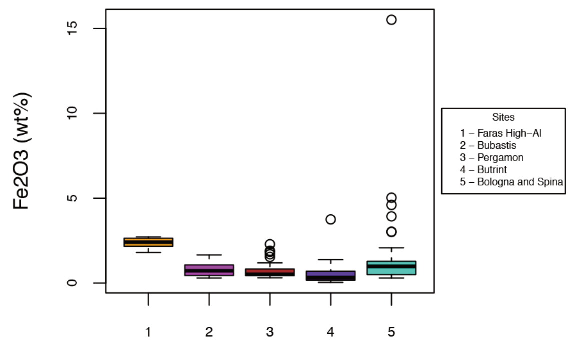

Figure 4: Boxplot of Fe2O3 levels for Faras high-aluminum, Bubastis, Pergamon, Butrint, and Bologna and Spina glasses.

product and objects such as crucibles, kilns, furnaces, and working waste can provide clues to the presence of glassmaking facilities.[58] Surface finds at the Indian site of Kopia in Sant Kabir Nagar District of Uttar Predesh hinted at it being a glass-manufacturing site.[59] The site of Kopia is attested by ceramic finds to have been occupied from the Fine Grey Ware material period (FGW, 700–600 BCE) and continuing into the Gupta Period of about 400–600 CE.[60] Archaeological excavations at Kopia revealed crucibles with molten glass attached, tuyeres, and a furnace to firmly confirm its identification as a glass-manufacturing site.[61] These finds by themselves do not indicate a link between Indian-produced glass and EA51716, but in addition to these excavations, two samples of riverine sands (CMG 9710 and CMG 9711) from near the site of Kopia, a possible silica source for glass making, were chemically analysed.[62] The levels of iron II oxide and alumina for CMG 9710 and CMG 9711 are compared to those from EA51716 in Table 3.

The identification of the high alumina present in the sands from Kopia and comparable high levels in EA51716 indicates a similarity of the natural contaminants of the silica source and suggest the possibility of an Asian origin for the Faras material. Alongside analyses of riverine sand from Kopia are published chemical analyses of glass identified as being of the Asian glass group known as "mineral-soda glass with high alumina" (abbreviated as m-Na-Al or mNA glass),[63] which has highlighted the striking chemical similarity between mNA glass and EA51716. This group was identified by Brill in 1987, and among its characteristics are a high alumina content, usually above 6 wt%, and low magnesia (MgO) (usually below 1 wt%).[64] EA51617, in addition to its high alumina content, also has magnesia levels of 0.7–1.18 wt%. When the average levels of alumina, iron II oxide, and copper II oxide (Cu_2O) for EA51716 are compared with those of other mNA glasses from Southeast Asian contexts, an interesting similarity emerges. The published analyses of the mNA glasses were divided into groups based on their colour, blue, red, black, and orange.[65] As

Table 3: Values of iron II oxide and alumina for CMG 9710, CMG 9711, and EA51716 (average) (data for CMG 9710 and CMG 9711 from Kanungo and Brill 2009, 18).

E51716		CMG 9710		CMG 9711	
Al_2O_3	Fe_2O_3	Al_2O_3	Fe_2O_3	Al_2O_3	Fe_2O_3
9.41%	2.37%	8.36%	3.74%	7.39%	2.23%

Table 4: Average values of the natural contaminants and the colourant for the blue, red, black, orange mNA glasses and EA51716 (data for mNA blue, red, black, and orange from Lankton and Dussubieux 2006, 129, table 2.).

Glass Type	Al_2O_3 (Contaminant)	Fe_2O_3 (Contaminant)	Cu_2O (Colourant)
Blue mNA	**9.4%**	1.3%	0.5%
Red mNA	**9.4%**	**2.0%**	1.4%
Black mNA	**9.3%**	**2.0%**	0.0%
Orange mNA	10.5%	3.1%	**7.0%**
EA51716	**9.41%**	**2.37%**	**7.03%**

EA51716 is of an unusual orange colour, such a comparison based on colour has the potential to show not only a similarity to a glass group but also a specific colour within this glass group. The results of these comparisons between mNA blue, red, black, and orange and EA51716 are shown in Table 4.

