

Scientific and Technological Contributions of the Indus Civilization: Their relevance for the present



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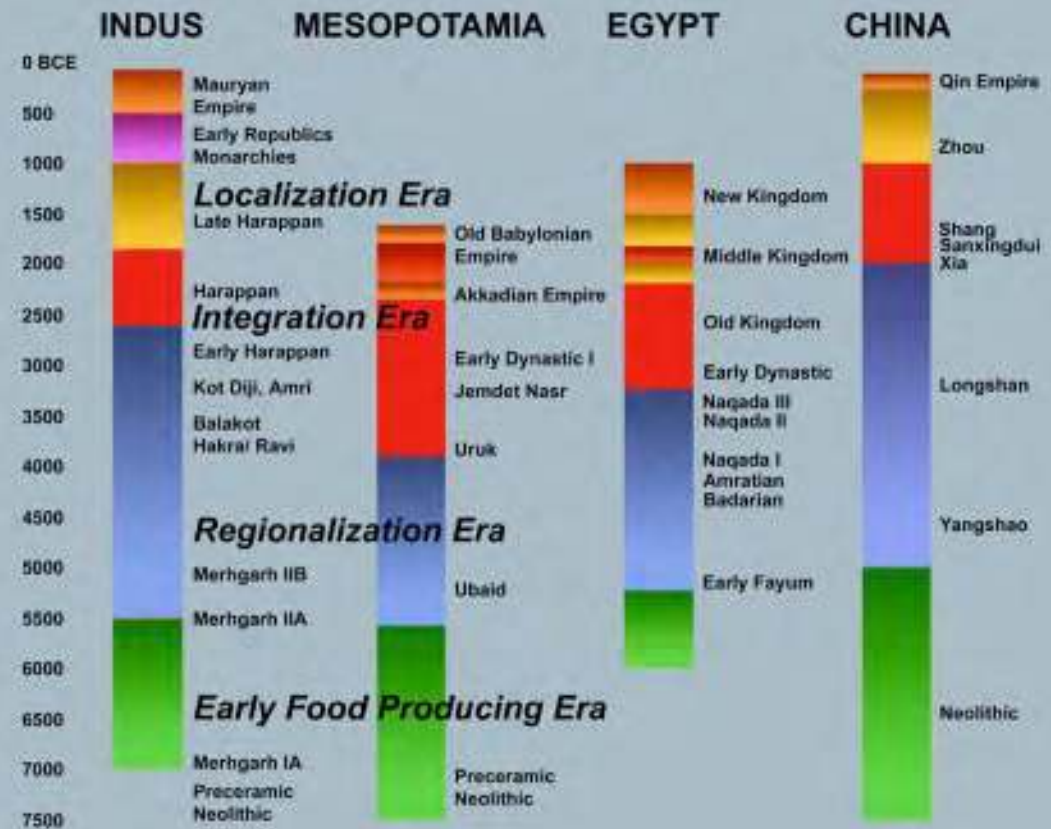


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Indus Civilization and other early state level societies

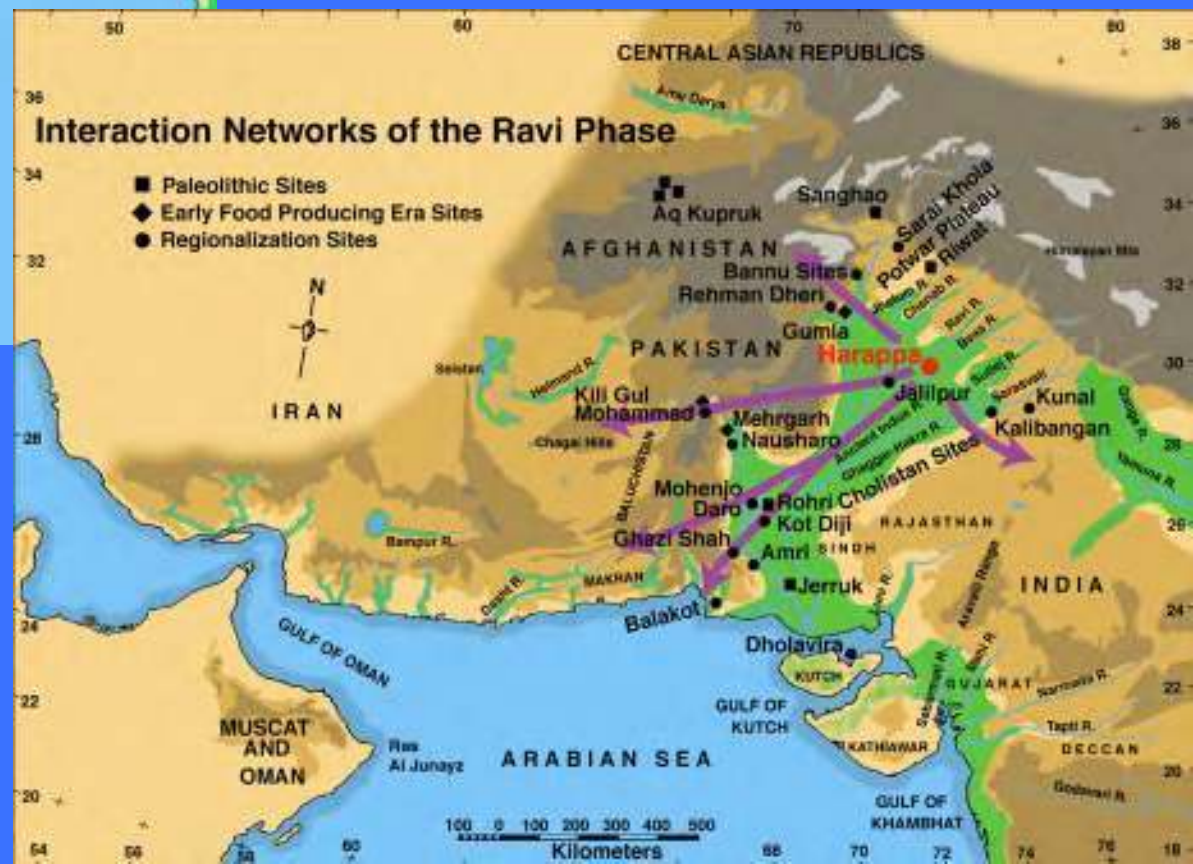
Major advances have been made in our understanding of the origins of the Indus and its relationships with surrounding regions.





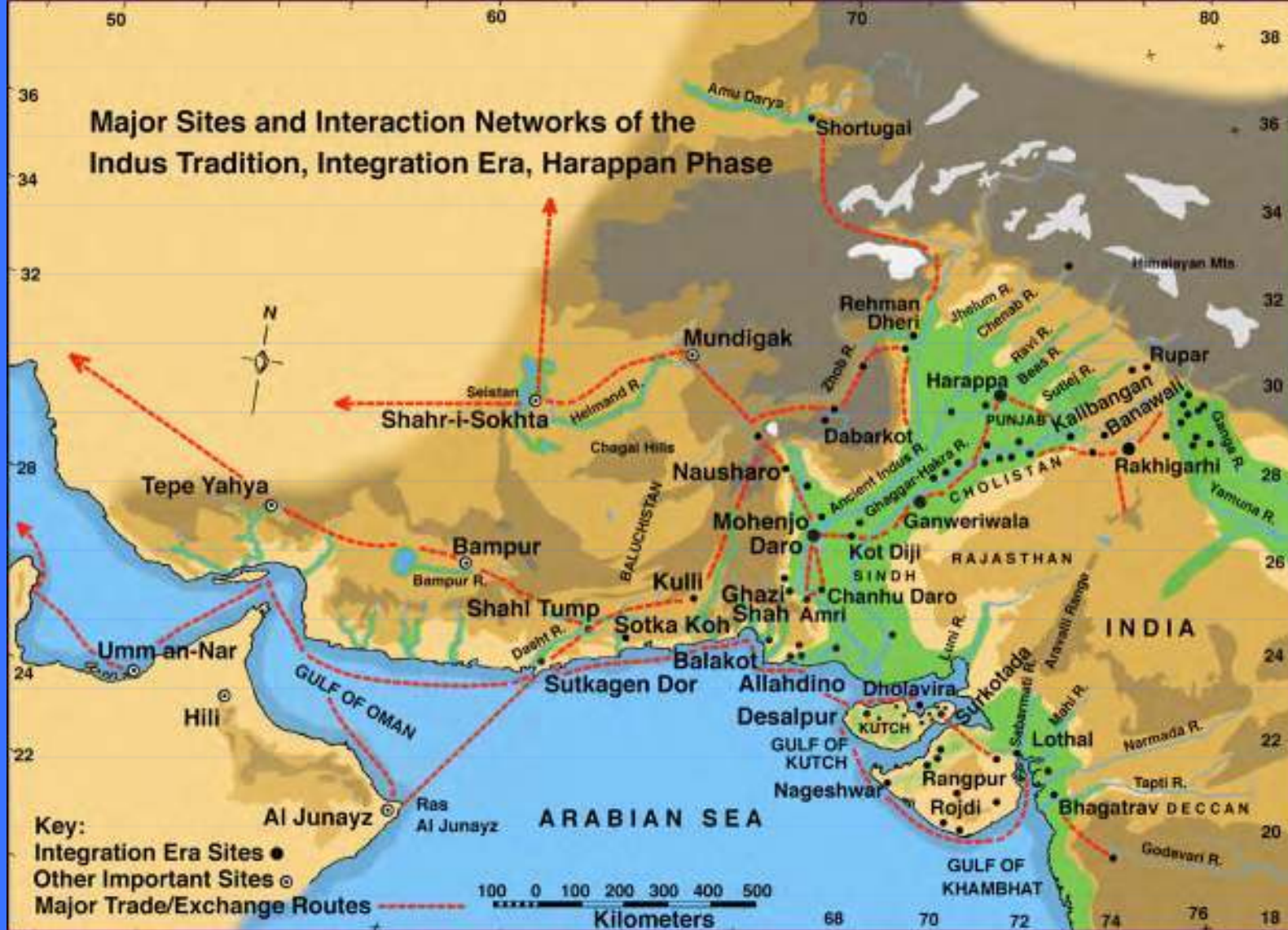
Prehistoric Cultural Traditions
Bactro-Margiana, Helmand,
Baluchistan, **INDUS**, Malwa,
Ganga-Vindhya, Deccan, etc.

