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Stone Beads of the Indus Tradition: New Perspectives on Harappan Bead Typology, Technology and Documentation

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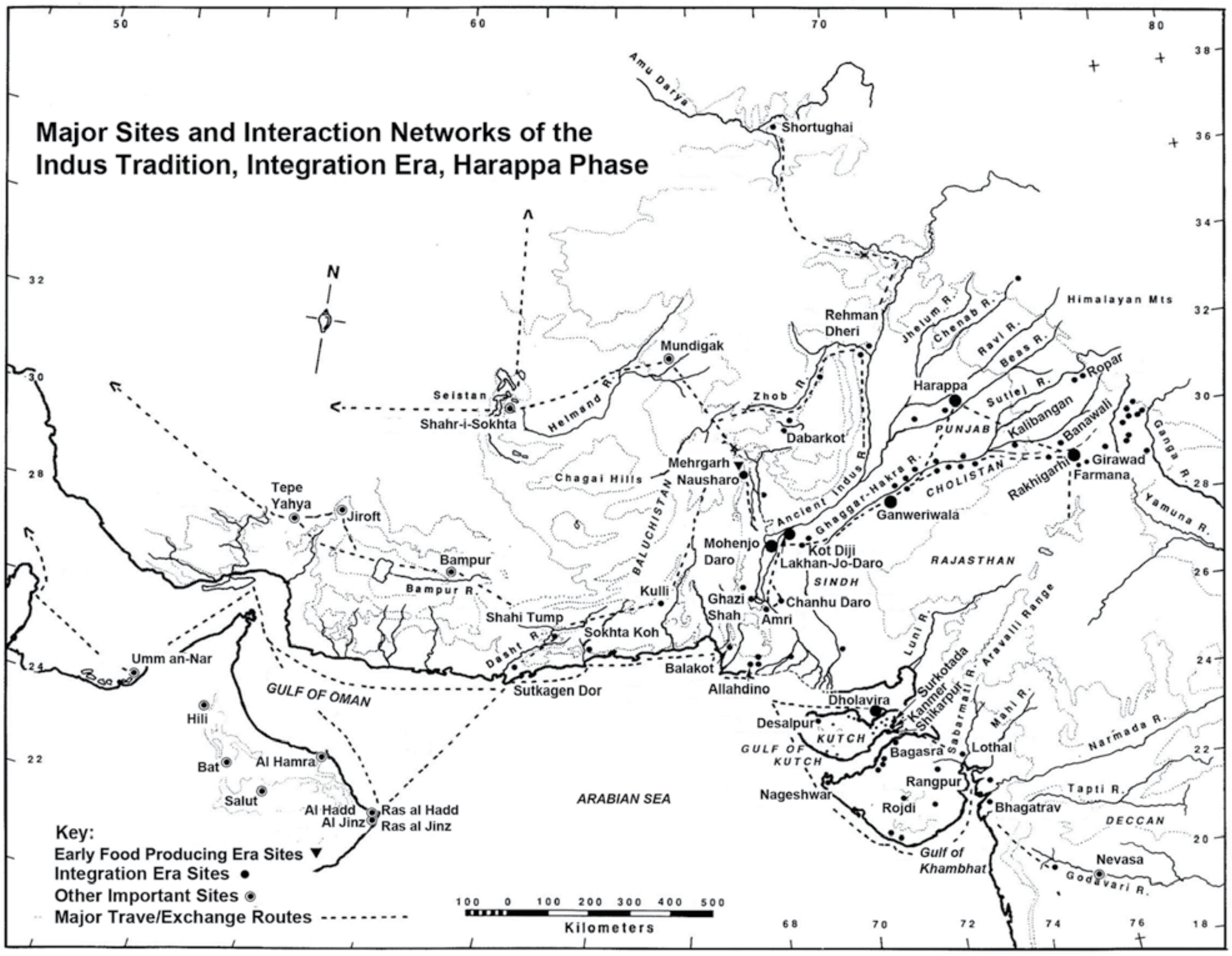
INTRODUCTION

The study of stone beads from sites of the Harappan Culture or Indus Civilization has been an important part of the archaeological research since the 1920s, beginning with the initial excavations at the sites of Harappa (Vats 1940) and Mohenjo-daro (Marshall 1931). The methods used to study Indus stone beads by scholars like Horace Beck (Beck 1928) and Ernest Mackay (Mackay 1933, 1937) were borrowed from methods being used in contemporaneous excavation projects in Mesopotamia and the Mediterranean region. These scholars also modified some of their terminologies and approaches to accommodate the rich variety of beads that were uncovered in the excavations of Indus sites, particularly after the discovery of the large stone bead workshop at the site of Chanhudaro, Sindh (Mackay 1943). Because of the great competence of these early scholars, and their foresight in developing a comprehensive typology for describing bead shapes and styles, it is not surprising that most subsequent archaeological projects have adopted the general terminology proposed by Beck and Mackay, without further critical evaluation. This approach was also reinforced by the major books and articles on beads produced by scholars such as M.G. Dikshit (1949), S.B. Deo (2000), as well as numerous excavation reports that have used their terminologies for describing the beads from sites dating to all major prehistoric and historical periods (Bannerjee 1959, Durrani et al. 1995, Kenoyer 2005, Ludvik 2012, Pande 2000,



| **Fig. 1.** Map of the Indus Region.

Rao 1979, Reade 1979, Schüssler et al. 2001, Sharma 1969, Vats 1940).

In my own research and articles on beads from Indus period sites, such as at Mohenjo-daro, Balakot, Harappa and Dholavira (Fig. 1), I have continued to use the same general terminology proposed by Horace Beck and Ernest Mackay because of its wide acceptance in the field. However, at the same time new data has been collected to better characterize Indus stone beads and to develop a more complex and detailed typology that is more sensitive to chronological changes in technology and style. This new approach involves the documentation of new variables regarding the specific variety of raw material (see Kenoyer History of Stone Beads this volume, Fig. 5), how it was processed, shaped, drilled (see Kenoyer History of Stone Beads this volume, Fig. 8), polished, decorated, and used (Kenoyer 2005). In addition, post-depositional processes such as weathering and burning are recorded that often obscure the critical information needed to make interpretations about the role of a bead in society that used it and discarded it. Some of the bead types proposed by Beck (Beck 1933), Mackay (1937: Pl. II, 6-10) and later by Reade (1979: 15) and Koiso (2008: Fig. 16), such as black on white etched beads, are not appropriate because they are the result of burning or post-depositional processes and not the result of cultural choices of the ancient bead makers. The new approach to stone bead identification and interpretation that I am developing is a continuously evolving process and must be modified as new techniques of analysis and documentation are developed. The main

Table 1: Chronological Framework of the Indus Tradition.

Foraging Era	Mesolithic and Microlithic	10,000 to 2000 BCE
Early Food Producing Era	Mehrgarh Phase	7000 to 5500 BCE
Regionalization Era	Early Harappan Phases	5500 to 2600 BCE
Integration Era	Harappan Phase	2600 to 1900 BCE
Localization Era	Late Harappan Phases	1900 to 1300 BCE

features of the recording techniques and typological approach to the study of Harappan stone beads will be presented below in order to facilitate future comparisons of stone beads between sites of the Indus Civilization and other related cultures.

