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SPACE AND SPATIAL ANALYSIS
IN ARCHAEOLOGY

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MOVING MOUNTAINS: THE TRADE AND TRANSPORT OF ROCKS AND MINERALS WITHIN THE GREATER INDUS VALLEY REGION

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ABSTRACT

The prehistoric urban center of Harappa is located in the middle of the Punjab plain of northwestern South Asia. There are no stone resources of any kind nearby, only sand and silt. Yet a great diversity of rock and mineral types are present at the site. This paper first examines Harappa's rock and mineral assemblage from the perspective of the greater Indus Valley's complex geology. The subsequent section will consider the *scale* – both quantity and bulk size – of the materials that were transported to Harappan cities. Next, the *distance* one would have to travel to acquire certain materials will be examined from the standpoint of the lack of stone resources around Harappa and the nature of the materials themselves. An outline of the several possible modes by which the physical *movement* of lithic commodities took place will follow. I conclude with a discussion of the differing *motivations* behind the acquisition and transport of rock and minerals in the greater Indus Valley region.

In this paper, I will present observations regarding the acquisition and the transportation of rock and mineral commodities to Harappa and other Indus Civilization sites from source areas located in the highlands (piedmont and mountains) of the greater Indus Valley region. Dependable access to sources of raw materials (including rocks and minerals) is essential for the growth and functioning of urban settlements and thus was a necessary precondition for the development of early state-level societies (Kenoyer 1991:343–344). However, past studies attempting to define these important resource areas for the Indus Civilization (Fentress 1977; Lahiri 1992) have relied too heavily on data from outdated, noncomprehensive geologic overviews and the limited information in century-old

British district gazetteer summaries. In order to produce the most accurate model of the extensive lithic exchange networks in the prehistoric Indus Valley, a project has been initiated that utilizes the vast body of contemporary geological literature, personal field observations, collection of raw rock and mineral samples from source areas, and geochemical comparisons of source materials to archaeological samples from the site of Harappa. The observations presented below regarding transportation systems are derived from recent fieldwork in Pakistan and India that marked the completion of the first phase of this project.

The Indus or Harappan Civilization (ca. 2600–1700 B.C.) encompassed over 680,000 km² (Kenoyer 1998:17) – more than twice the area occupied by its contemporaries in Egypt and Mesopotamia. Harappan sites across this great expanse shared many remarkable similarities in terms of their material culture, iconography and settlement pattern, and it was not uncommon for early investigators to speak of the Indus Civilization's cultural “uniformity” (Piggott 1950:140). Although regional variations have been defined (Mughal 1992), the geographical extent of the Harappan phenomenon demonstrates the presence of well-developed and far-reaching communication and transportation networks that bound its “various social groups as a distinct cultural entity” (Shaffer 1988:1316). The material assemblage at Harappa, the second-largest urban center and type-site of the Indus Civilization, reflects this enormous interaction system – especially in regard to its rock and mineral artifacts. A wide range of material types, from the comparatively common (such as quartzite and limestone) to the semiprecious (lapis lazuli and agate), is present at the site. However, Harappa lies in the center of a broad alluvial plain, hundreds of kilometres from any

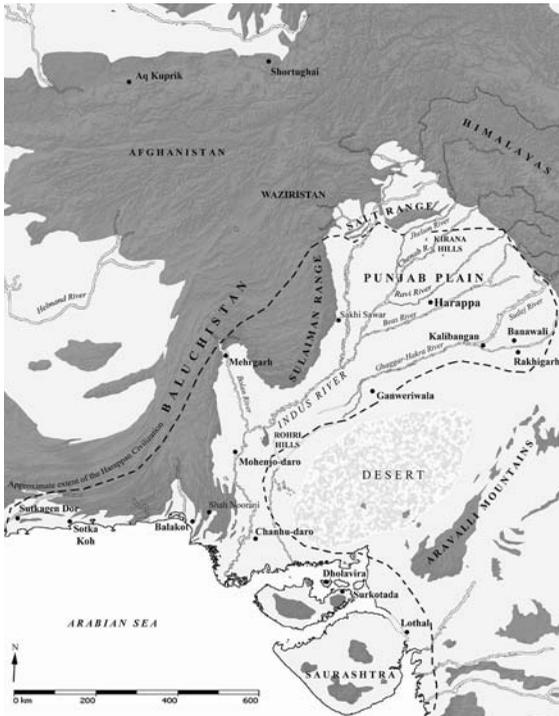


Figure 1. Sites and physical features of the greater Indus Valley region.