Indus Valley Sites –
general trade
networks of the
Ravi Phase -
>3700-2800 BC



GoogleEarthView - Gazetteer prepared by Randy Law





INTEGRATION ERA: Indus Valley Civilization,
Harappan Phase 2600 to 1900 B. C.
largest area covered by an early civilization



more than 65%
with unicorn motif
- most widespread
community or
officials - possibly
merchants



Seals with animal motifs and Indus script, may
represent ruling elites - landowners, merchants,
ritual specialists

Indus Writing

- not yet deciphered , possible languages are proto-Dravidian, Mundari, Indo-Aryan, Sino-Tibetan, Language “X”
- written from right to left
- used for economic, ritual and personal identification purposes
- found on **square seals**, used for trade and ritual purposes
- **faience, steatite or terra cotta tokens**, accounting and possible ritual purposes



Indus Numerals

1, 2, 3, 4,
5, 6, 7,

$2 \times 4 = 8$

$3 \times 4 = 12$

$4 \times 4 = 16$

$5 \times 4 = 20$

$6 \times 4 = 24$



K-72 A



**Square Indus seals,
large and small**

**Four different unicorn seal
impression on a clay sealing
indicates corporate
ownership or centralized
bureaucracy**



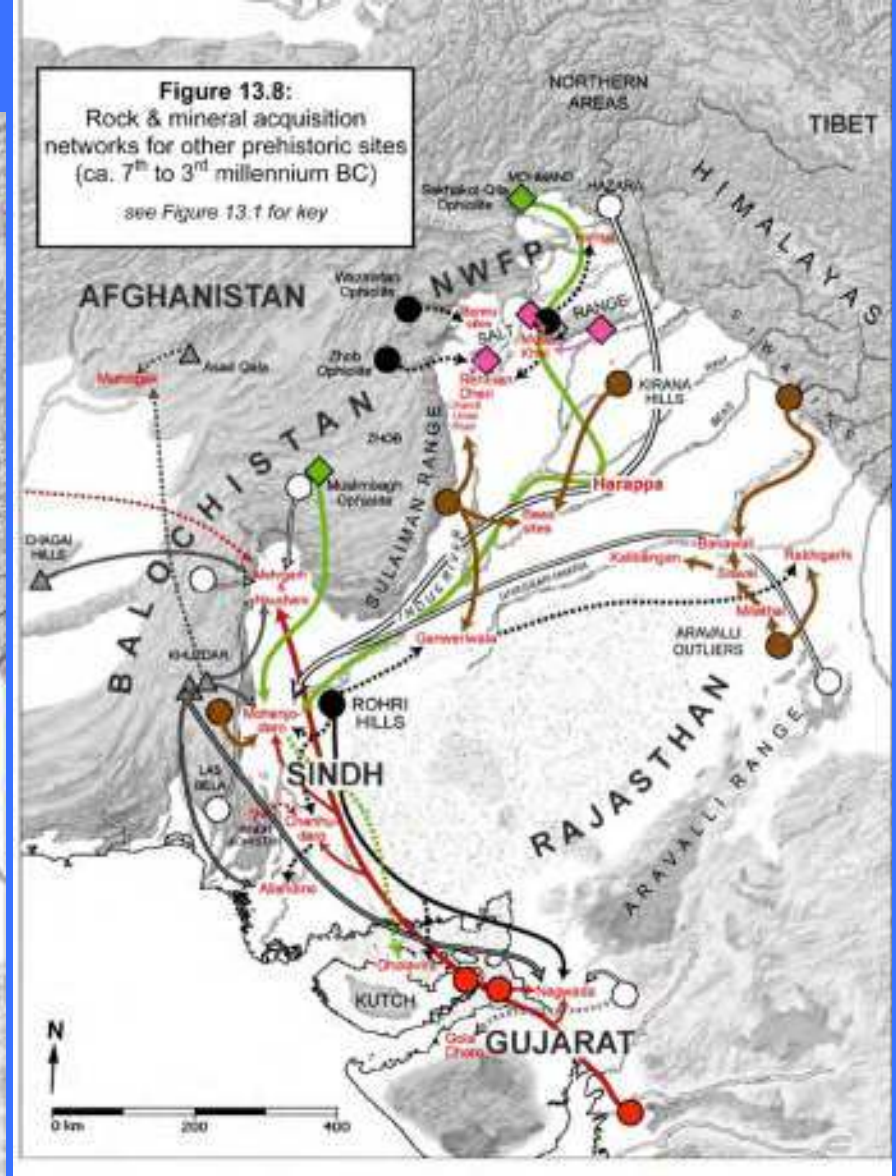
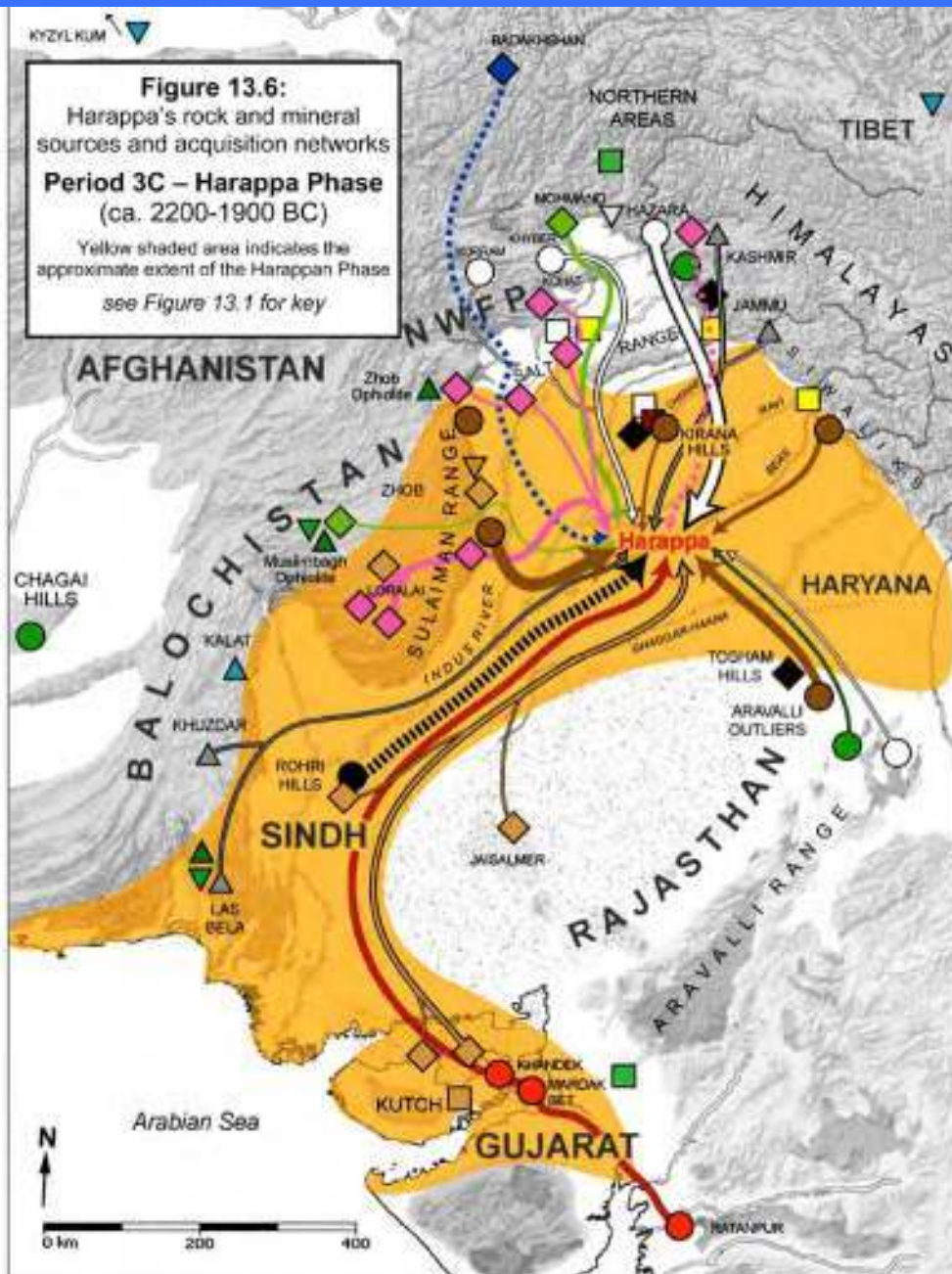
**Circular
Persian Gulf
seals**





**Seals also indicate direct control of trade by elites
Central Asian seals and Indus elephant seal.
Sealing with impressions of seals from both regions**

Harappa 3C: 2200-1900 BC

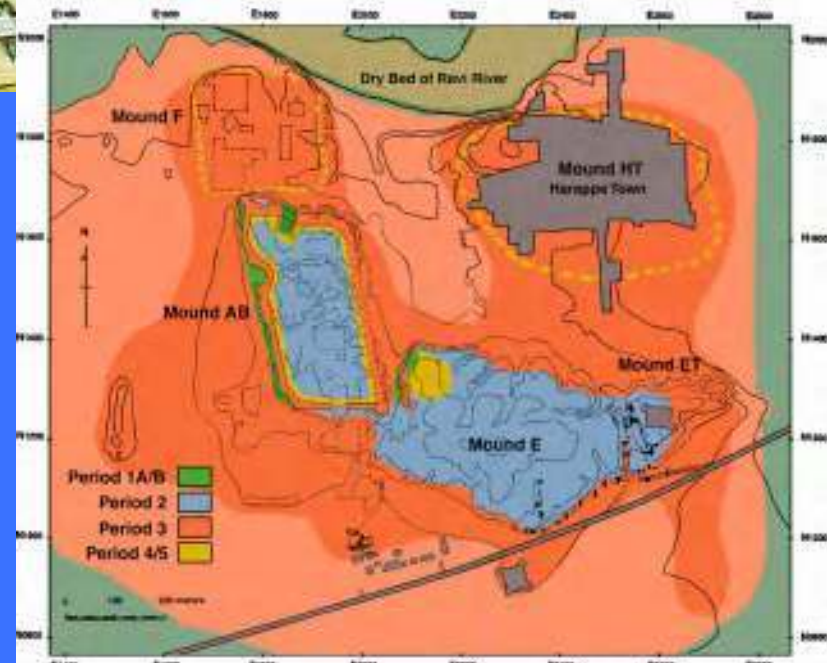


Trade networks to other sites – Maps by Randall Law 2011



Harappan phase- 2600-1900 BC

- mud brick walls, around each major mound
- sometimes with baked brick facing and fired brick gateways
- cities located near rivers but on high ground