INDUS CHRONOLOGY

One of the main objectives in studying beads is to determine their role in social, economic and ritual aspects of early societies. It is also important to define the chronological framework for a specific region in order to determine if beads of a specific type can be used as markers for different chronological time periods. The chronological framework used in this article follows the overall chronology for the Indus region presented in more detail in earlier publications (Table 1) (Kenoyer 1991, 2014, Shaffer 1992).

CHANGING ROLE OF STONE BEADS

Stone beads have not been reported from any Palaeolithic site in South Asia, but there is evidence for the use of ostrich egg-shell beads more than 30,000 years ago during the late Middle Palaeolithic and Upper Palaeolithic Periods in peninsular India (Bednarik 1993, Francis 1981, Kumar et al. 1990). The shapes of these beads were flat discs or more precisely short cylinders made by chipping, grinding and drilling flat pieces of ostrich egg shell. Detailed morphometric studies of these early ostrich eggshell beads have not been undertaken, but the approaches discussed below would be directly applicable to this body of data to better understand regional variations in bead diameters, drill hole diameters and drilling mechanisms in order to better understand their production and change over time. During the Palaeolithic period, beads represented one of the first preserved indicators of personal ornamentation among human communities, and as such were probably important symbols of individual identity, personal beliefs and cultural identity. Beads may have been used to distinguish one community from another, but there is not enough evidence to demonstrate this as a general cultural tradition.

The time period when we have clear evidence for the widespread production of marine shell and also stone beads begins around 7000 BCE during the Early Food Producing Era (Table 1) (Kenoyer 1991, 2015) at sites such as Mehrgarh (Barthélemy De Saizieu 2003, Jarrige 1982). The technologies used to shape these beads involved basic lithic technologies of chipping, grinding, sawing, snapping, drilling and smoothing, which have been well documented for stones such as steatite (Vidale 1995) and lapis (Tosi and Vidale 1990). The shells found at Mehrgarh and other later sites were used for personal ornamentation and also buried with the dead. Shell and stone beads and pendants were used in necklaces, headdresses, bracelets and anklets, as well as probably attached to clothing or worn in the hair (Barthélemy De Saizieu 2003). Burials at Mehrgarh provide a full range of ornament styles and the fact that ornaments were included in burials indicate the ritual importance of these ornaments not only during life but also for use or protective properties in the afterlife.

The types of raw materials used during the Early Food Producing Era include black steatite, white calcite or limestone, white fired steatite, light blue to blue-green turquoise, deep blue lapis-lazuli, greenish-black chlorite, dark green serpentine, red-orange carnelian, and a deep red-brown iron ore called Goethite (Barthélemy De Saizieu 2003). During this early period, stone beads were generally quite irregular in shape and made in relatively simple forms. After the extinction of the ostrich in South Asia at the end of the Pleistocene, white disc beads or short cylindrical forms began to be made from marine shell or soft stone such as steatite or chlorite. Marine shell and stone were also used to make new bead shapes, including long cylindrical, oblate to spherical, short and long barrel, biconical and tabular shapes.

During the Early Harappan period, there appears to have been some major shifts in the Indus region relating to the production and the use of stone beads. New types and colours of stones were collected from various resource areas to produce a wide range of bead shapes that built on the earlier forms, but also developed distinctive shaping processes that were used to accentuate natural patterns in the stone. In addition, there is evidence that Indus crafts persons began to develop colouring techniques that involved heating to colour and in some cases to glaze the surface of stone. By the beginning of the Harappa Phase, *c.* 2600 BCE, most of the major technological developments for producing stone beads had been established and these techniques are relatively similar to those used in other parts of the ancient Old World. The one major new development during the Harappa Phase was the discovery and development of constricted cylindrical drills using the hard stone Ernestite (Kenoyer and Vidale 1992) (see Kenoyer History of Stone Beads this volume Fig. 8). The development of this new drilling technique allowed Harappan bead makers to produce long and slender carnelian beads (Figs. 2 and 6) that were unique in the ancient world and were produced for both internal use by elites in Indus cities as well as for trade to other regions to the west of the Indus reaching as far as Mesopotamia (Kenoyer 2008) and even into Anatolia (Ludvik et al. 2015).

DOCUMENTING STONE BEADS (SEE APPENDIX 1)

In order to study stone beads, it is first important to identify the type of raw material and to determine if it is stone or some other material. Visual observation using a 10X hand lens is the most direct method of raw material identification, followed by determination of specific gravity, hardness and where necessary the use of X-ray florescence or X-ray defraction (Banning 2000: Chapter 8) (see Kenoyer History of Stone Beads this volume Fig. 5). The type of stone raw material is important to determine first in order to accurately observe and document other features of the production process and surface features. A soft stone such as unfired steatite, which has a hardness of 1 on the Moh's scale, will generally be worn and smooth. It also might have traces of sawing, as well as copper or stone drilling. If it has been hardened by firing, it might have traces of white or red or glazed surfaces. In contrast, a stone like chalcedony or carnelian, with a hardness of 7 on the Moh's scale, is unlikely to have been sawn, unless it was done with a copper blade and abrasive. For the prehistoric period, this type of stone could have been drilled using percussion, or a hard stone drill, or a copper drill with abrasives. The surfaces may have been chipped, ground and polished using various tools and materials. Each raw material has specific identifying characteristics and associated aspects of production that set it apart from other raw materials. Occasionally, a raw material that is processed in a unique manner is found that makes it stand out from the normal pattern. For example, a hard stone bead may have been carved and inlayed with pigment or a different type of rock to create a distinctive pattern. Such variations provide insight into the distinctive styles of specific sites or chronological periods.