significant stone sources. All lithic materials found at the site, down to the smallest pebble, had to have been *transported* there by some human activity from the surrounding highland areas. Hypotheses regarding potential modes and avenues of transportation and the groups involved in them can be generated by considering the nature of Harappa's lithic assemblage, the material types themselves, and the physical aspects of the greater Indus Valley region.

In the first section of this paper, I will discuss the *diversity* of the rock and mineral assemblage at Harappa, and how it is a reflection of complex geology of the greater Indus Valley region, the city's position at a nexus of numerous trade routes, and the social composition of Harappan society. The subsequent section will consider the *scale* – both quantity and bulk size – of the materials that were transported to Harappan cities. Next, the *distance* one would have to travel to acquire certain materials will be examined from the standpoint of the lack of stone resources around Harappa and the nature of the materials themselves. An outline of the several possible modes by which the physical

movement of lithic commodities took place will follow. I will conclude with a discussion of the differing *motivations* behind the acquisition and transport of rock and minerals in the greater Indus Valley region.

DIVERSITY

A five-period chronology (Table 1; Meadow and Kenoyer 2001) has been established at the Indus Valley site of Harappa extending from its foundation ca. 3300 B.C. through its long urban phase extending from 2600 B.C. to approximately 1900 B.C.. Although quan-

Table 1. Harappa Chronology.

Period	Phase	Dates
Period 1	Ravi Phase	> 3300 B.C. – ca. 2800 B.C.
Period 2	Kot Diji (Early Harappa) Phase	ca. 2800 B.C. – ca. 2600 B.C.
Period 3A	Harappa Phase A	ca. 2600 B.C. – ca. 2450 B.C.
Period 3B	Harappa Phase B	ca. 2450 B.C. – ca. 2200 B.C.
Period 3C	Harappa Phase C	ca. 2200 B.C. – ca. 1900 B.C.
Period 4	Harappa/ Late Harappa Transitional	ca. 1900 B.C. – ca. 1800 B.C.
Period 5	Late Harappa Phase	ca. 1800 B.C.? – < 1300 B.C.

Note: After Meadow and Kenoyer 2001.

tification of the rock and mineral assemblage through each phase at Harappa is still in progress, the greatest diversity of material types appears to be found, not

surprisingly, in period 3 – when the Indus Civilization was at its greatest extent (Figure 1). Over 30 rock and mineral types have been identified from this period through various means including visual comparison, petrography, X-ray diffraction, and electron microprobe analysis (Kenoyer and Vidale 1992; Law 2001; Vats 1940; Vidale and Bianchetti 1997). Within certain material categories such as steatite, chert, and stone for grinding purposes (sandstone, quartzite), there are recognizable subvarieties present, indicating the utilization of multiple source areas (Law 2004). Geologic source provenance studies currently in progress of lead ore, alabaster, limestone, and agate-carnelian are expected to reveal that more than one source may have been used to obtain these materials. Similarly, varied rock and mineral assemblages have been described at other Harappan settlements including Mohenjo-Daro (Marshall 1931), Lothal (Rao 1985), and Chanhu-Daro (Mackay 1938a).