It can be seen from Table 4 that there is a very clear similarity between the alumina and iron II oxide levels of EA51716 from Faras and the blue, red, and black mNA type (bolded in Table 4). The orange mNA-type glass shows higher averages of alumina and iron II oxide, but the final key part of this comparison is the level of the colourant, copper II oxide. When the levels of copper II oxide of mNa blue, red, and black are compared to EA51716 there is a very clear difference, but making the same comparison between EA51716 and the mNA orange samples shows an almost a perfect match (bolded in Table 4). As the EA51716 samples are all orange in colour, this combined with the high levels of alumina and iron II oxide demonstrates that these glasses from Faras were almost certainly produced in India, being of the mineral-soda glass with high alumina type. No other available glass analyses have produced such a convincing match.[66]

The results therefore strongly suggest that glass was making its way from India and eventually ending up in Nubia. The beads from Faras would have travelled from India to the Red Sea ports.[67] The exact mechanism for their arrival in Nubia will be discussed below in the context of trade, specifically evidence for glass trade, between the Roman and Indian worlds. It should be noted, however, that there is not necessarily a correlation between the time of manufacture and the time of deposition. The possibility of "heirloom" artefacts cannot be ruled out.

Glass Trade from India

The textual and archaeological evidence above clearly shows that glass (as both raw material and finished product) was traded from the Mediterranean, via the Red Sea, to India. While the above comparison shows a SE Asian origin for EA51716, what is less clear is how much glass might have been travelling from India to the Red Sea ports. What is also impossible to identify at this point is whether any movement of glass was the result of an organised trading network (whether direct or indirect) or simply due to glass objects being carried as personal items by the sailors and traders, and by which ports this material may have made its way into Egypt. Recent work by an American-Polish team at the port site of Berenike may begin to answer some of these questions. Of particular interest and relevance to this study is the excavation of 2,000 beads and pendants during the 2009–2012 seasons.[68] These beads came from early- and late-phase contexts of the occupation of Berenike, corresponding to the 3rd century BCE to 3rd century CE (contemporary to the Nubian Meroitic Period) and 4th century CE to beginning of 6th century CE (post-Meroitic Period/X-Group/Ballana Culture), respectively.[69] Joanna Then-Obluska performed a macroscopic examination of the beads excavated from this site. Only the results of the examination of the glass beads are relevant here. Then-Obluska observed that:

> a large part of the late Roman glass bead assemblages could be of Indo-Pacific Origin. Monochrome beads made of drawn glass and characterised by more or less rounded ends stand in support of this hypothesis.[70]

Of interest to the current study are the beads classified as "[d]rawn and rounded glass: monochrome." Then-Obluska also observed that "beads with rounded ends were common finds on the Indian subcontinent."[71] This bead type was the "most common glass bead type in late Berenike contexts (late Roman refuse dump in trench BE10-59) explored in season 2010 (637 objects)."[72] Included among the many colours was opaque orange. It must be stressed that to date no chemical analysis has been performed on these beads and the conclusions that follow are therefore based on a purely stylistic comparison between examples of these orange beads and EA51716. In the first place there is a very strong visual resemblance between EA51716 and the example given in Then-Obluska's article, including the darker orange stripes across the beads.[73] As shown above, this rather unusual orange colour was achieved using copper as the colourant and it was the concentration of this colourant in EA51716 and mNA (high-alumina mineral soda) orange beads that, along with the alumina and iron II oxide levels, gave the final confirmation that EA51716 is mNA glass. Because of this and the visual similarity, it indicates the possibility that these orange beads from Berenike have a South East Asian origin. In addition, the X-Group/Ballana Culture dating for EA51716 and the corresponding dating of these objects from Berenike also shows the presence of glass of a similar type in a comparable time period. The presence of these beads in a rubbish dump at Berenike may indicate that they were not necessarily part of a specific trade in glass objects, more that they were "everyday" objects.

Ports by their very nature provide opportunities for people from many different cultures to come together, bringing with them ideas, traditions, and innovations. An example of the possible movement of artisans and technologies can be found in the context of shipbuilding that combines materials from the Indian Ocean with Mediterranean construction techniques.[74] Additionally, Peter Francis has asserted that glass-bead makers from Arikamedu would move along the Indo-Pacific sea routes, but no evidence has yet been found to prove their presence at Berenike or production of monochrome beads.[75] Then-Obluska therefore concludes that these beads are imports.[76] The question is whether they were imported deliberately, were part of a means to barter and trade for other objects, or simply a personal object that ultimately ended up in Nubia, perhaps by chance.