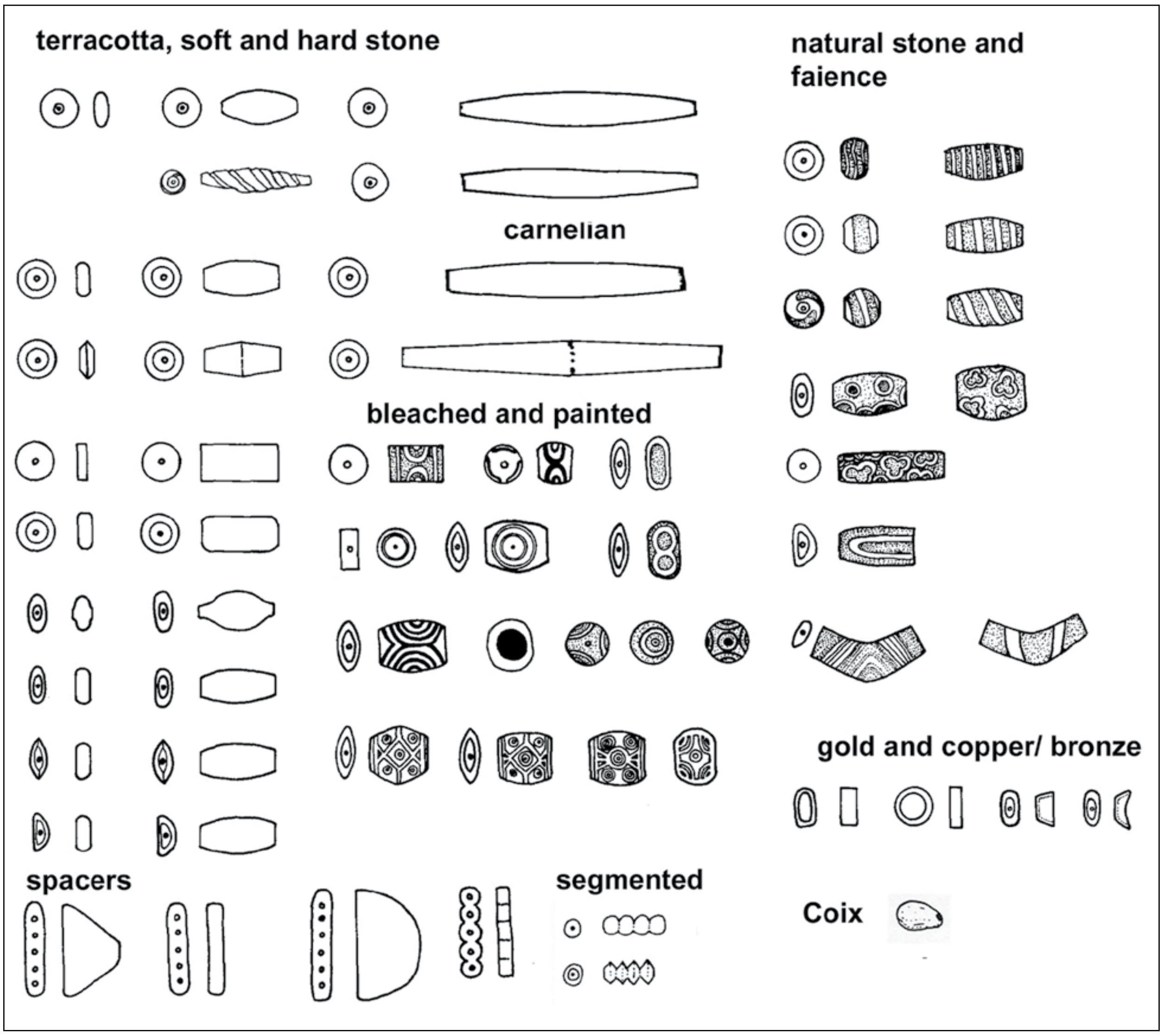


Fig. 2. Harappa Phase: Major bead types in all raw materials.

The next step is the measurement of all preserved features of the bead (Figs. 3 and 4) using non-metallic digital callipers if possible to avoid damaging the surface of the bead. Long cylindrical beads have a different set of measurements as compared to short biconical beads, or spherical beads. The number of measurements that should be taken depends on the types of studies being undertaken and the time available for making measurements. One of the most effective ways to document beads is to place them on a flat-bed digital scanner to make a scan of the bead using a scale and a contrasting background. The bead can be rotated and turned in different directions to try and record different views. After scanning different views of a bead, the digital images can be pieced together to provide a composite image showing all the relevant sides of a bead along with a scale and the bead number (Fig. 5). This is the best way to document each bead and is much more efficient than traditional photography. Scanning is also a more effective and safer technique when documenting lots of disc beads that can then be measured digitally on the computer. Great care should be taken when measuring thin steatite disc beads to avoid breaking the bead under the pressure of the calliper. Once a bead has been measured, it is possible to accurately define the

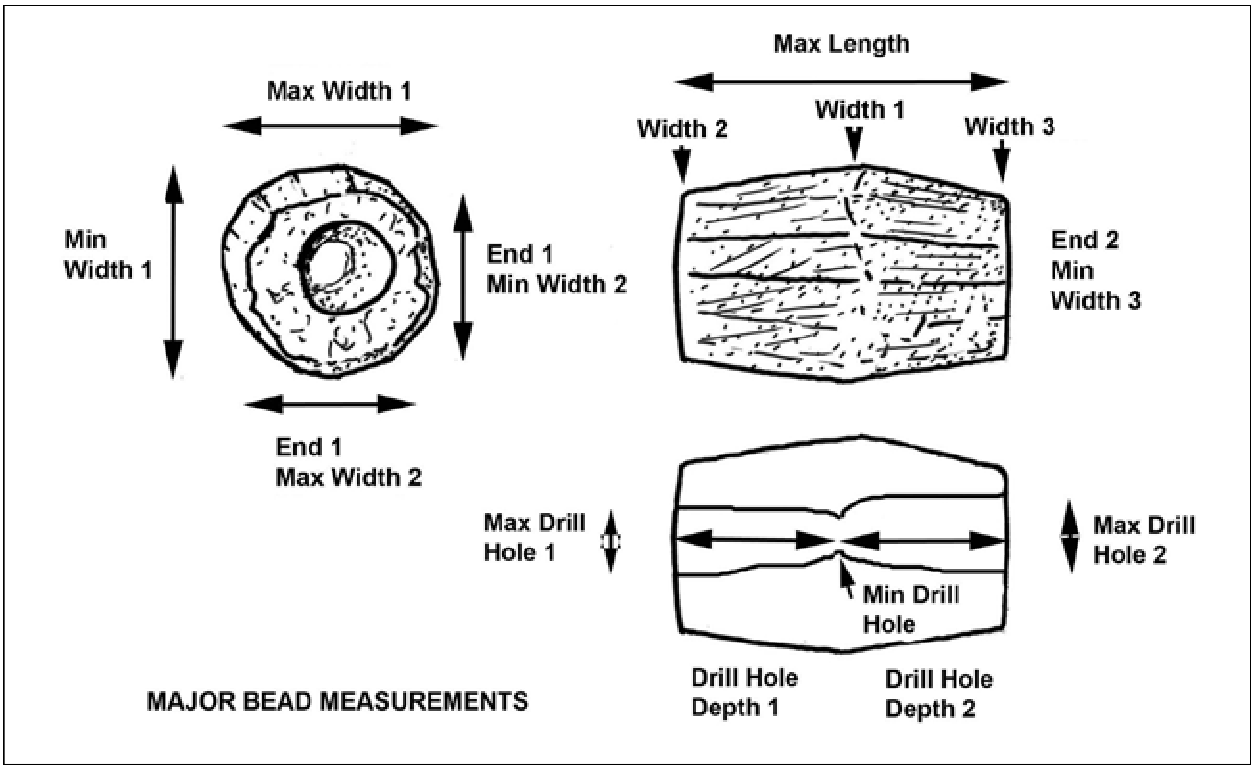


Fig. 3. Basic bead measurements.

bead shape, as some shape categories are based on the ratio between bead width and bead length. Even though scanning is the most effective technique for documentation, it is also important to take photographs of beads using raking light in order to properly document details of bead surfaces. Whenever possible, photography should be done to complete the overall documentation of a bead and for publication purposes.

BEAD SHAPE DOCUMENTATION

Most stone beads of the Indus Tradition are bilaterally symmetrical and therefore can be easily defined using basic geometric shapes (Fig. 6). A bead can be examined by looking first from the direction of the perforation and from this direction the bead shape is referred to as its transverse section (Beck 1928: 2). The orientation of beads for illustration should be horizontal to the perforation, which is the convention established by Beck. Some scholars have begun to orient beads with the perforation axis in a vertical position, but this is not the way most beads are worn and in my own research I only orient beads that have been strung as pendants in the vertical direction. The width measurements of a bead are taken perpendicular to the axis of the primary or longest hole. Bead sections can be described as being circular, oval, lenticular, elliptical, square, rectangular, triangular, pentagonal (five sided), hexagonal (six sided), octagonal (eight sided), irregular, etc. Turning the bead 90° to look at it along the length of the perforation or longitudinal section (Beck 1928: 2), the shape is once again determined using basic geometric shapes with the addition of a measurement proportion that is based on the maximum width to length.