On one level, the variety of rock and mineral types present at Harappan cities is a reflection of the rich geology of the greater Indus Valley region. The Indian subcontinent's collision with the Asian Plate beginning approximately 55 million years ago (Powell 1979:16) is the ultimate source of this richness. Enormous beds of sedimentary detrital rock (sandstone and shale), carbonates (limestone and dolomite), and sulfide evaporates (gypsum and anhydrite) developed in the shallow Tethys Sea that existed prior to and during the convergence of the two continental plates (Bender 1995:11–13). As the Indian Plate subducted beneath Asia, these beds were folded, raised and exposed in massive sequences along the northern and western margins of the Indus Valley (Farah et al. 1984:161–163). Another product of this subduction was the development of volcanic island arcs and their associated rocks (basalt, rhyolite, andesite, etc.), which eventually were emplaced between the sutured continental margins (Shams 1995:131–133). Similarly, large fragments of oceanic crust (ophiolites – composed of basalt, gneiss, etc. and containing radiolarian cherts) were obducted onto the continental crust (Asraullah and Abbas 1979). Pressure and stress from the collision altered existing rock in myriad ways and brought to the surface highly metamorphosed rock from as deep as the earth's mantle (Shams 1995). East of the Indus Valley, some of the oldest rocks on the earth, the Indian basement complex, rise in the form of the Aravalli Mountains and are rich in metals and metamorphic minerals (Wadia

1975:94–95). Finally, gem varieties of agate and carnelian erode from the basalts of the Deccan Traps that extend into Gujarat and the Saurashtra Peninsula southeast of the Indus Valley (Merh 1995).

It should come as no surprise that the lithic assemblages of Indus Valley settlements, surrounded by areas with such extreme geologic diversity, might reflect this diversity. The city of Harappa, located in the center of the Punjab plain (Figure 1), was especially well placed in terms of direct access to multiple resource zones and/or other large urban centers that could provide rocks and minerals indirectly from more distant areas. To the west of Harappa are the Sulaiman Mountains and passes leading into Northern Baluchistan and Afghanistan. Moving clockwise, to the north are found the Salt Range and the routes into the remote valleys and mountains of Kohistan and the Hindu Kush. Continuing clockwise, one only needed to follow the rivers of the Punjab northeast to their sources in Kashmir and the greater Himalaya region to access the rich resources there. Lying east of Harappa are the settlements (including the large urban site of Rakhghari) of the eastern Punjab and Haryana that would have provided indirect access to the resources of the northern Aravalli Mountains. To the south, the city of Ganweriwala and other sites along the now dry Ghaggar-Hakra River system are points where interaction with the ancient nomads of the Cholistan desert (Mughal 1994) would have made available the resources the southern Aravallis and northern Gujarat. Finally, the route following the Indus River southwest towards Mohenjo-Daro, the largest Indus city, would have been a supply route for the raw material sources of the Rohri Hills, Sindh Kohistan, and southern Baluchistan.

The composition of Harappan society would have also influenced the site's diverse rock and mineral assemblage. The current state of research suggests that Harappa and other Indus cities were likely occupied and/or utilized by peoples of different communities, classes, and ethnicities (Kenoyer 1998:126–127). Although Indus cities lacked the temples, palaces, and ostentatious burials that are considered indicators of elite status in other state-level societies, clear evidence that a high degree of social stratification and differentiation did exist is found in many forms, including the possession of items of personal adornment that would have been inaccessible to all members of Harappan society (Kenoyer 1992). Power and social standing could



Figure 2. Harappan ringstone. (Courtesy Dr. J. M. Kenoyer, Harappa Archaeological Research Project, photographer)

have been created and maintained through control of the raw material sources for these status-marking ornaments, as well as other critical resources including land and livestock (Kenoyer 1997). There is ample evidence that craft activities such as agate and steatite bead-making took place simultaneously in several different areas of Harappa (Kenoyer 1997:269) indicating more than one elite group took part in and/or controlled these activities. Competing elites would have certainly found it beneficial to maintain access to as many reliable sources as possible. This might have been achieved through ties with kin or clan relations (Kenoyer 1989) or via interaction with nomadic communities and other migrating ethnic groups. Given the complex geologic setting of the greater Indus Valley, such ties and interactions with peoples from distant parts of the Harappan realm should naturally be reflected in the rock and mineral assemblage of the city itself.