The route by which these beads moved from Berenike to the Nile Valley could have been along the roads that linked the port to Koptos. This road is approximately 380 km long,[77] and according to Pliny (*Naturalis Historia* 6.26.103) this route involved a twelve-day trip. While there was a road linking Berenike with Apollonopolis Magna (Edfu), a survey by Steven Sidebotham has revealed that this route fell out of use in the Late Ptolemaic or Early Roman Period, with the road from Berenike to Koptos rising to prominence, particularly in the mid- to late 1st century CE.[78] Another route, revealed by Sidebotham's survey, is that linking Berenike to Syene (Aswan).[79] Thus there was a choice of route that the material found at Faras could have followed in travelling from the port into Egypt. How these items came to Nubia is less clear.

In addition to the Egyptian Red Sea ports mentioned in the *Periplus*, is the port of Adulis "about 3000 stades beyond Ptolemaic Thêrôn" (*Periplus* 4).[80] The *Periplus* describes Adulis as "a legally limited port of trade" (*Periplus* 4:2.6), and Lionel Casson calls it "a modest village."[81] The *Periplus* describes Adulis as being

> a journey of three days to Koloê, an inland city that is the first trading post for ivory, and from there another five days to the metropolis itself, which is called Axômitês [Axum], into it is brought all the ivory from beyond the Nile through what is called Kyêneion and from there down to Adulis. (*Periplus* 4).[82]

The ivory was exported from Adulis and traded to the Roman Empire.[83]

As the *Periplus* has been dated to the 1st century CE, this means that it is possible that by the X-

Group/Ballana Culture time period Adulis could have grown. Recent surveys have discovered a port, probably that mentioned in the *Periplus* and by Pliny the Elder (*Naturalis Historia* 6.34.173), and more of the site from the 4th century CE has been revealed with it, implying that there were two ports at Adulis, one early, the other of late Roman date.[84] Glass has been found at the site, with 1st century CE sources including "glass from Judea" among their imported products.[85] Finds now in the National Museum of Eritrea include 400 glass objects with a wide date range of 1st millennium BCE to the 6th–7th century CE.[86] Unfortunately, there is not yet the same wealth of evidence or even precise dating possible for this Eritrean material, nor are there any beads that resemble those from Faras, such as were found at Berenike. Any role Adulis might have played in EA51716's arrival in Nubian can, therefore, only be speculative.

In addition to the evidence provided by the *Periplus* and archaeological excavations along the Red Sea coast from Berenike for the movement of glass, there has also been recent work on the East African coast where finds of beads of the mNA group highlight the trade in this glass type from South Indian and Southeast Asian sites. While these sites date to just after the time period attested by EA51716 at Faras, evidence of this (direct?) connection between India and Africa must also be briefly considered, as just like the material at Faras, while we may have a deposition date, that does not mean that such objects were not present at these sites at an earlier time.[87] Sites that have provided the best comparison with the Faras mNA glasses are on the island of Zanzibar, where mNA-type orange-coloured glass, amongst others, has been found.

The Zanzibar material comes from finds made during 2011 and 2012 archaeological excavations as part of the Sealinks Project at the 7th to 10th century CE sites of Unguja Ukuu, a significant port town on the southwest coast of Zanzibar opposite present-day Dar es Salaam, and Fukuchani, lying on the northwest coast.[88] The mNa glass type accounts for 64.8% of the Zanzibar beads tested.[89] Five different subtypes of this glass type have been identified by Dussubieux et al., dating from c. 5th century BCE to the 19th century CE.[90] Two of these types, mNA 1 and mNA 2, are found at sites in Africa, although the timespan for when this glass occurred at the African sites sampled to date are more restricted.[91] It is the mNA 1 subtype that is present in the Zanzibar bead samples.[92] Of the 192 mNA 1 beads, 167 in these contexts are a translucent blue-green. Previous excavations at Unguja Ukuu by Jurna recorded a large number of drawn translucent blue-green beads in Period Ia (500 to 700 CE) contexts.[93] Wood et al. consider it likely, therefore, that mNA 1 beads are "the earliest glass beads yet recognised on the East Coast."[94] Should they prove to be of this earlier date, then that would give a c. 100-year period when beads of this particular type are attested in both Zanzibar and Nubia.