At the most general level, beads that have a length measurement less than the maximum width are considered to be short (Fig. 6); beads that are longer than their maximum width are considered to be long. Beck defined many different types of beads, some of which are relevant to Indus beads, while others are not very useful. For example, "A standard

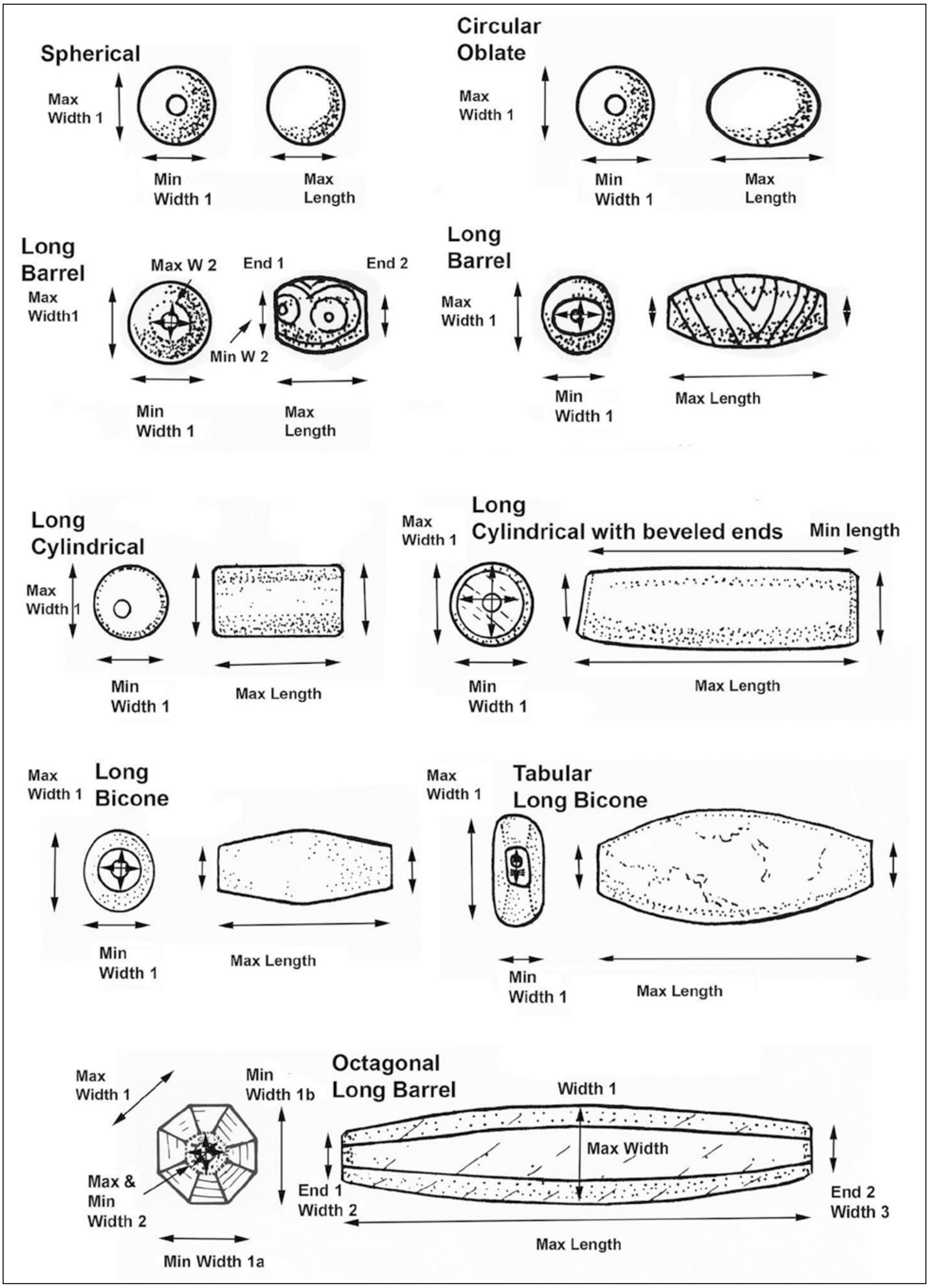


Fig. 4. Bead measurement examples.

Fig. 5. Bead scan composite.

bead is a regular bead in which the diameter is approximately the same as the length. In order to fix it more definitely, it is one which has the length more than nine-tenths and less than one and a tenth times the diameter" (Beck 1928: 4). He also defines disc beads as "A disc bead is a regular bead in which the length is less than one-third the diameter of the bead. Very thin disc beads are sometimes called 'wafer beads'" (Beck 1928: 4). At the time that Beck proposed these definitions, there were no detailed studies of bead assemblages and he was making this definition arbitrarily. In my own study I have avoided the use of the term standard bead, as it is necessary to first define what Indus bead makers were trying to achieve in terms of specific shapes. Once a large enough database is acquired from each of the excavated Indus sites where beads were being produced, it will be possible to determine the precise range in sizes of specific beads and also determine if there are specific favoured ratios of length to width during different time periods. To better define the bead types, it is necessary to measure a large number of beads from a specific chronologically defined assemblage to determine more precise ratios of length to width that are the result of cultural choices in bead shape manufacture. A preliminary study of Harappan beads indicates that there are at least six divisions of length to width category for some specific shapes of beads. The so-called "wafer" beads defined by Beck are "Very Very Short Cylindrical" beads. The other Harappan beads fall into the categories of "Very Short", "Short", "Long", "Very Long", and in a limited range of shapes there are "Very Very Long" beads (Fig. 6).

BEAD COMPLETENESS

After the raw material and the basic bead shape or type is recorded, it is necessary to determine the completeness of the bead. This determination is important for sorting the bead database at a later point to develop measurement ratios and proportions. A "complete" bead is not necessarily perfectly preserved, but is one that has all relevant measurable parts. For example, a bead can be determined as being complete even if it has a slight chip at one end, or a spall off one side, since it is possible to measure the entire length of the bead and the maximum width. A bead that has been broken and reground is also a complete bead, because the broken bead was once again modified in the past to reshape the broken edge to make it a functional bead. A bead can be complete, broken at one end, broken at both ends, split longitudinally, or be just one end or one central fragment.