**Monsoonal Indus –August 19
– 2010 +One million cusecs
water cross through Sukkur
barrage**



Same river May 24, 2010



Villages on ancient mounds were above the flood levels



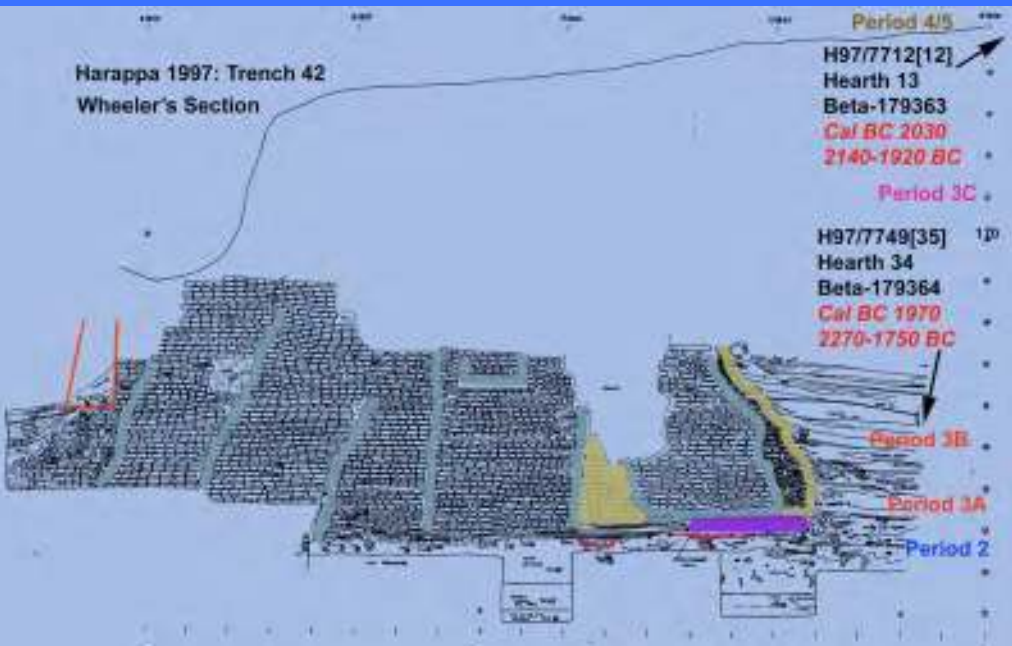
Mohenjo-daro Mound



Indus at winter low water level



- using molds it takes **three people 3 days** to make **500 large mud bricks** 10 x 20 x 40 cm or **1000 small mud bricks** , 7 x 14 x 28 cm



wet mud bricks

Large - 17 kg each

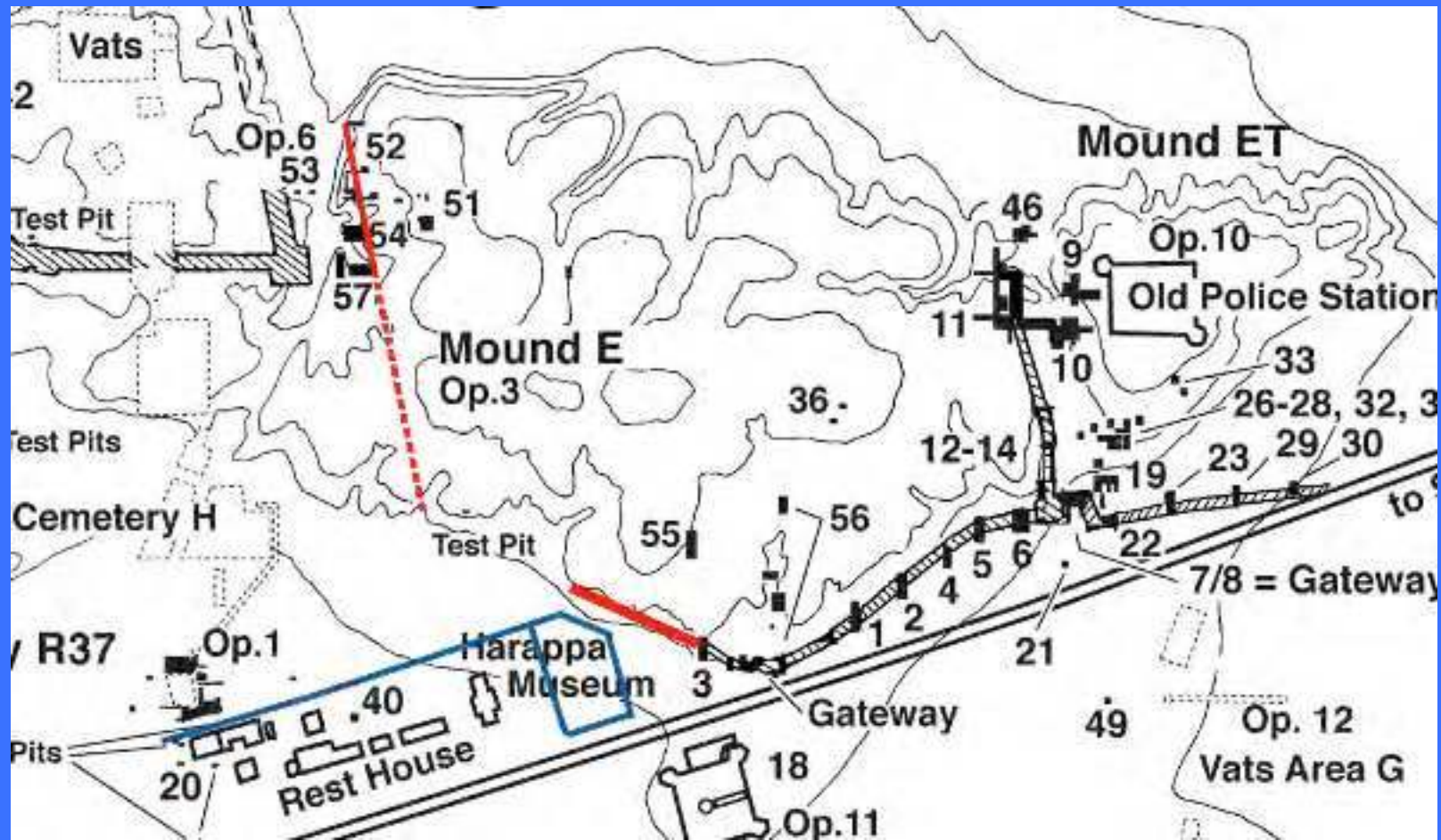
Small - 9 kg each

dry mud bricks

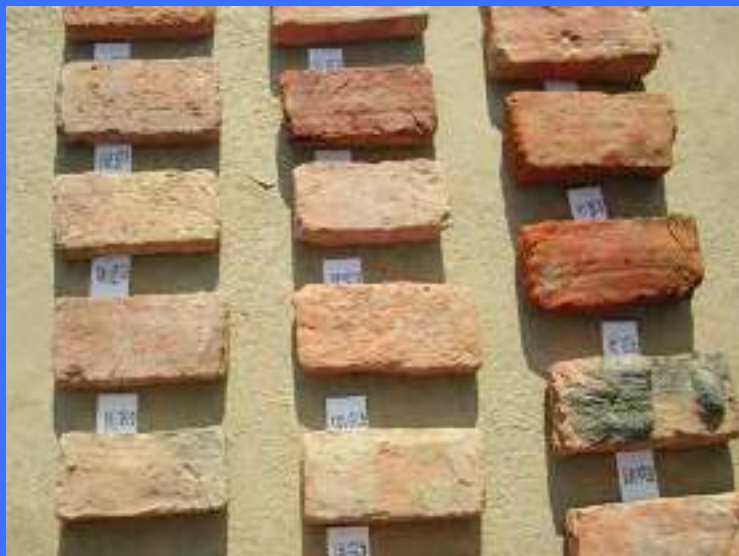
Large - 14 kg each

Small - 7 kg each

Mound E Harappan period Western and Southern City Wall
- Early Wall - 1500 meter, 2.5 m wide, 4 m high
around 610 people three months to build
- Later Wall - 1800 meters long, 7 m wide and 4 m high.
around 2013 people three months to build



Bricks from different periods – used as header and stretcher – saru/bai- Harappan Bond, or English Bond



Indus Linear measurements

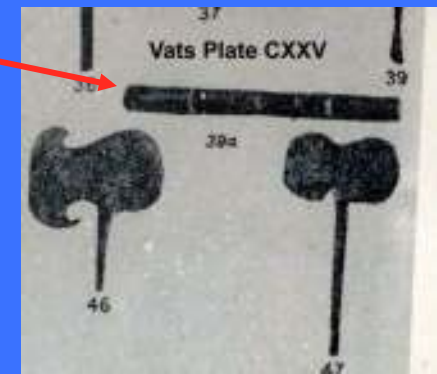
Mohenjodaro - shell scale

- five divisions of 1.32 inches (3.35 cm)
- = decimal foot of 13.2 inches (33.52 cm)



Harappa

- bronze scale with 4 divisions averaging .3676 inches = 0.937 cm



Lothal - ivory scale, much finer divisions
approximately 1.7 cm, in possible decimal divisions, =
17 or 34 cm “foot”
(Mohenjodaro decimal foot = 33.5 but with larger
subdivisions)

Arthashastra - angula = 17.78 mm

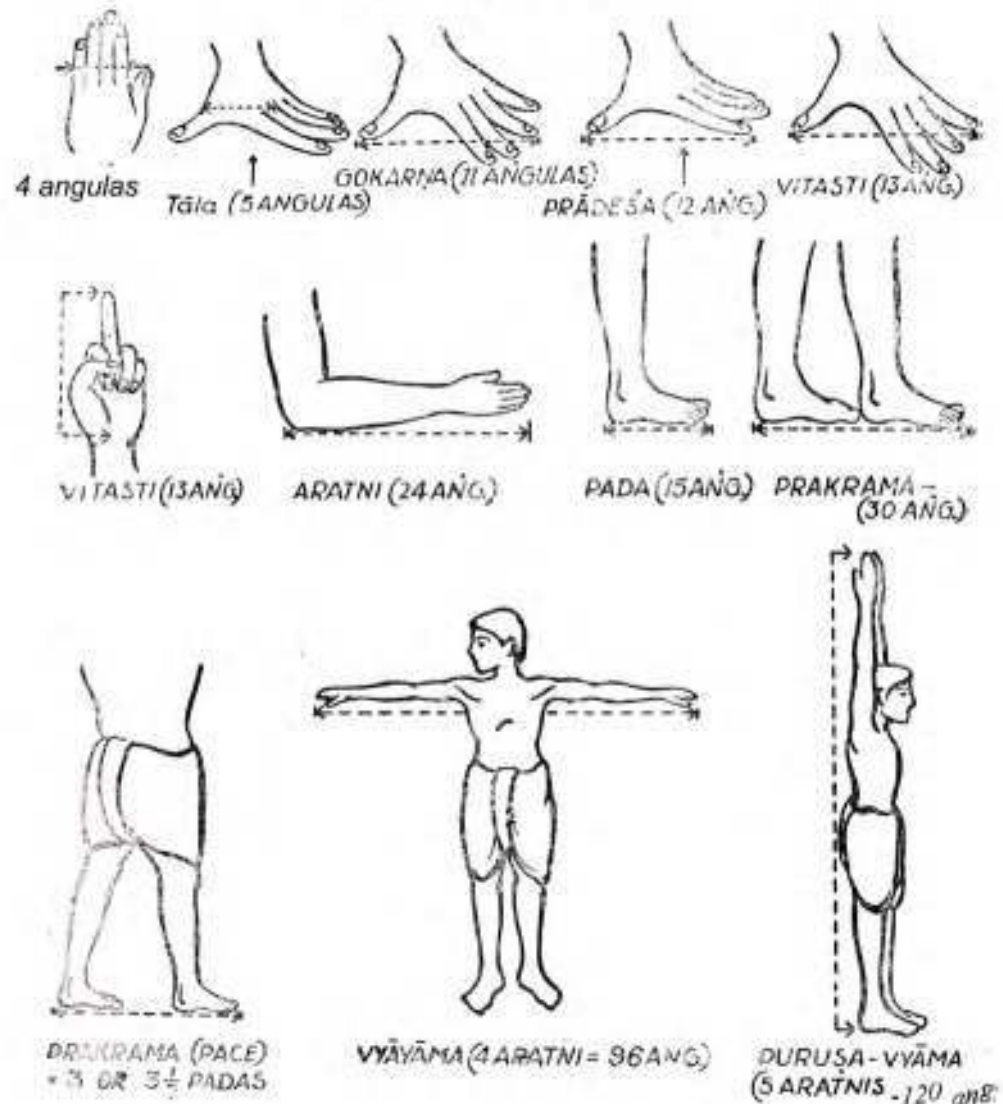


Traditional Indian Measurements based on body parts

- brick thickness approx equal to **4 finger widths** or angula

PLATE I

Linear Measures in Ancient India in Relation to the Parts of the Body





-latrines or commodes
in each house with
water pot for washing

- bathing platforms and
private wells made from
wedge shaped bricks (stone
at Dholavira)