Of particular interest among the glasses discovered in Zanzibar are orange-coloured beads of the mNA 1 type, the first time beads of this colour have been recorded in eastern Africa.[95] The average values for the analysis of natural contaminants (Al_2O_3, Fe_2O_3) and colourant (Cu_2O) for these mNA 1 beads from Zanzibar are compared in Table 5 to those from Southeast Asian contexts and

Table 5: Average values of the natural contaminants and the colourant for EA51716, orange mNA glasses from SE Asian sources, and orange mNA glass from Zanzibar (data for orange mNA from Zanzibar from Wood et al. 2015, Online Resource 4, < https://static-content.springer.com/esm/art%3A10.1007 %2Fs12520-015-0310-z/MediaObjects/12520_2015_310_MOESM4_ESM.xlsx >, accessed 23 April 2019).

Glass Type	Al_2O_3 (Contaminant)	Fe_2O_3 (Contaminant)	Cu_2O (Colourant)
EA51716	9.41%	**2.37%**	**7.03%**
Orange mNA (SE Asian sources)	10.5%	3.1%	**7.0%**
Orange mNA (Zanzibar)	10.4%	**2.13%**	**6.79%**

EA51716 from Faras, Nubia.

The comparison clearly shows the high resemblance among the Zanzibar beads, those from Southeast Asia, and those found at Faras. While the Al_2O_3 levels are closer in the Zanzibar and Southeast Asian beads, the Fe_2O_3 concentrations are more closely similar between the EA51716 samples and those from Zanzibar. In terms of the colourant, levels for all three are very similar. The chemical resemblance between the orange mNA beads from these sites also raises the possibility of a similar production site. This in turn makes it possible that these beads arrived in Nubia by an alternative route to the Red Sea trade. One possibility is that they arrived at a more southerly African port and headed up the coast to Berenike, where beads of a similar colour have been found (see above). There is also the possibility of inland travel, via established caravan routes through Nubia and, later, via the kingdom of Aksum, both of which acted as "gateways" to the treasures of central Africa.[96]

Movement of Ideas from India

The Indian Ocean trade route permitted economic exchanges between the Mediterranean, Pacific Ocean, and the regions of Europe, Africa, Arabia, India, and East Asia.[97] But it was not only objects that moved along these trade routes. As Francis suggested, the artefacts were accompanied by people who brought different ideas and traditions, bringing innovations to the indigenous culture. Trade between the Egyptian Red Sea ports and India reached its peak well before EA51716 was deposited.[98] This calls into question how much contact there might have been between the Indian and Egyptian/Nubian cultures before EA51716 entered Nubia, and how much Indian influence, if any, can be identified.

One example of such contact might be seen at the Meroitic cities of Naqa and Musaeearat es Sufra, sites that held strategic positions on the trade route between the Nile and Red Sea.[99] The site of Naga, 29 km east of the Nile (170 km northeast of Khartoum), has a number of temples and religious buildings. One, the "Roman Kiosk," has been dated to the 1st century CE, and its location in front of the Lion Temple shows a merging of Roman-Hellenistic, Egyptian, and indigenous cultures, seen, for example, in the Roman-inspired god with a Mediterranean-type beard, wearing the crown associated with the lion god Apedemak.[100] A scene on the outside of the Lion Temple that is of particular interest, as it shows Apedemak, the lion-headed god, being "uniquely represented as a three-headed god with four arms, a common attribute of Indian gods."[101] As A. Arkell points out, this is not seen in the Nile Valley but is very familiar in India, seen with examples of Siva on coins in the 2nd century CE. [102] Furthermore, Haaland describes the position of Apedemak's hands, with his fingers displayed, which is similar to Indian iconography, being hand positions of the *mudra* convention that are prominent from both Hindu and Buddhist traditions.[103] Also at Naga, Apedemak is seen with the body of a snake emerging from what Shinnie[104] and Wildung describe as being a "lotus-flower."[105] Again, this iconography is reminiscent of Hindu and Buddhist traditions.[106] Such styles of representation are seen in India in connection with Ashoka's edifices and along 3rd century BCE trade routes through the Maurian Period (325–184 BCE).[107]