BEAD CONDITION AND SURFACE FEATURES

The next stages of documentation are to record the condition and surface features of the bead. Condition refers to the overall preservation of a bead, either fresh, burned, rolled, weathered, etc. There can be several overlapping conditions and all need to be recorded. The various surface features reflect production processes and post-depositional processes, such as weathering and burning.
Most early bead researchers have recognized the importance of recording such features as "wear and tear" (Xia 2014: 4) in order to determine if beads were reused or curated for long periods of time, but none have developed a protocol for more precise documentation. In the study of Indus beads, there are several different variables that have been defined to document different aspects of "wear and tear." These variables are somewhat overlapping and

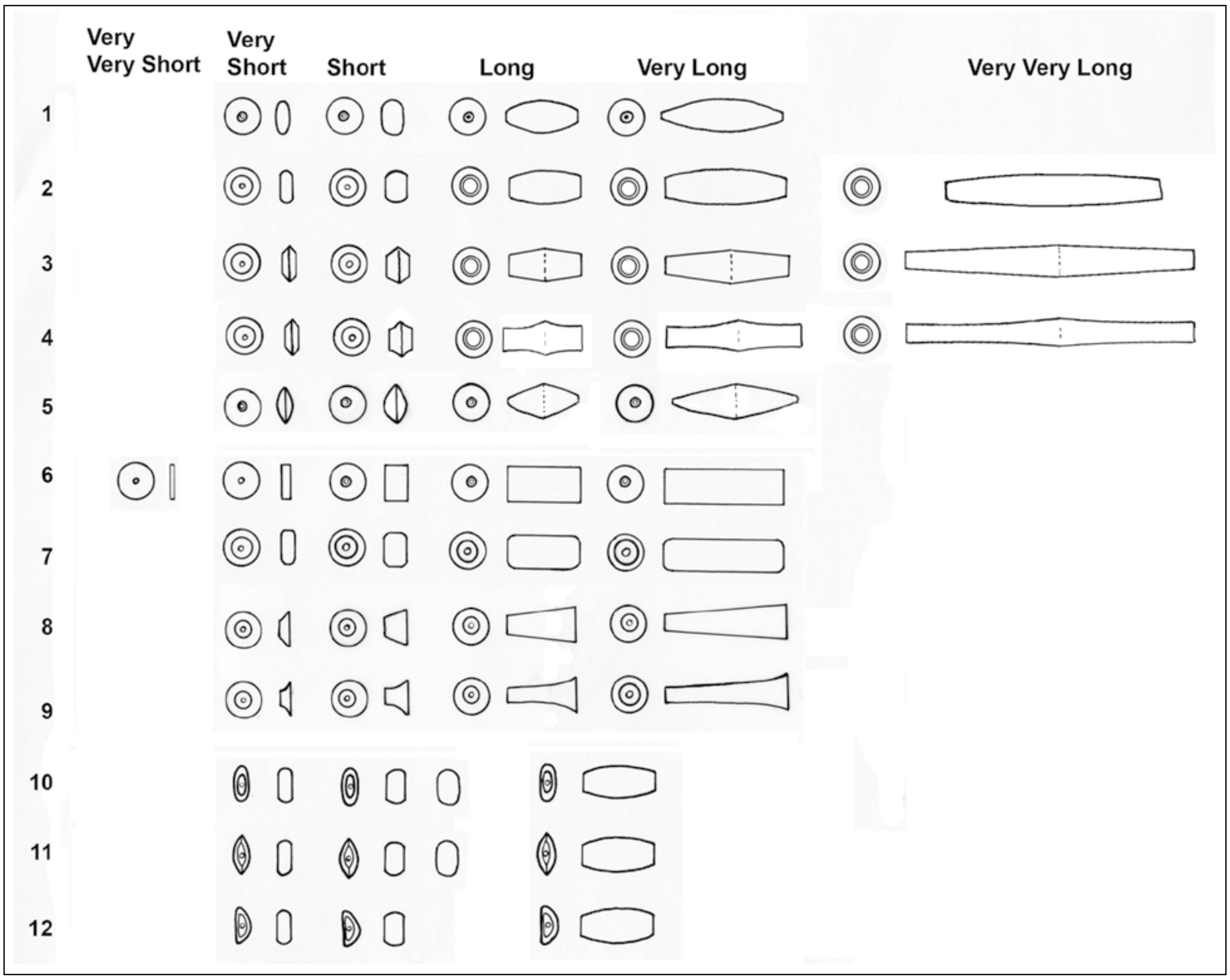


Fig. 6. Harappan bead typology sample (1 to 9. Circular transverse section, and various shaped longitudinal sections, 10. Oval transverse section, and various shaped longitudinal sections, 11. Lenticular transverse section, and various shaped longitudinal sections, 12. Plano-convex transverse section, and various shaped longitudinal sections).

redundant but together they can help to sort out the various ways in which a bead is produced, used, weathered and buried.

The surfaces of the bead provide key indicators of manufacturing processes and use wear, so it is first necessary to document the condition of the bead surface. If the surface is weathered, rolled, abraded, etc., then it may not be possible to determine if it was ever polished properly. A weathered bead can also be whitened intentionally or from burial in alkaline soil. Some beads are whitened from burning or blackened and fire cracked. All types of post-depositional conditions should be documented before describing the actual preserved surface of the bead. The surface of the bead preserves a record of manufacture and use, such as chipping, sawing, grinding, low or high lustre polish, use wear, percussion weathering, etc. Some beads have all of these features, because they were not made in a manner that removed all traces of earlier stages of production. For example, some Indus beads were roughly made with little effort to remove traces of chipping or grinding before they were drilled, polished and used. In contrast, some beads have been carefully polished to remove all or most traces of earlier manufacturing stages. If a bead surface were described as being highly polished on all surfaces, it would mean that all traces of chipping and grinding had been removed by carefully polishing the surface.

The degree of finishing is based on the type of workshop that was producing the bead as well as the preferences of the consumer that used the bead. Some bead workshops, such as the one discovered by Mackay at Chanhudaro, were producing multiple qualities of beads that may have been made for different markets or for different purposes (Mackay 1937). Based on careful studies of the Chanhudaro beads in the collections that are still in Pakistan as well as ones in the USA at the Boston Museum of Fine Arts and the University of Pennsylvania Museum, it is evident that this workshop was producing roughly made short biconical beads perforated by pecking, and only partly ground and polished (Mackay 1937: Pl. 1, 7). In the same workshop they were also producing exquisitely shaped, ground and polished long biconical carnelian beads drilled with specialized Ernestite drills (Mackay 1937: Pl. 1, 8). None of these beads were ever used as they were buried before ever being marketed and there is no trace of string-wear on the interior drill holes. The differences in such beads are important for defining the nature of workshops and also the overall quality of the beads being produced.

In the study of beads from the site of Harappa, it is clear that some beads that were only partly ground and polished were used and worn for long periods of time before they were deposited in the archaeological record. In other cases, partly chipped and ground beads were lost shortly after they were perforated and do not appear to have been used at all. These later beads could be examples that were unfinished. Similarly, there are some examples of beads that have been perfectly smoothed and highly polished, but there is no evidence of wear on the drill hole and it is possible that they were lost prior to being worn, but they are clearly finished beads. These minute features of beads are important to record in order to better reconstruct their use life and role in the ancient economic and cultural context where they were produced.