Public wells for convenience
of visitors and traders in the
cities

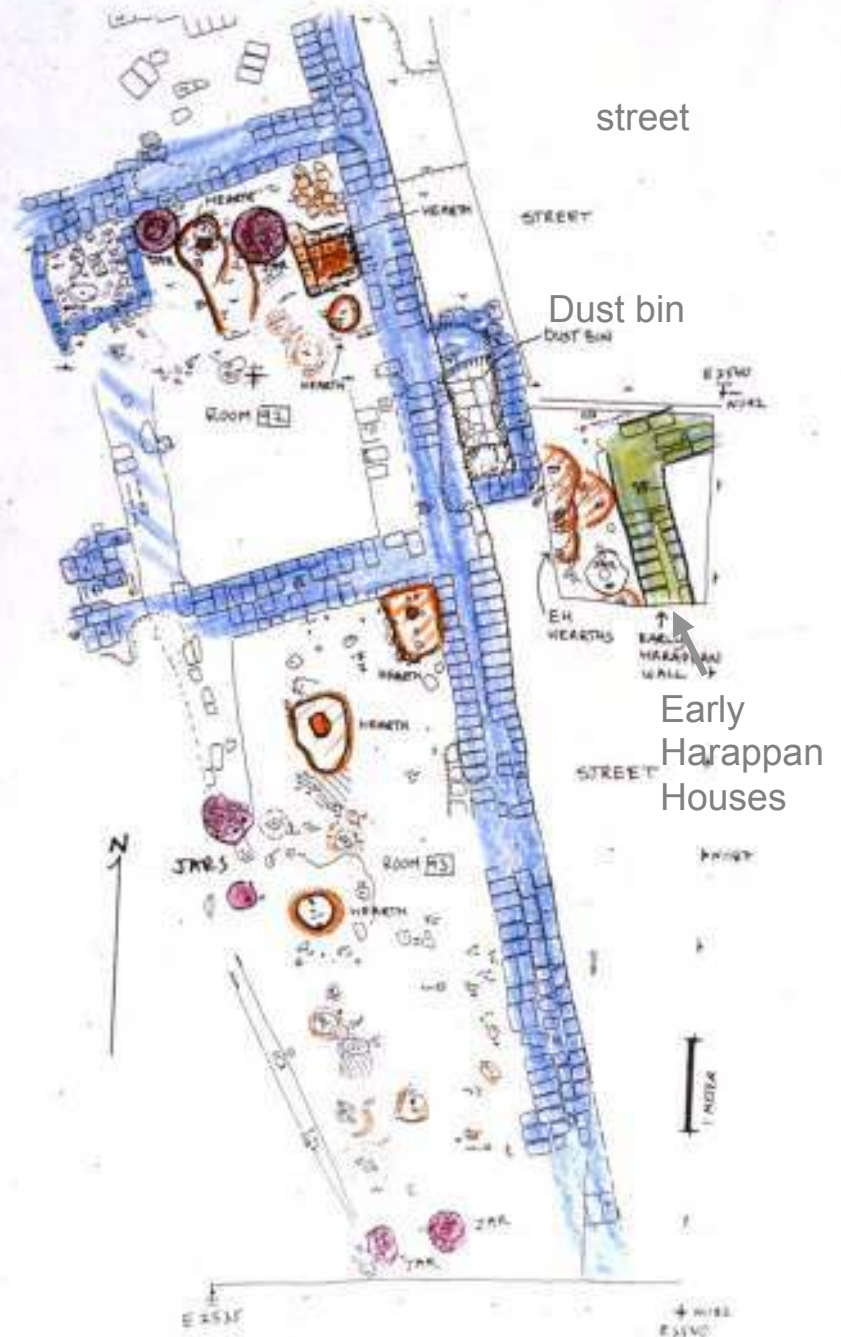


Harappa houses with
hearths and kitchen areas in
the northeast corner of the
courtyards.



Oven
like
hearth

HARAPPA 1993: Trench # 10



Vastu purana, traditional layout of a Brahmanical house - face down “vastu” with the most sacred area the northeast and the most polluted in the south or west.

DIAGRAM 4
THE BODY OF 'VASTU' AS FILLING THE SACRED SQUARE

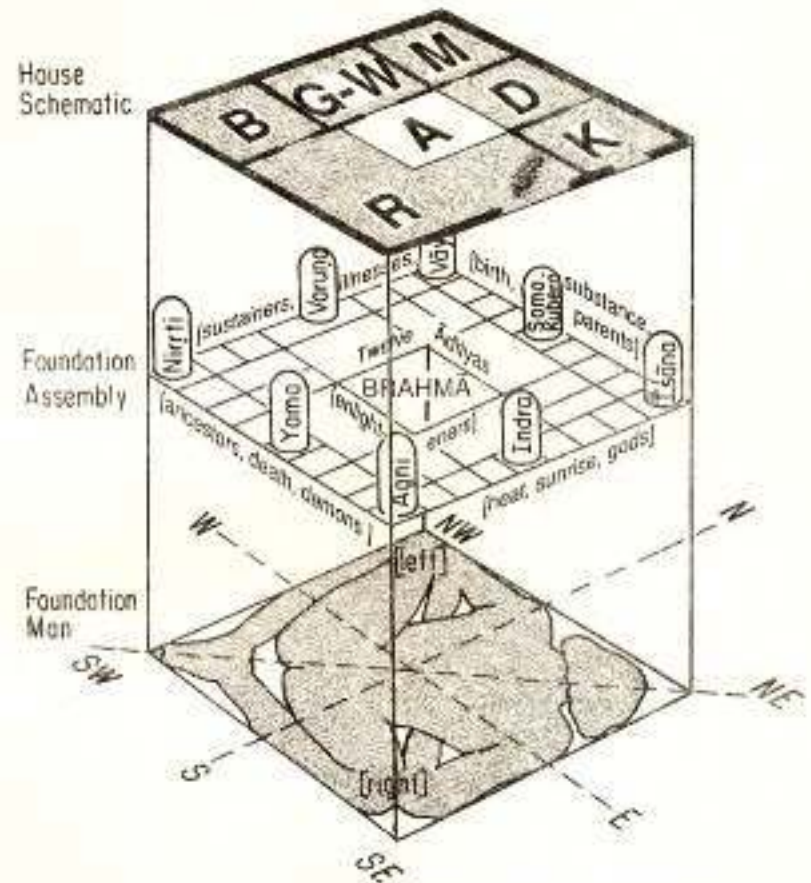
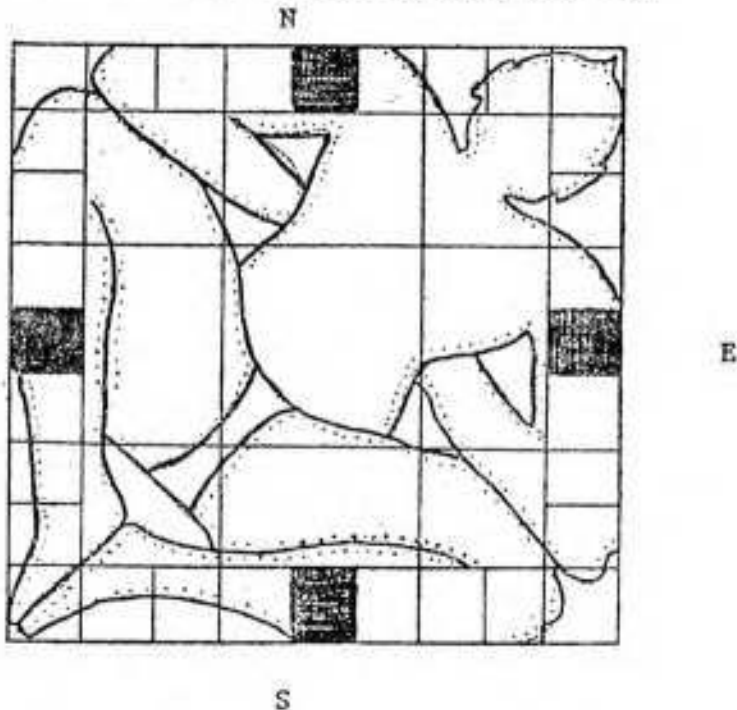


Fig. 3 HOUSE WITH GODS AND FOUNDATION MAN
as interpreted by Krommisch 1976:1: 85-97



Windows, doors and grill work



**Indus style figurine
Mari, Mesopotamia,
2400 BC**



**Male
Figurine
with beard
and head
dress**



**Allahdino, Pakistan
jewelry hoard**

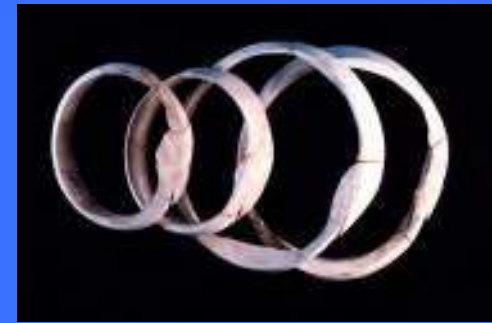
**Indus Female figurine
with elaborate jewelry
indicates use of
ornament to represent
status and power**