Another site that shows cultural influences from India is Musawwaret es Sufra, 30 km east of the Nile (20 km north of Naqa), the location of the most famous temple of Apedemak.[108] Here we do not see Apedemak represented in Indian-influenced scenes as at Naqa, but there are other Indian-influenced cultural features. For example, a column drum depicting a number of gods in unusual high relief and one figure that has been described as sitting in a "yoga-like" position.[109] Most significantly, there are also a number of elephant representations at the site. Indeed, the Meroitic name of the site, "Aborepi," has been translated as "place of the Elephant."[110] There has been debate as to how much of an influence India had on the symbolism of these elephant depictions.[111] One such representation of the king wearing the crowns of Upper and Lower Egypt riding an elephant bareback, accompanied by a *mahout* (elephant trainer) kneeling in front of the elephant, is considered by Arkell to be quite foreign to the Nile Valley and to have been inspired by Indian cultural traditions.[112] A further relief on the northwest wall of the Lion Temple shows elephants leading prisoners on ropes, with the elephants wearing elaborately made clothes, something Haaland observes as being "unusual in Meroitic culture but common in India, as we can see of [*sic*] the relief of an elephant from the Pitalkhara cave, dated to *ca.* 2nd century BCE to 2nd century CE."[113]

Haaland suggests that it may have been the *mahouts* who carried the traditions we see depicted, as the elephants show similarities to Asian elephants in the size and shape of their ears.[114] Other cultural ideas could have been carried by them and transmitted to sites such as Mussawwarat and Naga, particularly as these sites are geographically close.

Conclusions

Identification of the EA51716 beads, found in Nubia, as belonging to the Southeast Asian high-alumina mineral soda group has shown that glass made in India or Southeast Asia was making its way across the Indian Ocean. The exact means by which it arrived at Faras is still a matter for speculation, but from current archaeological evidence it would appear that the glass entered Egypt at the Red Sea port of Berenike, headed to Koptos via the desert road, and then somehow made its way south to Faras. Recent glass finds have also provided new evidence that there might have been trading links between India and East Africa requiring a different, possibly overland, route by which EA51716 could have entered Nubia.

The presence of apparently Indian-inspired reliefs of Nubian gods indicates that it was not only objects that were moving from India but also ideas. This invites the question of how much material from Asia could have travelled into Egypt and Nubia and, furthermore, what other ideas and traditions from Asia could have been introduced to the west by this route, influencing the cultures with which they interacted.

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Notes

1 Sagui 2007, 212.

2 Sagui 2007, 212.

3 Henderson 1985, 277.

4 Rehren and Freestone 2015, 234.

5 Rehren and Freestone 2015, 234.

6 Rehren and Freestone 2015, 234.

7 Schibille et al. 2016, 1.

8 Jackson and Nicholson 2010, 299; Tite et al. 2008, 9; Walkton et al. 2009, 1502.

9 Shortland et al. 2007, 781–789.

10 For example, Schibille et al. 2016, 1–19; Freestone et al. 2000, 65–83.

11 Rehren and Freestone 2015, 236.

12 Freestone et al. 2002, 257–272.

13 Sidebotham 1986, 2.

14 Theophrastus *Enquiry into Plants*, on cotton, rice, frankincense, myrrh, cassia, balsam, and cinnamon (4.4.8; 4.4.10; 4.4.14), on Indian barley (8.4.2); on pepper (9.20.1); on descriptions of the frankincense and myrrh trees (9.4.1-10); on the properties of myrrh see *Concerning Odor* 32.

15 For other references to Indians in Ptolemaic papyri, see Stein 1929, 35.

16 Sidebotham 1986, 2.

17 Sidebotham 1986, 2. This idea persisted in some later works of Classical literature; see Cobb 2018b 519–559 (specifically 520 n.2 and 524) for a brief discussion.