SCALE

When discussing the transportation of rock and mineral resources, it is necessary to consider the scale – both quantity and bulk size – of the materials being moved. From a qualitative standpoint, the amount of stone transported to Harappa would appear to be quite significant. Grindstones (querns and mullers), most often composed of sandstone or quartzite, make up the majority (by weight) of all lithic material types identi-

fied at Harappa. The nearly 2600 examples that have been recovered since excavations resumed in 1986 collectively weigh 15,500 kg. A preliminary source provenance study of these grindstones indicated that the vast majority derived from sources that were located 200 km or more from Harappa (Law 2001). In terms of the number of individually tabulated artifacts ($n = 20,125$), however, chert is by far a more common lithic material than grindstone. Based on the appearance, uniformity, and quality of the material, the extensive beds of the Rohri Hills of Sindh are generally acknowledged to be the primary chert source for Harappa during Period 3 (Kenoyer 1995:218–219). Although ratios of grindstone and chert in relation to the volume of excavated strata are still being calculated, the abundance of these materials in all periods and habitation areas at Harappa suggests that they were transported to the site in large quantities to supply the needs of a densely populated urban settlement.

At the Indus Civilization city of Dholavira (Bisht 2000), which is located directly adjacent to building stone sources, limestone slabs (some perhaps weighing up to several tons) were used as elements in a variety of constructions including gateways and drains. Most Indus settlements, however, are found on the alluvial plains and were generally constructed of baked or mud brick. All stone had to be transported to them from often very great distances. Therefore the size of stone artifacts at plains sites can be revealing in terms of the labour spent on their transportation. The very largest and heaviest artifacts recovered at Indus Civilization cities located on the plains are perforated stone rings. These “ringstones” are usually made of limestone or calcareous sandstone. Interpretations of these enigmatic objects have ranged from Shivite “yoni” stones (Marshall 1931:158–160), to astronomical “calendar stones” (Maula 1984), to ceremonial stones associated with cultic tree-worship (During-Caspers and Nieskens 1992:94), to decorative bases for wooden columns (Kenoyer 1998:53). The largest ringstone found at Harappa weighs 135 kg. So while Harappa did contain monumental structures (walls, platforms, etc.), the largest materials used in their creation (if indeed ringstones were used for architectural purposes) do not appear to have exceeded a size that would have required more than two people to carry (Figure 2). Some debitage associated with the manufacture of ringstones has been identified at Harappa (J. Mark Kenoyer, personal communication 2002); however the quantity of it

suggests that material was brought to the site in a rough-out form close the final size of the finished ringstone, rather than as large unworked boulders. Nevertheless, a significant expenditure in energy would have been involved in transporting stone of this size. A recently completed provenance study of ringstone fragments from Harappa indicated that certain varieties of limestone used in their creation derived from sources over 800 km away (Law and Burton 2004).

Steatite (talc) artifacts have been found at almost every excavated Harappan site. This easily carveable material was used by Indus craftsmen not only for the production of common items, such as ornamental disc beads, but also for the manufacture of objects with political and/or economic value such as seals and tablets. Wafer-like steatite disc beads are so common that their presence alone could almost be considered a marker of the Harappan character of a site (Vidale 1989:29). The large-scale use of steatite at the city of Harappa is suggested by the fact that this material is found during all periods and in most excavated areas of the site. However, in terms size the scale of use was apparently much smaller. The square unicorn seal recovered during the 1999 excavations at Harappa is one of the largest (5.2 by 5.2 cm) examples of these rare objects ever found (Meadow and Kenoyer 2001:32). The largest steatite object found at any Indus site is the famous “Priest King” bust from Mohenjo-Daro (Marshall 1931:356–357, Plate XCVIII). At 17.5 cm in height, this rare example of Harappan statuary is extremely small compared to the life-size and larger figures that became common in South Asia starting in the Early Historic period (Chakrabarti 1995:251–252). All evidence indicates that although steatite was an important and widely used material, it would not have been necessary to transport it in blocks larger than a single individual could carry.

In summary, although stone was utilized on a large scale during the Harappan period, the individual portions transported to sites on the Indus Valley plains were generally small in scale. This is in stark contrast to other early Old World states such as Egypt, where the long-distance transportation of large monolithic blocks of stone for statuary and architectural purposes would have necessarily required the labour of numer-

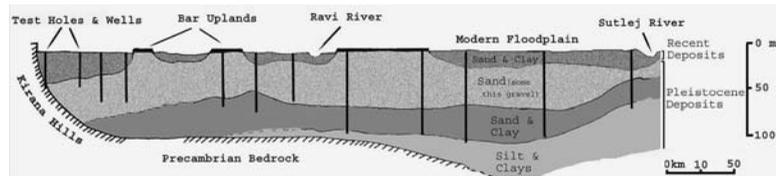


Figure 3. Alluvial deposits of the Punjab plain (after Kazmi and Jan 1997).

ous individuals (Arnold 1991). In South Asia this did not occur until the Mauryan Period – ca. 185 B.C.–A.D. 320 (Jayaswal 1998).