Hierarchies of materials can be linked to status and wealth



**Gold ornaments
from hoards**



Shell



terracotta

Stoneware

Faience

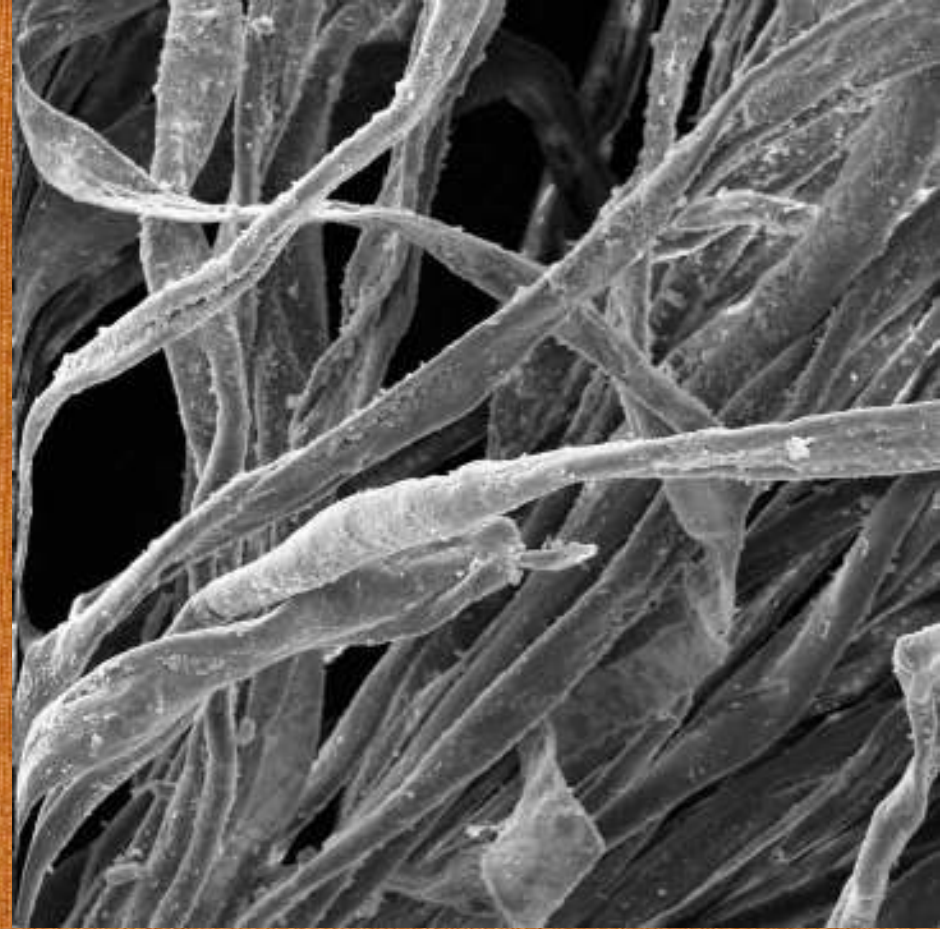


Copper



Textile Traditions

- spinning wheel, Punjab



**Modern cotton fibers, local
brown cotton, unbleached**

Mound E, Trench 54

Harappa excavations in 2000

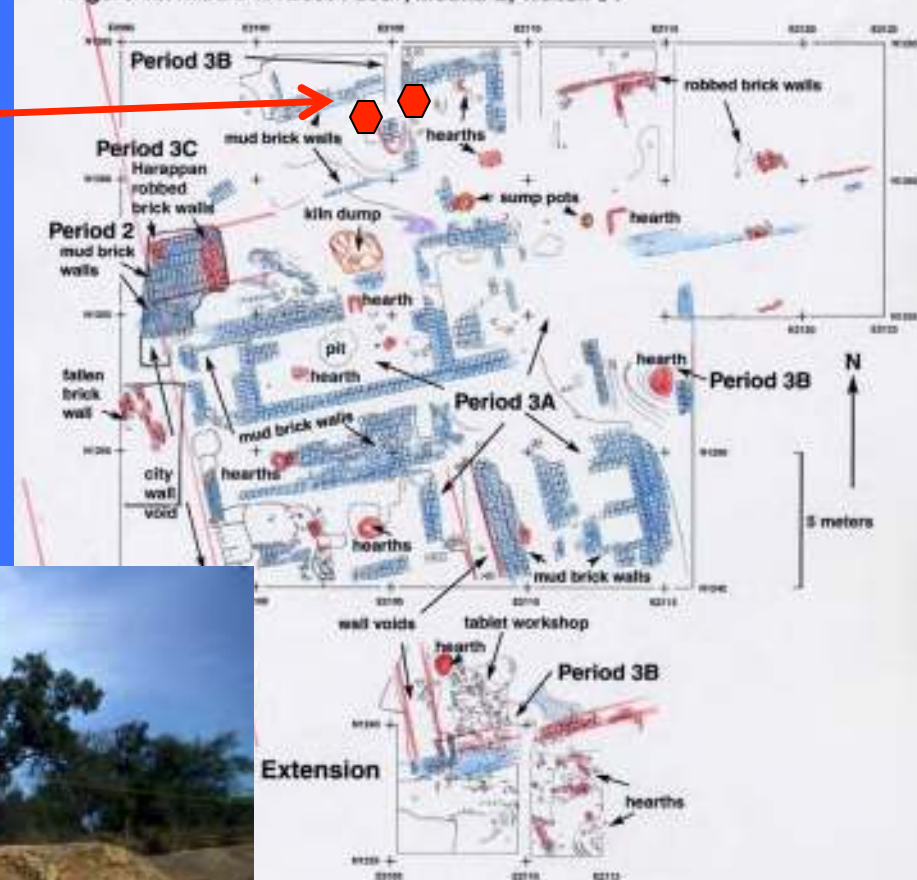
Period 3B 2450-2200 BC

- lowest levels just about

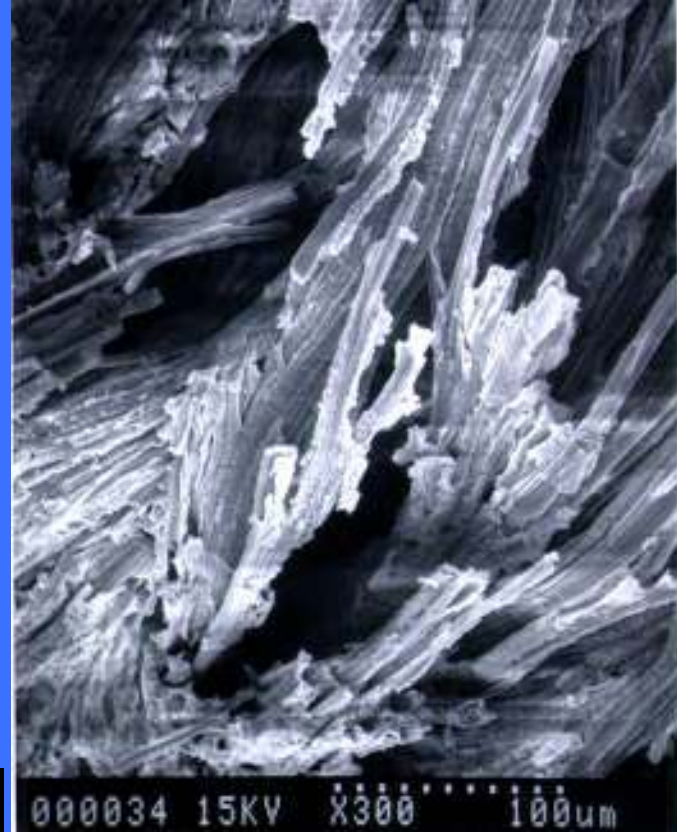
Period 3A

location of two important
discoveries of silk

Figure 18. HARAPPA 2000 / 2001, Mound E, Trench 54



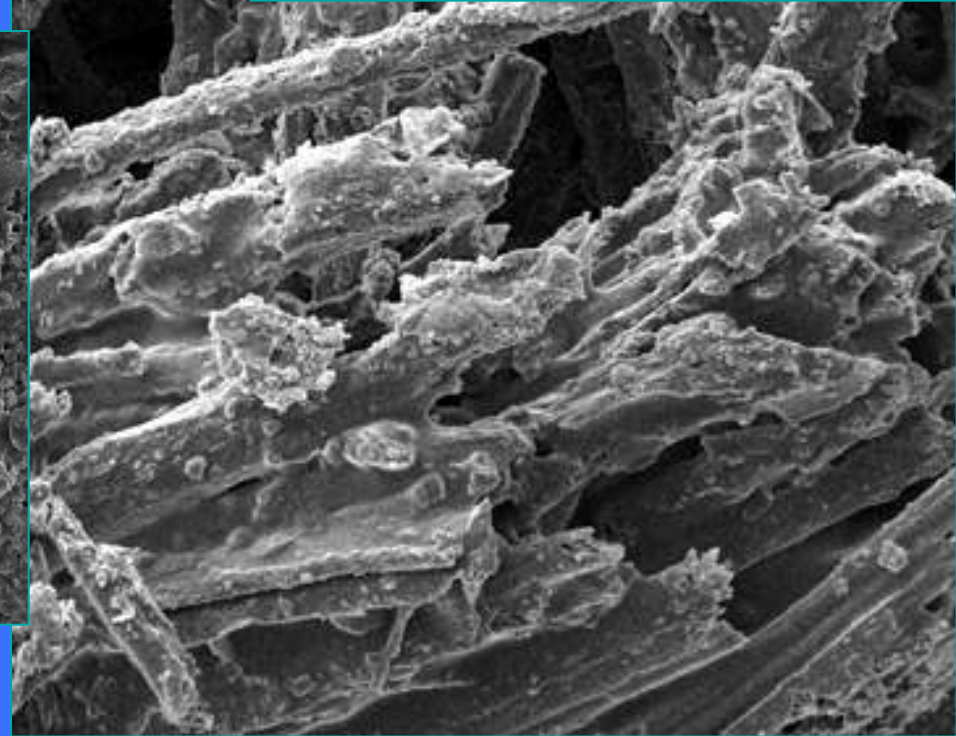
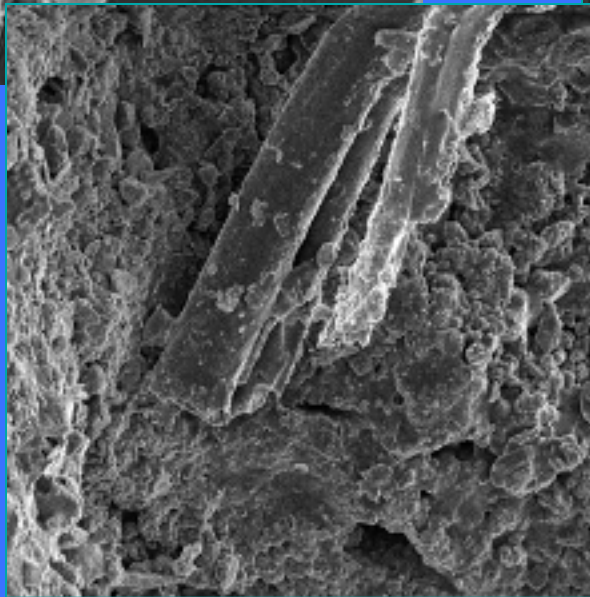
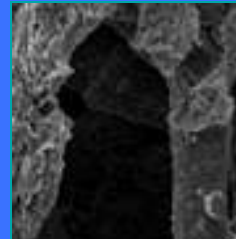
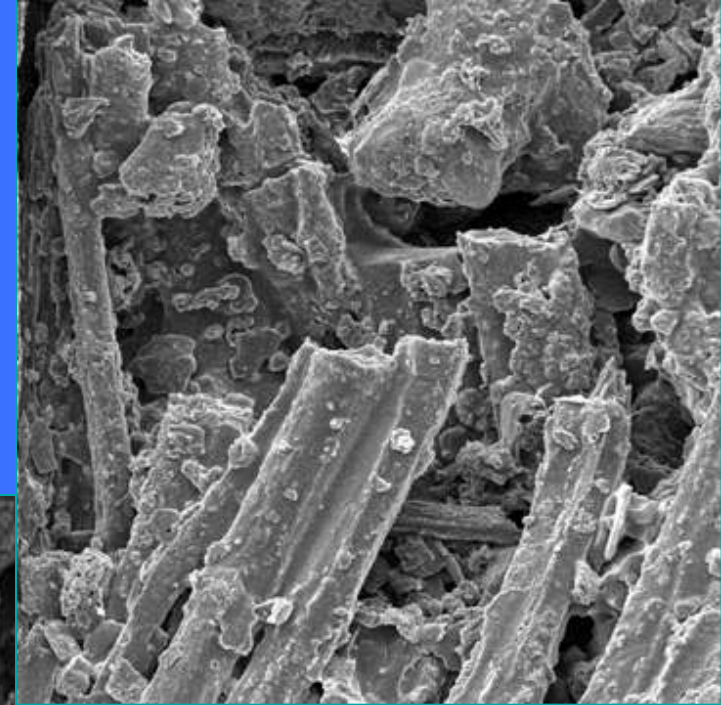
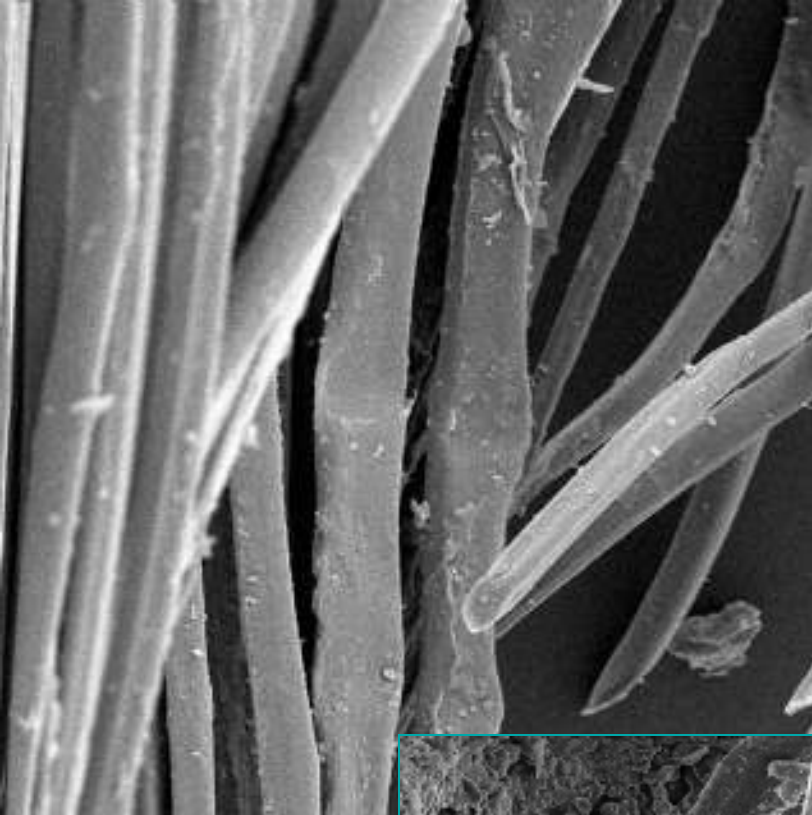
**Silk thread inside
wire necklace from
Harappa, 2450 BC**