DRILLING DOCUMENTATION

The documentation of bead drilling requires that the bead drill hole is carefully cleaned and if possible a silicone impression should be taken of the drill hole. This will allow for complete and accurate documentation of the technology used to perforate the bead (Fig. 7). Harappan beads show a great deal of variation in drilling techniques as well as in the actual process of drilling. More detailed documentation of these features will help to identify drilling styles that can be linked to specific workshops or changes in cultural traditions over time. The main sets of information needed to fully document drilling is 1) the nature of the drilled surface, 2) the directions of drilling, 3) the distance, 4) alignment of the drilling, and 5) the shape of the drill hole. Using a 10X hand lens, it is possible to determine some basic features of the drilled surface such as pecked surface, parallel drilling striae matte surface, parallel drilling striae high polished surface, irregular scratches, longitudinal striae, or worn smooth from wear, etc.

Drilling can be from one side or two sides of the bead and the bead needs to be placed in a vise so that is stable for the drilling process. The vise can be a hole in a piece of wood in which the bead is stable and will not turn or fall out. Alternatively a bead can be embedded in a mastic or resin and held in place so that it can be drilled. These two techniques were probably the preferred technique for holding beads that were drilled only from one side. A different form of vise could have been made with two pieces of wood. The bead would be placed between the two pieces and then held in place by fastening the two pieces of wood tightly. After drilling partly through the bead from one side, the vise can be loosened and the bead rotated to allow drilling from the opposite end. With this technique the bead driller must be sure to align the drilling such that it meets directly at the tip of the first drilling. Generally speaking, Indus bead drillers were extremely skilled at centring the drill and

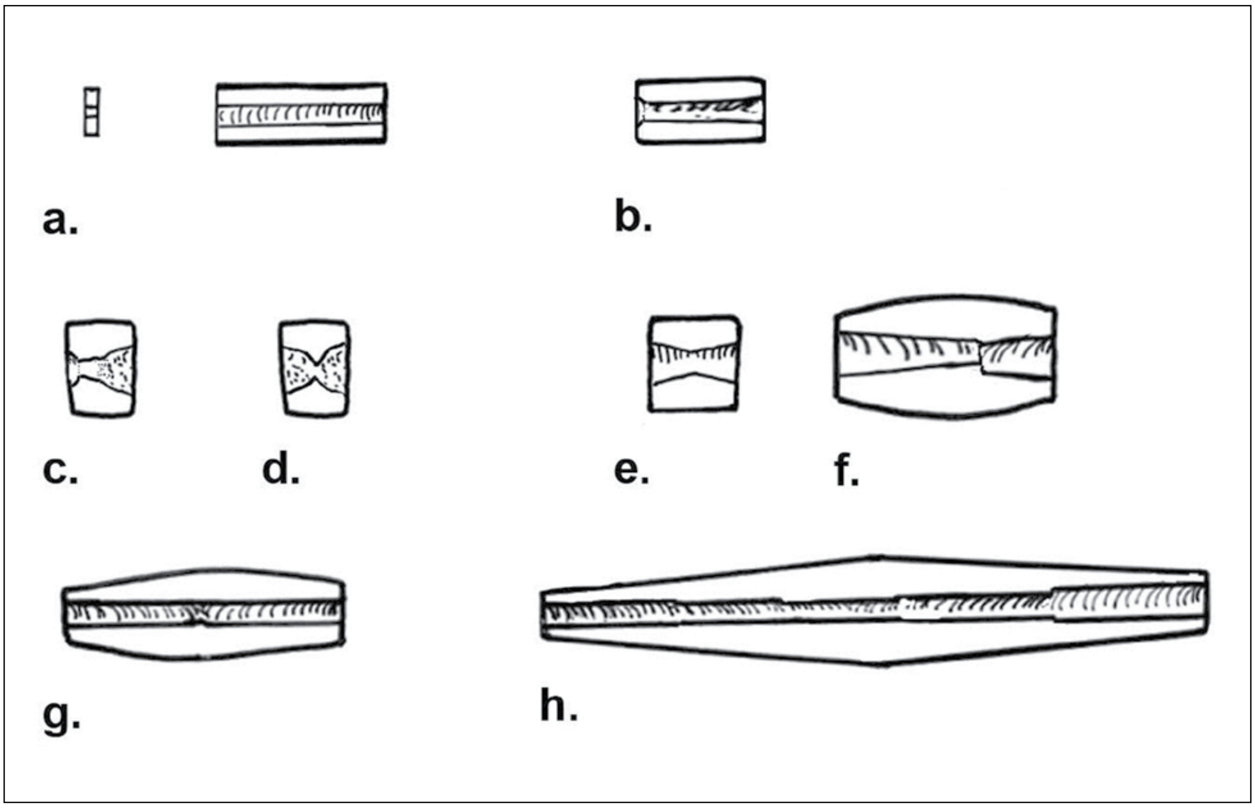


Fig. 7. Drill hole shapes and variations (a. straight cylindrical short and long, b. long tapered cylindrical, drilled from one side and popped out, c. short conical, drilled from one side and popped out d. short conical, drilled from two sides, meet in centre, drilled equally from both sides, e. short tapered cylindrical, drilled from two sides, meet in centre, drilled equally from both sides, f. long tapered cylindrical, drilled from two side, not centred, drilled more from one side, g. straight cylindrical, meet in centre, drilled equally from both sides, h. straight cylindrical, stepped drilling, meet in centre, drilled equally from both sides).

meeting perfectly in the precise midpoint of the bead. When the drill points do not meet perfectly, there is often a jagged edge where the two off-centre tips meet. This jagged edge can cut the string of a necklace and the beads can be lost more easily. In some cases, the wear of the string can be seen along part of this jagged edge and this provides evidence that the bead was worn for a very long time before it was eventually lost or buried.

The actual drilling itself can also be documented by examining the alignment of the drill hole, the number of drill sizes used in the drilling process, and the depth of drilling from each end of the bead. A hand-held drill will result in considerable lateral movement and irregularity of the drill hole, while a drill held in a stable vise will have a perfectly straight alignment.

BEAD END DOCUMENTATION

The exterior surface of the bead provides a general understanding of the use and post-depositional processes that have impacted the bead, but the ends of the bead provide unique insight into the ways in which a bead was strung, worn and reused (Fig. 8). Each end of the bead needs to be separately studied and documented. The use of a digital microscope to examine and photograph the ends of the beads is very useful for providing a photographic record of the end wear. During the Harappan Phase, some spherical beads show chipping and grinding, with high polish from use and string wear at the edge of the drill hole (Fig. 8a). Other short biconical beads that were perforated by pecking were only partly ground on the ends, leaving traces of the initial chipping still visible (Fig. 8b). These beads were

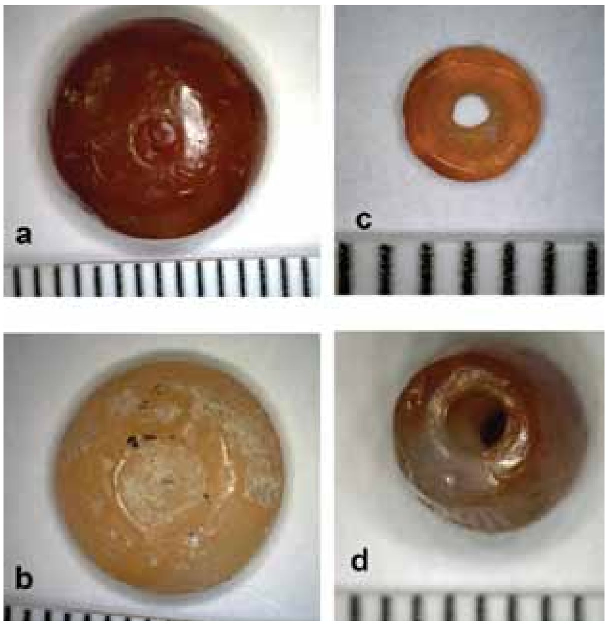


Fig. 8. Bead end wear (a. chipped, ground, high polish, string wear, b. chipped, ground, worn, string wear, c. chipped, popped out drill hole, string wear, d. chipped, worn smooth, some chipping around drill hole, concave wear, high polish).