18 Sidebotham 1986, 2

19 Sidebotham 1986, 2–3. For more recent discussion of the development of trade activity in the Red Sea in the Ptolemaic era, see: Sidebotham and Zych 2016, 1–34, Zych et al. 2016, 315–348 (Ptolemaic era activity at Berenike), and, more generally, Cobb 2019, 17–51.

20 Török 2009, 385; cf. Phillips 1997, 445ff.

21 Sidebotham 1986, 3.

22 Young 2001, 27.

23 See Pliny *Naturalis Historia* vi 22–24/84-91 (Pliny 1945, 401–409); Millar 1998, 529.

24 Fitzpatrick 2011, 39.

25 For example, see: Casson 1986, 73–79; Casson 1990, 195–206; Casson 1980, 22. Merchants from southern India, and possibly other regions of the subcontinent, also appear to have visited Myos Hormos and Berenike, either staying there or potentially traveling to Alexandria for a few months in the year before they could make the return journey to India. Their presence at these ports may be inferred from finds of coarse/domestic South Asian wares, rice consumption, and Brahmi script. See Cobb 2018a, 150–155.

26 Casson 1980, 39; Casson 1989. See Adams 2007, 9–10 for discussion on survival of papyrical evidence.

27 Casson (1980, 39) favors the dates of between 60–120 CE, while Fitzpatrick (2011) gives a date of 40–70 CE, as does Millar (1998, 529). For a brief summary, see Cobb 2018a, 22–24.

28 Casson 1989, 15.

29 Casson 1980, 39.

30 Casson 1989, 21. See also de Romanis 2016, 97–110.

31 Casson 1989, 13. Pliny *Naturalis Historia* 6.102–103 gives in detail the route to Berenike; for Myos Hormos, see: Strabo 2.5.12 (118); Casson 1980, 22.

32 Sidebotham 1986, 48. Strabo (2.5.12) says that it was in the reign of Augustus that Roman maritime trade with these regions was greater than under the Ptolemies: "Now one hundred twenty ships sail from Myos Hormos to India. Before, under the Ptolemaic kings, only a few vessels undertook to sail there and carry back Indian merchandise" (Sidebotham 1986, 49). There may also have been an increase in direct trade with Sri Lanka, at least by a few Roman/Byzantine merchants in the Late Antique Period; see de Saxcé 2015, 53–73.

[33] Young 2001, 28.

[34] Young 2001, 28.; Casson 1989, line 38. Young (2001, 142) believes that the ports where ships from Carax docked in "Scythia" were the same as those from Egypt, Barygaza and Barbarikon.

[35] Starcky 1949, 96.

[36] For example see Colledge 1976, 76, pl. 103.

[37] See Ghirshman 1958, 265–268.

[38] Casson 1989, 22.

[39] Casson 1989, 22.

[40] Casson 1989, 75.

[41] Casson 1989, 81. A third form was also imported, millefiori and mosaic wares "numerous types of glass tones and also of millefiori glass of the kind produced in Diospolis" (*Periplus* 6), but they will not be discussed further; Botan 2014, 159.

[42] Borell 2010, 127.

[43] Borell 2010, 127.

[44] Borell 2010, 127–129.

[45] Borell 2010, 127–129.

[46] Borell 2010, 129.

[47] Borell 2010, 127–129.

[48] Botan 2014, 164.

[49] I would like to thank the conservators and curators of the British Museum (A. Meek, Dr D. Welsby) for allowing me access to this material.

[50] Griffith 1925, 87.

[51] Griffith 1925, 86.

[52] Full details of the analysis and results can be found in Spedding, 2018.

[53] Henderson 1985, 270.

[54] Rehren and Freestone 2015, 235.

[55] Data for Bubastis from Rosenow and Rehren 2014, 170–184; data for Pergamon from Rehren, Connolly, Schibille, and Schawrzer 2015, 266–279; data for Butrint from Schibille 2011, 703–712.

[56] I. Freestone, pers. comm.

[57] Rehren and Freestone 2015, 235.

[58] Rehren and Freestone 2015, 235.

[59] Kanungo and Brill 2009, 12.

[60] Kanungo and Brill 2009, 13.

[61] Kanungo and Brill 2009, 13.

[62] Kanungo and Brill 2009, 18.

[63] Dussubieux et al. 2008, 2.