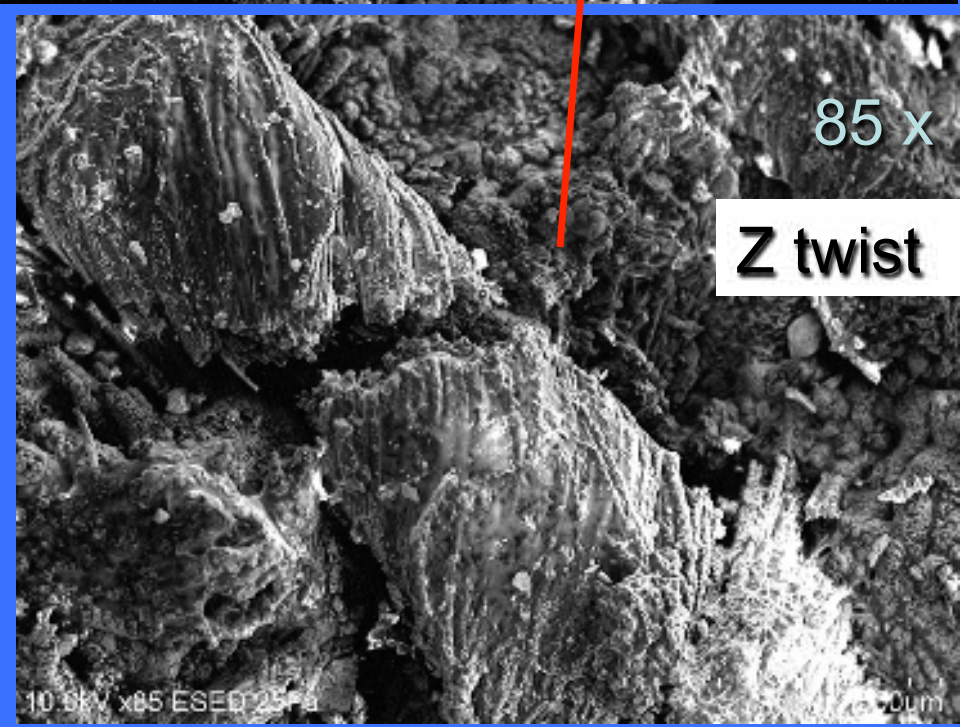
SEM of ancient silk



**Silk, wild
tussar
variety**



H2000/2114-73



Copper Razor
with fabric
pseudomorphs
H2000 2164-1



Circular platforms
enclosed in small rooms,
green stained silt in the
bottom of the central pit
? possible indigo
production ?