nevertheless used and worn for long periods of time such that the ends became heavily worn and in some cases resulted in high polish from wear. Many of the small carnelian short biconical or short cylindrical beads were only chipped on one side and they were perforated by pecking from one side and popped out from the other side, but show string wear from use (Fig. 8c). On other beads the ends were carefully ground and polished, in some cases with convex rounding from wear against another bead, and with traces of chipping around the edge of the drill hole from lateral movement of the drill during perforation (Fig. 8d). These indicators demonstrate that a specific bead was worn for a long period of time before it was lost or buried. Beads that do not show these features may have been lost before they were used from long periods of time.

CONCLUSION

The use of any typology for the study of artefacts is defined by the questions that are being posed of the assemblage. In this discussion of Indus beads, it is important to emphasize that there are many questions that can be answered using different levels of recording and analysis. The most basic issue relates to the acquisition of stone raw materials for making beads, from either local sources, as is the case with bead workshops in many parts of Gujarat, or from distant resource areas as is demonstrated in the workshops of Chanhudaro, Harappa and Mohenjo-daro. Another set of questions revolves around the organization of bead manufacture and the shapes and qualities of beads being produced in specific workshops. This area needs considerable research in order to develop more precise models for interpreting and defining the nature of bead making at specific sites during the Harappa Phase. Once this is accomplished, it could be possible to trace the movement of finished beads from one workshop to other parts of the Indus region and beyond. Finally there is the issue of bead used and reuse. Some of the beads found at Harappa and many of those studied at sites such as Gola Dhoro (Bagasra) and Dholavira, do not appear to have ever been used, and represent primary phases of production. In contrast, beads from the Indus that have been studied at sites in Oman or Mesopotamia have been used for many generations and in some cases even for thousands of years. As more Indus sites are excavated in South Asia as well as in other regions of West Asia, the study of beads needs to be more closely integrated so that scholars can compare the results of their studies with those from other sites. The approaches outlined above, along with the use of digital images that have high resolution, will be extremely useful in building a more robust database for further studies of this important group of artefacts.

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APPENDIX 1. INDUS BEAD RECORDING

(Adapted from Harappa Bead Recording Updated April 2016)

After recording all site information and individual bead identification number

ARTEFACT TYPE

Use general term or specific bead code (e.g. Figs. 4, 5 and 6)

RAW MATERIAL

Use geological term or raw material code (add details in comment section or separate column)

STATE

1 = complete, no damage
2 = complete, slightly chipped/broken
3 = one end missing
4 = both ends missing
5 = fragment, portion not determinable
6 = split longitudinally
7 = one end only
8 = central fragment

CONDITION

1 = fresh, not weathered
2 = slightly rolled/weathered
3 = heavily rolled/weathered
4 = burned/fire cracked
5 = whitened/"calcified"
6 = green "garbage" stained
7 = vitrified

EXTERIOR SURFACE

1 = natural surface/cortex
2 = partly ground
3 = ground smooth with visible striae
4 = smooth/no striae (high polish)
5 = smooth/rounded/worn (high polish)
6 = incised, design worn
7 = incised, design fresh
8 = incised, design faint
9 = not determinable as to design
10 = ground smooth, some natural surface
11 = ground, saw marks visible
12 = ground, saw marks, natural surface
13 = sawn, natural surface
14 = chipped
15 = chipped and sawn
16 = chipped and ground
17 = chipped, sawn, ground
18 = saw marks

19 = glazed
20 = slightly porous even
21 = smooth, no fingerprints
22 = smooth with fingerprints
23 = slipped and bleached surface
25 = smooth, hammered, folding
26 = sawn and ground (unfinished)
27 = sawn, ground, cortex
28 = hammered surface
29 = smooth, pecking/percussion weathering

BEAD MEASUREMENTS

Max. Length	mm
Min. Length	mm
Max. Width 1	mm
Min. Width 1	mm
Max. Width 2 (end one)	mm
Min. Width 2 (end one)	mm
Max. Width 3 (end two)	mm
Max. Width 3 (end two)	mm

Perforation Dia. – End 1	mm
Perforation Dia. – End 2	mm
Min. Perforation	mm

Bead Surface Design **See Surface Design Code**

Drill Perforation Surface

1 = parallel drilling striae, matte surface
2 = parallel drilling striae, high polish
3 = pecked, percussion drilling
4 = worn smooth, drilling not determinable
5 = smoothed (terracotta)
6 = weathered - not determinable
7 = longitudinal striae
8 = irregular scratches

Drilling Directions

1 = Drilled from one side, popped out
2 = Drilled from two sides
3 = Drilled from more than two sides
4 = Drilling directions not determinable – broken bead fragment

Drilling Distance (when drilled from two sides)

1 = Drilling equally from both sides
2 = Drilling more from one side (need measurements in comments section)
3 = Drilling more than half way from one side, does not meet in centre
4 = Drilling distance not determined – broken bead fragment

Drill length from side one	mm
Drill length from side two	mm

Drilling Alignment (when drilled from two sides)

1 = Drilling is perfectly aligned and centred
2 = Drilling is off centre, but do touch
3 = Drilling is off centre and holes do not touch, broken through with pressure
4 = Drilling alignment not determinable – broken bead fragment

Drill Section from Side 1 (and separately from Side 2)

1 = straight cylindrical, single drill size
2 = straight cylindrical, stepped (multiple drill sizes)
3 = straight cylindrical, collared (solid or tubular copper drill with abrasive)
4 = short concave conical (minimum drill hole is < ½ of maximum drill hole)
5 = long concave conical (minimum drill hole is < ½ of maximum drill hole)
6 = short conical (minimum drill hole is < ½ of maximum drill hole)
7 = long conical (minimum drill hole is < ½ of maximum drill hole)
8 = short convex conical (minimum drill hole is < ½ of maximum drill hole)
9 = long convex conical (minimum drill hole is < ½ of maximum drill hole)

10 = short tapered cylindrical (minimum drill hole is >= ½ of maximum drill hole)
11 = long tapered cylindrical (minimum drill hole is >= ½ of maximum drill hole)
12 = hole poked in from one side (terracotta)
13 = drilled from one side, popped through
14 = drilled from one side, rounded edge (not popped through)
15 = straight cylindrical with spiralling undulation (diamond drilling)

Drill Section from Side 2 (same code as above)

Bead End Wear (each end needs to be recorded separately – similar code as exterior surface)

1 = natural surface/cortex
2 = partly ground
3 = ground smooth with visible striae
4 = smooth/no striae (high polish)
5 = worn (high polish) – concave
6 = worn (high polish) – convex
7 = ground smooth, some natural surface
8 = ground, saw marks visible
9 = ground, saw marks, natural surface
10 = sawn, natural surface
11 = chipped
12 = chipped and sawn
13 = chipped and ground
14 = chipped, sawn, ground
15 = saw marks
16 = sawn and ground (unfinished)
17 = sawn, ground, cortex
18 = smooth, pecking/percussion weathering
19 = broken/snapped
20 = chipped, ground, worn smooth rounded
21 = ground, no striae, worn
22 = rounded worn, no striae visible
23 = chipped ground, polished, worn

Specific Gravity of Raw Material

REFERENCES

Bannerjee, N.R. 1959. The Technique and the Manufacture of Stone Beads in Ancient Ujjain, *Journal of the Asiatic Society* 1: 189-196.