DISTANCE

If you lived at Harappa and you needed stone for a tool, what distance would you need to travel to find one? The site is located in the middle of the vast alluvial plain known as the Punjab – Land of the Five Rivers. The alluvium of the Punjab has been accumulating since at least the early Pleistocene (Kazmi and Jan 1997:267) and cross sections based on tube well logs indicates its great depth (Figure 3). With the exception of sporadic beds of thin gravels (Kazmi and Jan 1997:267) and pedogenic carbonate nodules, or *kankar* (Amundson and Pendall 1991:18), the alluvial strata of this part of the Indus basin are composed entirely of sand, silt, clay and loess. The nearest rock sources to Harappa begin at the Kirana Hills, located 120 km to the north-northwest. These Precambrian outcrops related to the Indian Shield are the only rocks to penetrate the deep alluvium of the Punjab plain. The alluvium becomes progressively deeper as one moves west toward the Sulaiman Range. There are no other known subsurface rocks formations in the Punjab that might have been exposed during the Harappan period some 4,000 years ago. Therefore, except for the Kirana Hills, all rocks and minerals found at Harappa must have come from the foothills and ranges surrounding the Indus Basin or beyond.

Several scholars have proposed that certain lithic materials could be acquired from riverbeds in and near the mountain ranges west of the Indus Valley, thus making it unnecessary travel to the actual geologic sources of those materials (Inizan and Lechevallier



Figure 4. Terracotta boat model from Harappa. (Courtesy Dr. J. M. Kenoyer, Harappa Archaeological Research Project, photographer)

1990:51–52; Kenoyer 1998:35; Khan et al. 1987:102). However, it is important to determine if river deposits could actually have served as sources for many or all of the stones found in the mountains that they drain. River-borne sediments undergo rapid fining through abrasion, chipping, splitting, cracking, and chemical weathering as they are moved downstream (Werrity 1992). Rocks such as granitoids and limestones suffer slower attrition than others like sandstone (Werrity 1992:343), allowing larger clasts of those materials to be acquired at greater distance from formations that they occur in. A resident of Harappa seeking a grindingstone would have needed only to travel to one of the massive alluvial fans at the base of the Sulaiman Range to get a suitable cobble rather than into the mountains themselves. However, to obtain a material like chert, which easily becomes chipped and fractured as it is carried downstream, or steatite, which quickly disintegrates, it was probably necessary to travel to the actual source or very close to it. While further study is needed, preliminary observations of the movement of radiolarian chert down the Tochi River from its source in the Barzai region of Waziristan indicate that this material becomes highly fractured and rare at the point the river reaches the plain some 70 km away. Similar examinations were made of drainages in Northern Baluchistan confirming Inizan and Lechevallier's observations of chert in the Bolan River near Mehrgarh (Inizan and Lechevallier 1990:52), which suggested that finding good quality (unfractured) chert is quite rare at locations far from source areas. While it is certainly true that slope gradient and river discharge may have changed since prehistoric times, thus altering and/or obscuring the composition of drainages that once contained good material, it is much more likely that then, as now, the best quality

chert or steatite was obtained at or near the formation from which they originated.

MOVEMENT

A central question in the study of Indus Valley rocks and mineral exchange system is how these materials were physically moved to lowland sites like Harappa from their highland sources. Heather Miller (2005) notes that because the settlement pattern of the Indus Civilization was oriented toward the river systems and coastal zones of northwestern South Asia it has been commonly assumed that boats were a primary mode of transportation. Shaffer (1988) points out that while boats are an important means of transportation and communication in other riverine civilizations like Egypt and Mesopotamia, it need not be automatically assumed this was true for the Harappans. Like so many other aspects of the indigenously developed Indus Civilization, its systems of exchange and interaction along with primary modes of transportation may have been fundamentally different than that of its contemporaries to the west.