**Traditional indigo
preparation vats,
Sindh**



**Indigo plant
and final indigo
dye**

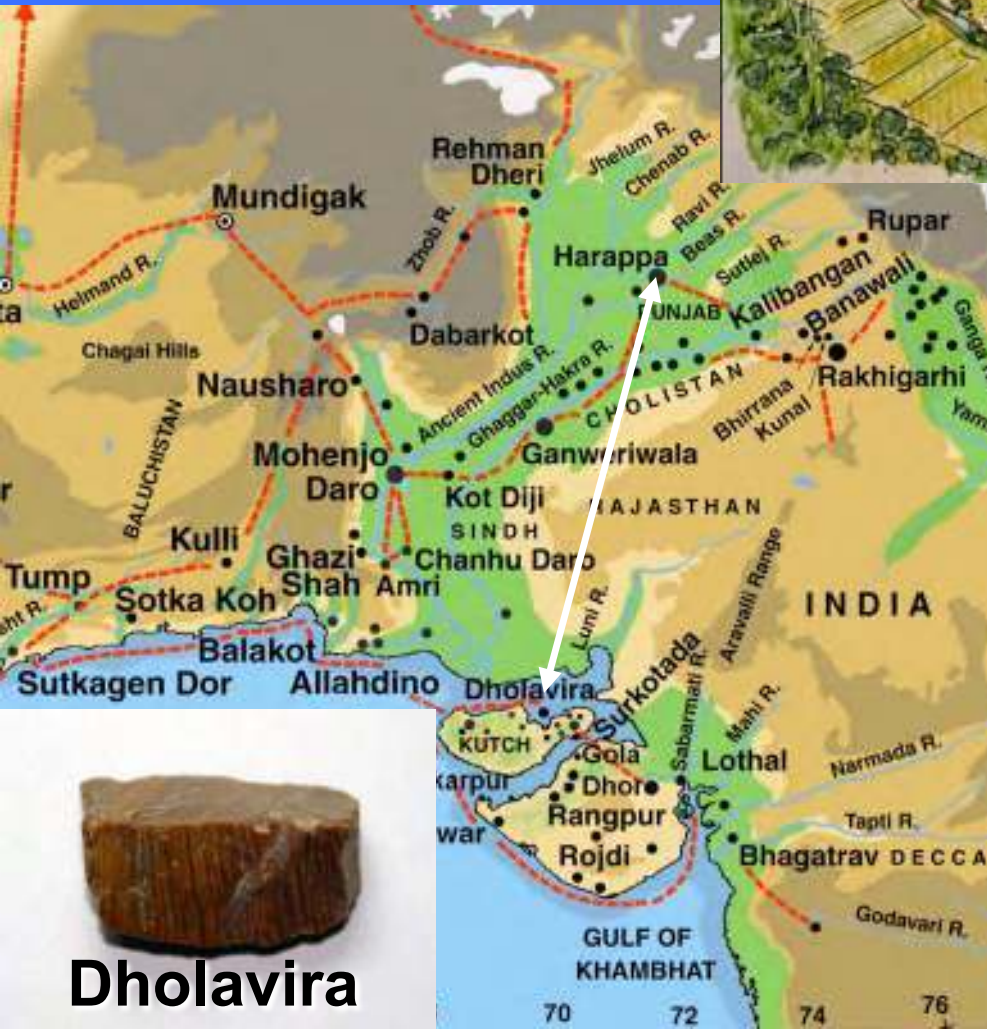






Male burial with beads

**Mound E
workshop to the
Cemetery**



**Harappa roughout
and bead**



Dholavira

**Raw material goes from
Dholavira to Harappa**

Harappan - 2600-1900 BC

Ernestite drills for long and hard stone beads

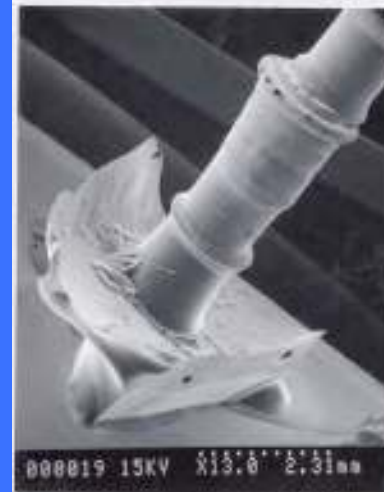


Ernestite drills



Late Harappan Period, 1900-1000 BC

Tubular drilling with copper tube and abrasive

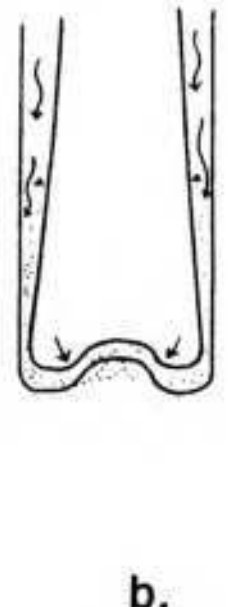
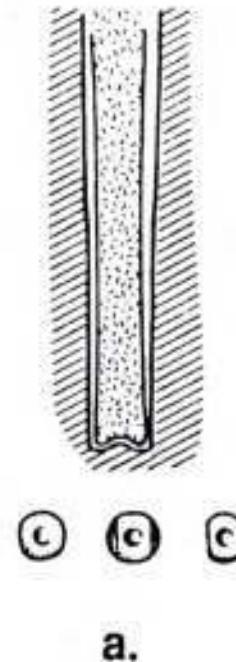
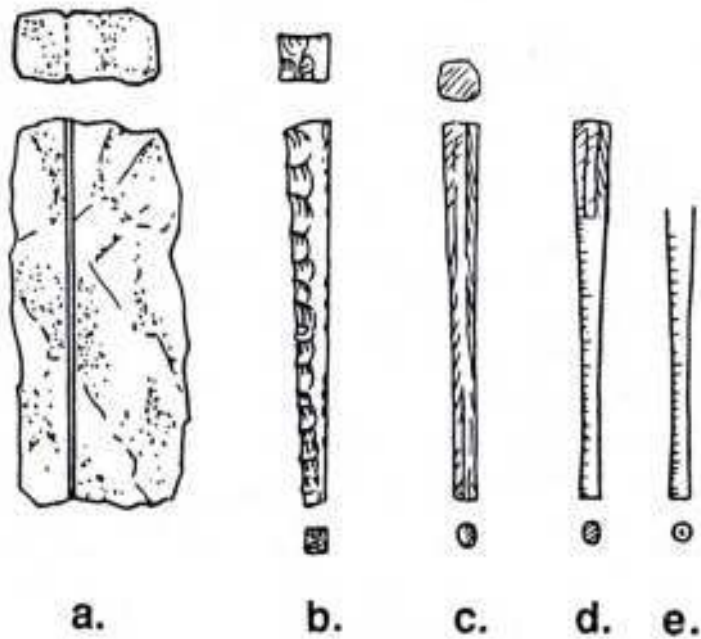
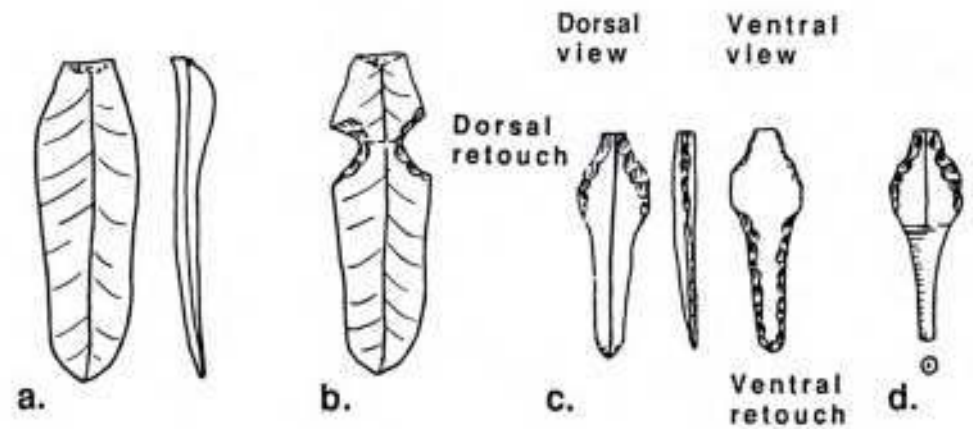




**Chanhudaro – long bead
manufacture – sawn and
chipped blanks**

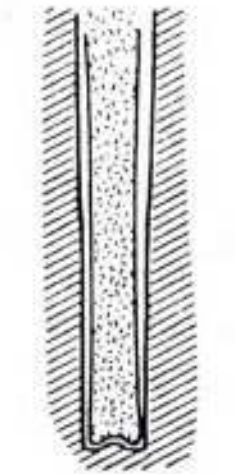


Tapered Cylindrical drills and constricted cylindrical drills



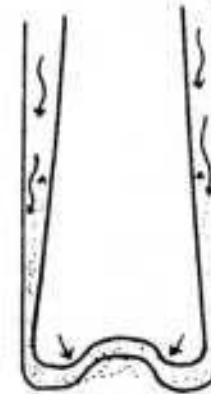
Harappan Period, 2600-1900 BC

Straight and stepped drilling with
constricted cylindrical drills of Ernestite –
set the foundation for later drilling using
diamond drills



c c c

a.



b.

Bleached carnelian beads - white design made with alkali and organic glue made from the kirar - caper tree

Bleaching breaks down the surface and looks etched after thousands of years in the soil



Dholavira Bleached Carnelian Beads



10 mm



10 mm



10 mm



10 mm

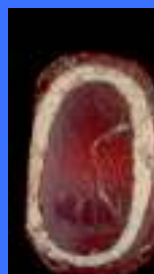


5 mm



10 mm

2 cm



10 mm

10 mm



10 mm



5 mm



5 mm



5 mm



10 mm



10 mm



5 mm



10 mm

**Burials with evidence for
hereditary genetic
relationships**

**Female burials with shell
bangles indicate
changing status of some
women over time**



**Wide
sturdy**

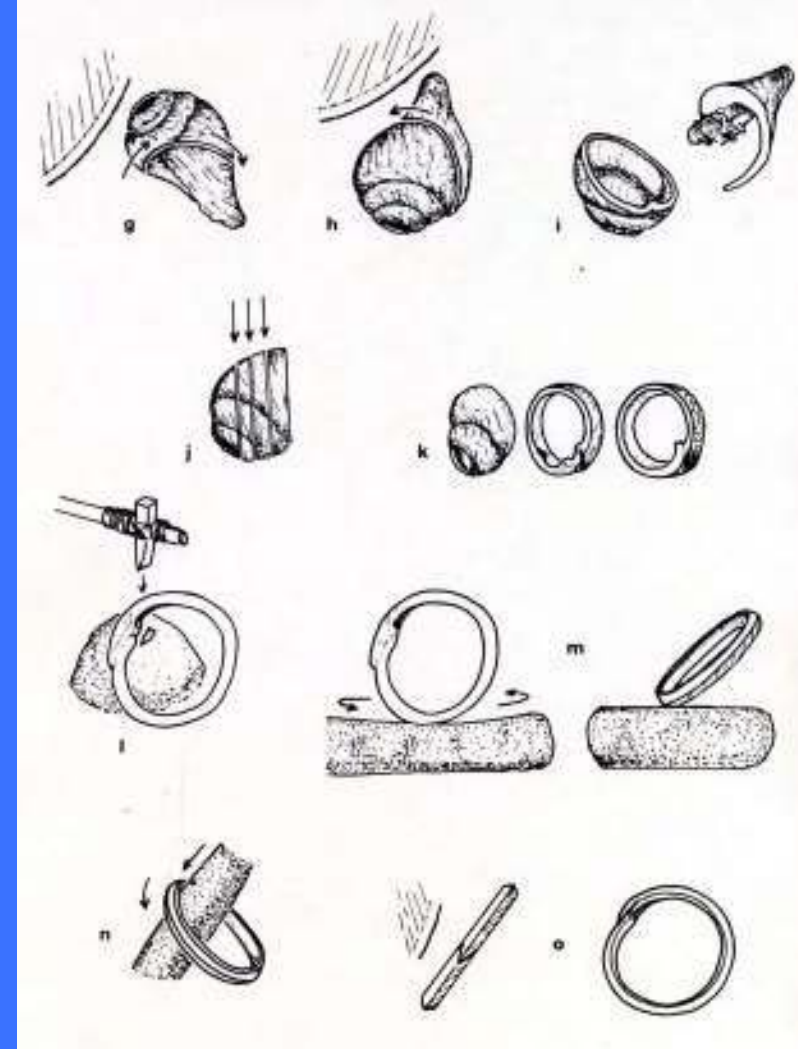
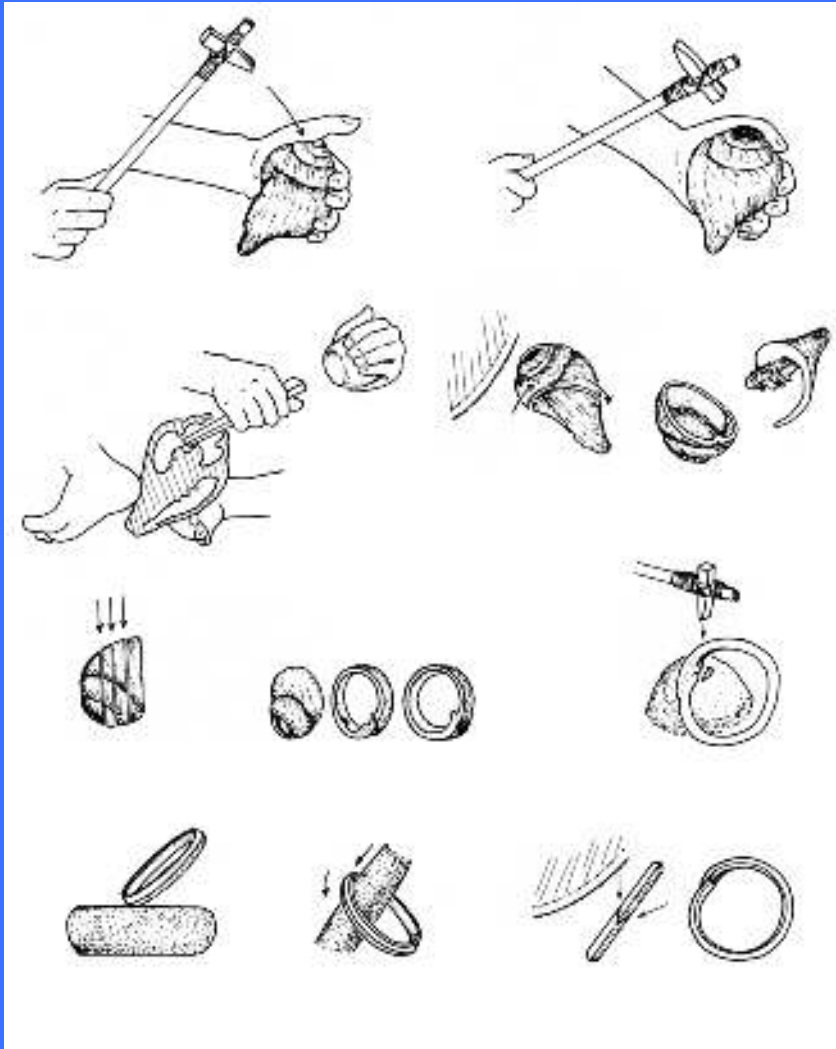
**Thin
Fragile**



Shell Bangle manufacturing clam shell and gastropod



Turbinella pyrum





Bishnupur, Bengal, Rabi Nandi using a “korat” steel saw

Turbinella pyrum saw cuts from a bronze saw are as deep as with a modern steel saw



Harappa Burial Pottery,
early burials with
elaborately painted
pottery that was
covered with a plain
slip and plain pottery,
and later burials with
banded designs