Banning, E.B. 2000. *The Archaeologists Laboratory: The Analysis of Archaeological Data*. Toronto: Springer.

Barthélemy De Saizieu, B. 2003. *Les Parures De Mehrgarh: Perles Et Pendentifs Du Néolithique Préceramique Á La Période Pré-Indus: Fouilles 1974-1985*. Paris: Editions Recherche sur les Civilisations.

Beck, H.C. 1928. *Classification and Nomenclature of Beads and Pendants*, *Archaeologia* 77: 1-76.

Beck, H.C. 1933. Etched Carnelian Beads, *The Antiquaries Journal* 13: 384-398.

Bednarik, R.G. 1993. About Palaeolithic Ostrich Eggshell in India, *Bulletin of the Indo-Pacific Prehistosy Asscociation* 13: 34-43.

Deo, S.B. 2000. *Indian Beads: A Cultural and Technological Study*. Poona: Deccan College Post-Graduate and Research Institute.

Dikshit, M.G. 1949. *Etched Beads in India*. Poona: Deccan College: Postgraduate and Research Institute.

Durrani, F.A., I. Ali and G. Erdosy 1995. The Beads of Rehman Dheri, *Ancient Pakistan* 10: 15-81.

Francis, P. 1981. Early Human Adornment in India, Part I, the Upper Palaeolithic, *Bulletin of the Deccan College Past Graduate Research Institute* 40: 137-144.

Jarrige, J.F. 1982. Excavations at Mehrgarh: Their Significance for Understanding the Background of the Harappan Civilization, in *Harappan Civilization* (G.L. Possehl ed.), pp. 79-84. New Delhi: Oxford and IBH Publishing Co.

Kenoyer, J.M. 1991. The Indus Valley Tradition of Pakistan and Western India, *Journal of World Prehistory* 5: 331-385.

Kenoyer, J.M. 2005. Bead Technologies at Harappa, 3300-1900 BC: A Comparison of Tools, Techniques and Finished Beads from the Ravi to the Late Harappan Period, in *South Asian Archaeology 2001* (C. Jarrige and V. Lefèvre eds.), pp. 157-170. Paris: CNRS.

Kenoyer, J.M. 2008. Indus and Mesopotamian Trade Networks: New Insights from Shell and Carnelian Artefacts, in *Intercultural Relations between South and Southwest Asia. Studies in Commemoration of E.C.L. During-Caspers (1934-1996)* (E. Olijdam and R.H. Spoor eds.), pp. 19-28. Oxford: BAR International Series 1826.

Kenoyer, J.M. 2014. The Indus Civilization, in *The Cambridge Prehistory* (C. Renfrew and C. Bahn eds.), pp. 407-432. Cambridge: Cambridge University Press.

Kenoyer, J.M. 2015. The Archaeological Heritage of Pakistan: From the Palaeolithic to the Indus Civilization, in *History of Pakistan* (R. Long ed.), pp. 1-90. Karachi: Oxford University Press.

Kenoyer, J.M. and M. Vidale 1992. A New Look at Stone Drills of the Indus Valley Tradition, in *Materials Issues in Art and Archaeology III* (P. Vandiver, J.R. Druzick, G.S. Wheeler and I. Freestone eds.), pp. 495-518. Pittsburgh: Materials Research Society.

Koiso, M. 2008. Etched Carnelian Beads and Trade Activities of the Indus Civilization, *Cultura Antiqua* (*Kodai Bunka*) 60: 95-110.

Kumar, G., A. Sahni, R. Pancholi and G. Narvare 1990. Archaeological Discoveries and a Study of Ostrich Eggshell Objects in India, *Man and Environment* 15: 29-40.

Ludvik, G.E. 2012. Stone Beads of Ancient Afghanistan: Stylistic and Technical Analysis, *Field Notes: A Journal of Collegiate Anthropology* 3: 1-8.

Ludvik, G.E., J.M. Kenoyer, M. Pieniążek and W. Aylward 2015. New Perspectives on Stone Bead Technology at Bronze Age Troy, *Anatolian Studies Journal* 65: 1-18.

Mackay, E.J.H. 1933. Decorated Carnelian Beads (India: Technology), *Man*: 143-146.

Mackay, E.J.H. 1937. Bead Making in Ancient Sind, *Journal of the American Oriental Society* 57: 1-15.

Mackay, E.J.H. 1943. *Chanhu-Daro Excavations 1935-36*. New Haven: American Oriental Society.

Marshall, J.H. 1931. *Mohenjo-Daro and the Indus Civilization: Being an Official Account of Archaeological Excavations at Mohenjo-Daro Carried out by the Government of India between the Years 1922 and 1927*. London: A. Probsthain.

Pande, B.M. 2000. Burzahom Beads, in *South Asian Archaeology 1997* (M. Taddei and G.D. Marco eds.), pp. 383-93. Rome: Istituto italiano per l'Africa e l'Oriente.

Rao, S.R. 1979. *Lothal A Harappan Port Town (1955-62)* Volume I. New Delhi: Memoirs of the Archaeological Survey of India No. 78.

Reade, J. 1979. *Early Etched Beads and the Indus-Mesopotamian Trade*. British Museum Occasional Papers 2.

Schüssler, U., C. Rösch and R. Hock 2001. Beads from Ancient Sri Lanka - First Results of a Systematic Material Analysis, in *Ancient Ruhuna: Sri Lankan-German Archaeological Project in the Southern Province* (H.-J. Weisshaar, H. Roth and W. Wijeyapala eds.), pp. 227-242. Mainz am Rhein: Verlag Philipp von Zabern.

Shaffer, J.G. 1992. The Indus Valley, Baluchistan and Helmand Traditions: Neolithic through Bronze Age, in *Chronologies in Old World Archaeology* (3rd Edition) (R. Ehrich ed.), pp. 441-464. Chicago: University of Chicago Press.

Sharma, G.R. 1969. *Excavations at Kausambi 1949-50*. Delhi: Manager of Publications, Government of India.

Tosi, M. and M. Vidale 1990. 4th Millennium BC Lapis Lazuli Working at Mehrgarh, Pakistan, *Paléorient* 16: 89-101.

Vats, M.S. 1940. *Excavations at Harappa: Being an Account of Archaeological Excavations at Harappa Carried out between the Years of 1920-21 and 1933-34*. Delhi: Government of India Press.

Vidale, M. 1995. Early Beadmakers of the Indus Tradition: The Manufacturing Sequence of Talc Beads at Mehrgarh in the 5th Millenium BC, *East and West* 45: 45-80.

Xia N. 2014. *Ancient Egyptian Beads*. London: Springer.