In all likelihood, however, some degree of transportation and communication within the Indus Valley region did take place by boat. While no physical remains of watercraft from the Harappan period have been found in the Indus Valley, there are three depictions from Mohenjo-Daro: one on an unfired seal (Mackay 1938b:Plate LXXXIII, 30); one as graffiti on a potsherd (Mackay 1938b:Plate LXIX, 4); and one on a terracotta tablet (Dales 1968:39). These depictions feature high-prowed, flat-bottomed boats quite similar in appearance to the ones still used on portions of the lower Indus River today (Greenhill 1972). A terracotta model of a flat-bottomed boat was excavated at Harappa in 1989 (Figure 4; J. Mark Kenoyer, personal communication 2002). Evidence for seagoing vessels is indirectly provided by the existence of sites like Lothal, Dholavira, Sotka Koh and Sutkagen Dor that are located along what would be important coastal trade routes and, in the case of Lothal, have port facilities and ample evidence of trade with cultures across the Arabian Sea in present-day Oman (Rao 1979). One complete and four fragmentary terracotta models of boats were also found at Lothal (Rao 1985:505). Finds at Ra's al-Junayz, Oman, of bitumen fragments with

reed bundle impressions and barnacles still attached appear to be caulking material for some type of sea-going craft (Cleuziou and Tosi 1994). Although chemical analysis indicated that the bitumen was of Near Eastern origin (Cleuziou and Tosi 1994:756), many fragments were found in association with Harappan materials including a copper stamp seal (Cleuziou and Tosi 1994:748). Harappan-period traders, as the above evidence makes clear, were at the very least familiar with large river- and ocean-going vessels, if not experienced users of such craft themselves.

Certainly some form of watercraft, like the rafts of inflated bullock hides employed to ford the Kabul River during the Mughal period (Verma 1977:71), had to have existed so that land travelers could cross the Indus and its tributaries. Assurance that rivers could be reliably forded would have been of vital importance to any ancient group involved in seasonal migration or long-distance trade. Historically, the control of ferry points in South Asia has shifted between the state and specialized groups (Deloche 1993:126–128). Today, traders and pastoralists who seasonally cross the Indus near Mohenjo-Daro supply the local fisher-ferryman who move them with goods such as grain and livestock (Begum 1987:184). Such specialization and interdependence of social groups, common in South Asia today (Dumont 1980:92), is argued to have had its origins deep in the prehistoric period (Kenoyer 1998:43). In this social milieu, the groups who traveled by land, although relying on specialists to assist in crossing the region's many wide rivers, were perhaps the most instrumental in terms of transporting rock and mineral commodities during the Harappan period.

While there is some limited evidence that Harappans had knowledge of both the domesticated horse and camel (Shaffer 1988), the presence of these animals in South Asia clearly did not become common until after the Harappan period (Meadow 1987:51–54). The primary mode of material transport on the plains and plateaus of the greater Indus Valley region during the third millennium B.C. almost certainly would have been zebu cattle (var. *Bos indicus*), or Indian ox, either pulling a cart or carrying an individual load. Small terracotta models of carts (Figure 5) are found in abundance at Harappan sites, including Mohenjo-Daro (Mackay 1938b:568–569), Harappa (Vats 1940:451–452) Lothal (Rao 1985:225), Surkotada (Joshi 1990:282), Banawali (Bisht 1983:119), Kalibangan (Thapar 1973:89) and Shortugai (Francfort 1984:302) to name a few. No other

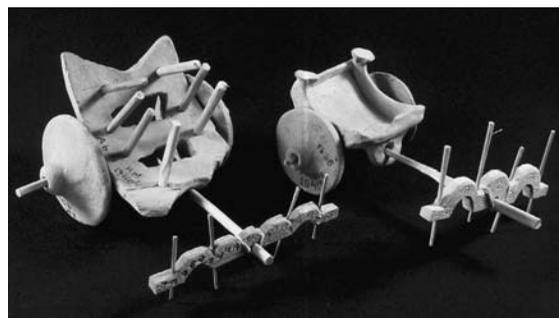


Figure 5. Two cart models from Harappa. (Courtesy Dr. J. M. Kenoyer, Harappa Archaeological Research Project, photographer)