[64] Lankton and Dussubieux 2006, 127.

[65] Lankton and Dussubieux 2006, 129.

[66] Gallo et al. 2013, 2589–2605; Arletti et al. 2011, 2094–2100; Arletti et al. 2010, 703–712; Mirti et al. 2008, 429–450; Mirti et al. 2009, 1061–1069; Rehren et al. 2015, 266–279; Rosenow and Rehren 2014, 170–184; Schibille 2011, 2939–2948.

[67] Casson 1980, 21–36; Casson 1984, 39–47; Casson, 1989; Deo 1991, 39–45; Fitzpatrick 2011, 27–54; Millar 1989, 507–531; Sidebotham 1986; Young 2001.

[68] Then-Obluska 2015, 736.

[69] Then-Obluska 2015, 736.

[70] Then-Obluska 2015, 751.

[71] Then-Obluska 2015, 753.

[72] Then-Obluska 2015, 753.

[73] Then-Obluska 2015, 755, fig. 4, no. 38.

[74] Heldaas Seland 2017, 10.

[75] Francis Jr., 2002; Then-Obluska 2015, 766.

[76] Then-Obluska 2015, 766.

[77] Sidebotham 2011, 128.

[78] Sidebotham 2011, 160. The Muziris Papyrus (mid-2nd century CE) shows the presence of a customs house at Koptos, goods remaining there under seal before being taken to Alexandria where the 25% tax would be levied. See: Casson 1986, 73–79; Casson 1990, 195–206; de Romanis 2014, 73–89; Morelli 2011, 199–233; Rathbone 2000, 39–50; and Thür 1987, 229–245.

[79] Sidebotham 2011, 128.

[80] Casson 1989, 51.

[81] Casson 1989, 20.

[82] Casson 1989, 53.

[83] Haaland 2014, 656.

[84] Sidebotham 2011, 187; Geresus et al. 2005; Peacock and Blue 2007, 135–140; Peacock et al. 2007, 2–5, 7–9, 31–32, 37, 57–64, 79–86, 95–96, 103–104, 112, 125–134; Habtemichael et al. 2004; Munro-Hay 1982, 107.

[85] Zazzaro 2013, 5.

86 Zazzaro 2013, 32.

87 Other investigations of mNA-type glass found at African sites include: Robertshaw et al. 2003, 139–146; Robertshaw et al. 2006, 91–109; Robertshaw et al. 2010, 1898–1912; Sinclair et al. 2012, 723–737; Wood et al. 2009, 239–261; and Wood et al. 2012, 59–74. The contexts for this material, however, are after the time period attested for the samples from Faras, and while the samples at the African sites could have arrived in Africa far earlier than is indicated by their deposited, without further evidence they cannot be discussed further here. These later African samples do, however, show the links between Southeast Asia and Eastern and Southeastern Africa and highlight other possible means for this glass type to have reached Africa, potentially to make their way to Nubia.

88 Wood et al. 2015, 1–2.

89 Wood et al. 2015, 6.

90 Dussubieux et al. 2010.

91 Wood et al. 2015, 6.

92 Wood et al. 2015, 6.

93 Wood et al. 2015, 20.

94 Wood et al. 2015, 20

95 Wood et al. 2015, 8.

96 Török 2009, 466–467.

97 Fitzpatrick 2011, 44. Fitzpatrick considers this consistent with Schaffer's understanding of the role India played in global trade; see Schaffer 1994, 1–21.

98 On this general issue see Cobb 2015, 362–418.

99 Haaland 2014, 661.

100 Haaland 2014, 661; Shinnie 1967, 92; Kroeper 2011; Wildung 2011.

101 Haaland 2014, 662.

102 Arkell 1951, 35.

103 Haaland 2014, 662.

104 Shinnie 1967, 113.

105 Wildung 2004, 175.

106 Haaland 2014, 662.

107 Haaland 2014, 662.

108 Haaland 2014, 664.

109 Haaland 2014, 664; Shinnie 1967, pl. 22.

110 See Rilly and de Voogt 2012, 102.

111 See Wenig 1978, 177–178.

112 Arkell 1951, 36; Arkell 1961, 166.

113 Haaland 2014, 665.

114 Haaland 2014, 668.