vehicle in the ancient world was depicted in such abundance. While miniature models of humans, animals, and other objects are sometimes created as children's toys or used for decorative purposes, in South Asia they are also important symbols for economic or ritual activities (Jayaswal 1984). From this perspective the cart was clearly a significant aspect of Harappan culture. Figurines of humped cattle are equally common at Harappan sites (Figure 6). While there are no depictions of zebu actually pulling carts, the rapid size diminution of early domestic cattle that you see in Europe, the Middle East, and peninsular India is not apparent in cattle varieties at Indus Valley sites (Meadow 1988). This is possibly indicative of a conscious effort by Harappan and pre-Harappan peoples to maintain cattle size for draft purposes (Meadow 1988:207). Single animals of good breeds can carry upwards of 150 kg 20 km per day (Deloche 1993:241–246).

Zebu cattle, with or without carts, probably would not have fared well, however, on the steep, rocky trails and talus slopes of the mountains where many of the materials found at Harappan sites are located. How then were minerals transported from those sources to the points where they could be loaded onto zebu carts or boats? One possibility to be considered is the use of sheep or goats as pack animals. In highland Asia, the use of these animals for transporting goods is still practiced today (Fisher 1986:89; Minhas 1998:73), and it has been suggested (Shaffer 1988) that they were used for this purpose in the prehistoric period as well. Evidence from Aq Kuprik (Dupree 1972) and Mehrgarh (Meadow 1993) indicates that goats were domesticated by the seventh millennium B.C., if not earlier in the Baluchistan-Afghanistan highlands. Sheep and goat dominate the faunal assemblages of highland



Figure 6. Zebu figurine and modern zebu at the Harappan site of Balakot.

sites throughout the prehistoric period (Meadow 1982). While none of this proves that these animals were used to carry stone commodities from mountain sources, it can be argued that, of all the animals utilized by the inhabitants of the highland regions during this period, sheep and goats would have been the most capable of performing this difficult task. These animals evolved in highland settings and thus can move across landscapes inaccessible to other pack animals due to the rugged terrain, and/or water and fodder requirements. Although a single large goat can only carry a few dozen kilograms at most (Mionczynski 1992), an entire herd could potentially move a great deal of stone.

Human portage of rock and mineral commodities should also be considered. The use of bamboo frames and dozens of porters to transport large masses of quarried stone, statuary and other cargo in and out of the mountains of North India was once common (Deloche 1993:208–210). Depending on the altitude, gradient, individual and wage, single porters transporting goods in the mountains reportedly could carry anywhere from 30–100 kg on their heads or backs (Deloche 1993:210–212). In the absence of animals for transport, prehistoric peoples of the greater Indus highlands could realistically have transported stones, in the amounts and sizes discussed in this paper, from their sources to the point where they could have been loaded onto zebu-drawn carts or river transport.

MOTIVATIONS

The motivations behind acquiring rocks and minerals and transporting them over long distances are varied. The simplest ones are need-based and involve obtaining materials necessary for day-to-day utilitarian uses. At the other end of the spectrum would be the motivation to control access to and distribution of semi-precious materials that were important status markers. Consumption of such wealth items is necessary to maintain hierarchical social stratification, and it is strict control of these materials that partly characterizes state-level societies (Kenoyer 1991:345). It is ease of access (dependent on distance and abundance), as well as the technological modifications required to craft usable items, which imbues raw materials with differing degrees of value, provides the possibility of control, and allows individuals and groups to establish and maintain social power (Kenoyer 2000; Vidale and Miller 2000).

At sites like Harappa where all stone is nonlocal, even the supply of comparatively mundane materials like chert and quartzite would appear to have been controlled to some degree. The widespread distribution and standardization of chert blades produced at the Harappan quarry-factories in the Rohri Hills (Allchin 1979; Biagi 1995; Biagi et al. 1995) point to the existence of some form of an organized large-scale distribution network for this material (Inizan and Lechevallier 1990, 1997:79). The dominance of sandstone-quartzite from the Sulaiman Range in the lithic assemblage at Harappa perhaps indicates the existence of organized procurement of this material as well. While the Indus Civilization encompassed sources for these and many other materials, it was primarily composed of lowland settlements poor in stone commodities. Highland sites did exist, most notably in the Harappan settlements of the southern Baluchistan region (Franke-Vogt et al. 2000). However, materials not found within the alluvial areas would have had to been obtained by direct long-distance exploitation by Harappans themselves or through interaction with non-Harappan highland groups.

Harappans themselves certainly could have journeyed to regions outside of their realm to collect rock and mineral commodities. The distant Harappan outpost of Shortugai in Northern Afghanistan (Francfort 1984) might be representative of just such an activity. However, in order to procure the materials they sought

in these areas, Harappans would have needed the sanction and/or assistance of local populations. Shaffer's overview of the prehistoric cultures of Baluchistan led him to conclude that the "primary procurer/carrier of raw materials" in the greater Indus Valley region was probably the pastoralist (Shaffer 1978:153). As seasons change, pastoral peoples are compelled to move where their herds can find adequate water and pasturage. In northwestern South Asia a pattern of wintering on the plains and spending summers in the highlands surrounding still exists (Bozdar et al. 1989; Nagy et al. 1989), and a symbiotic relationship with the settled cultures on the plains has developed. This allows pastoral peoples to obtain agricultural products that they lack (Khazanov 1994) and provides the plains dweller a way to access the resources of the highland regions. Because of their migration patterns, pastoralists would have been intimately familiar with both the sources of materials in the highlands and the people who would wish to acquire them on the plains. Most importantly pastoralists had the animals to transport the materials between the two.

Beyond internally organized trade, direct long-distance procurement and interaction with pastoral groups, materials may have been passed along through what Possehl (1999:15) describes as itinerant specialists who engage in a variety of craft, labour or entertainment activities. Another avenue of transportation that has deep historical roots in South Asia is the movement of goods in tandem with the movement of pilgrims traveling to and from sacred places. One arm of the great pilgrimage to the tomb of Saidi Ahmad at Sakhi Sawar and other shrines in the foothills of the Sulaiman Range (Diack 1898:51–56) passes directly next to the mounds at Harappa. Sacred spots such as these serve as seasonal gathering places of people from different regions (Nolan 1994). Pilgrims often return with charms or medicinals of mineral origin. Vidale and Shar (1990) have documented steatite carvers from throughout Pakistan who are among those making the annual pilgrimage to the shrine of Shah Bilwal Noorani in southern Baluchistan. Also making the journey are the Mengel tribesmen who mine steatite. After performing anniversary prayers (*urs*) at the saint's tomb, the steatite carver returns to his city with 50 kg or so of material – enough stock until the following season. Shah Noorani is deep in the southern Baluchistan highland region, and the many Buddhist and Hindu shrines in the area testify to pilgrimage ac-

tivities having a long history in this region (Minchin 1907:35–44).

CONCLUSION

While utilizing a large quantity of diverse rocks and minerals, Harappans did not appear to have needed to move massive blocks of those materials over long distances. This, however, is not to imply that Harappans could not or did not move large amounts of material. The scale of Harappan lithic transportation system might best be described as extensive but not necessarily labour intensive in regard to single loads. The alluvium of the Indus basin is extremely deep, nearly devoid of rocks and minerals, and does not appear to have obscured any rock outcrops in the past 4,000 years that might have been close to cities like Harappa. Cobbles of tough rocks could be acquired at the base of mountain ranges. Other material such as chert could have been collected from riverbeds downstream from source areas, but for reliable quantities of good quality stone, one would have needed to travel directly to or close to the source. Sheep or goat and/or human porters would have been necessary to move lithic commodities out of mountain source areas that were too rugged or remote for other pack animals. Once on the plains, bullock carts and boats were, perhaps, a primary method of transportation. Mineral commodities could either have been obtained directly by Harappans themselves or via trade with highland groups. While organized procurement and transportation networks appear to have existed, other avenues of material exchange such as the migrations of pastoral peoples, the movement of itinerant specialists, and pilgrimage routes may have also played a vital role in the transmission of rocks and mineral commodities to and from the Harappan settlements of the greater Indus Valley.

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