Harappan Rituals and Dowries

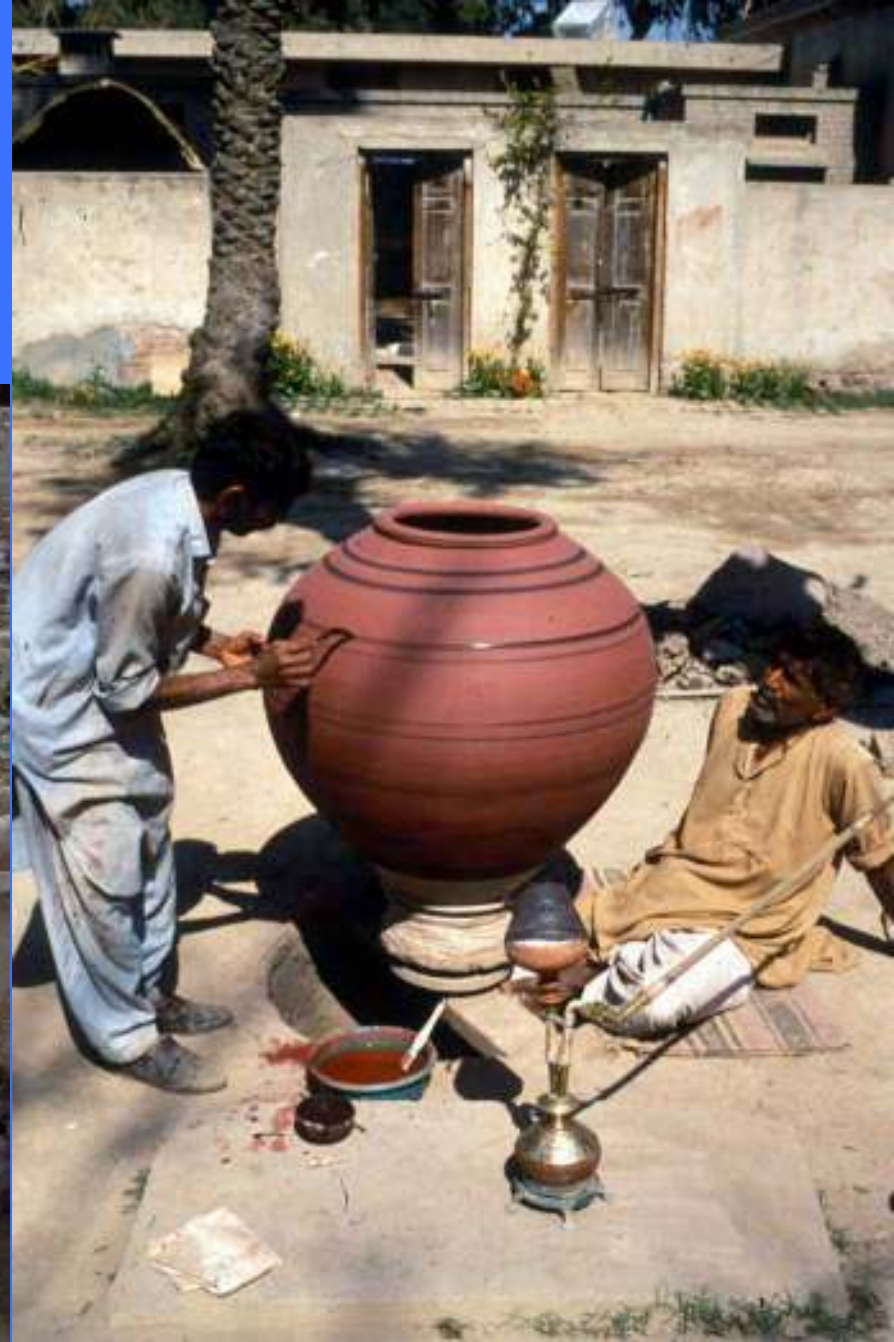
Feasting and Presentation



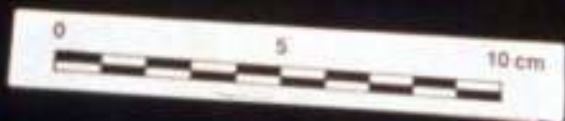
**Cooking specific Harappan
tasting foods and beer**



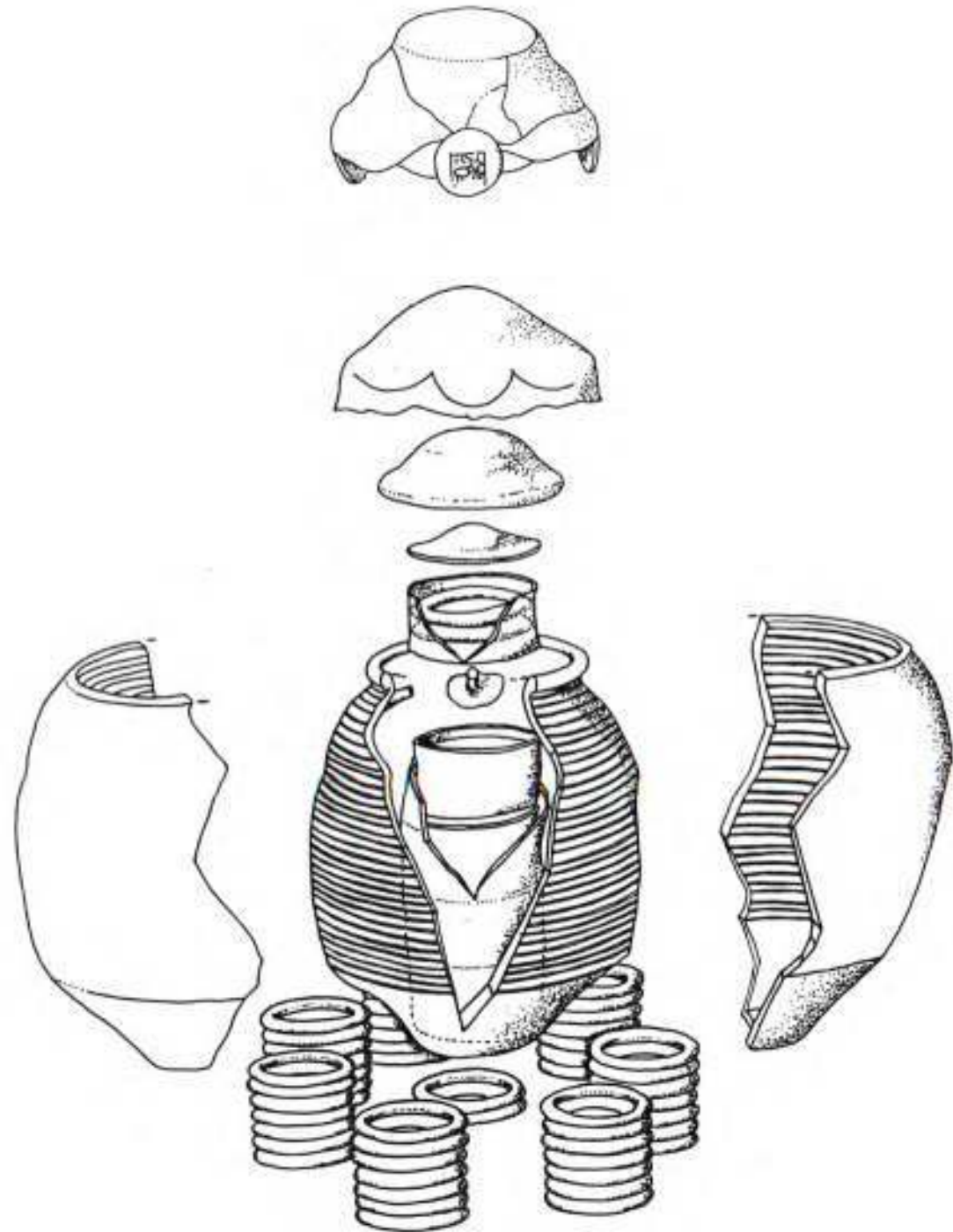
Storage vessels, highly specialized production



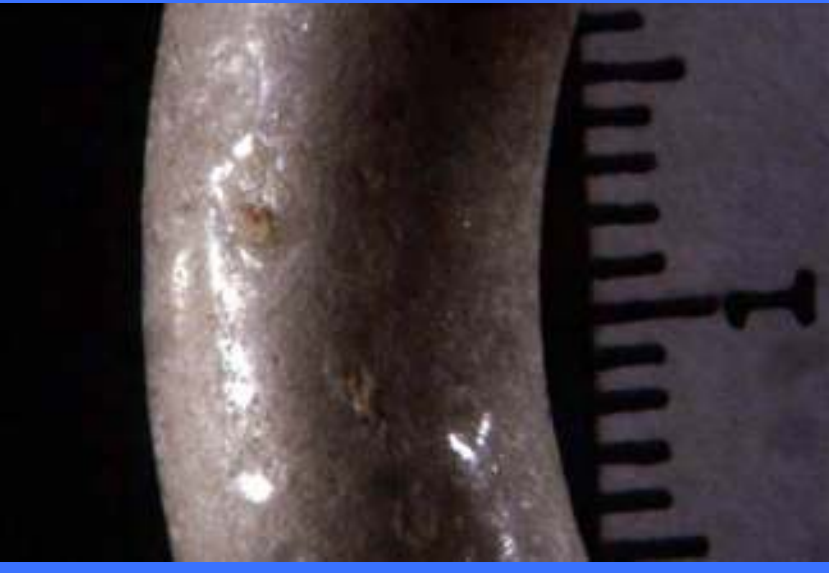
**Stoneware
Bangle
making-
control at all
stages of
manufacture**



**Hypothetical
reconstruction** by
Halim and Vidale,
based on
workshop debris,
but the
technology for
making the clay
and for firing the
bangles is still
unknown

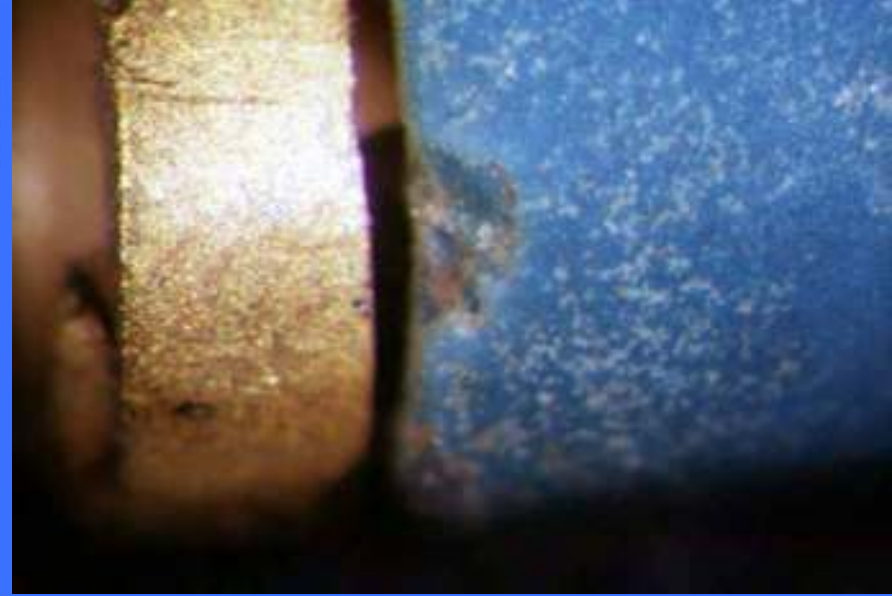


Faience Bangles

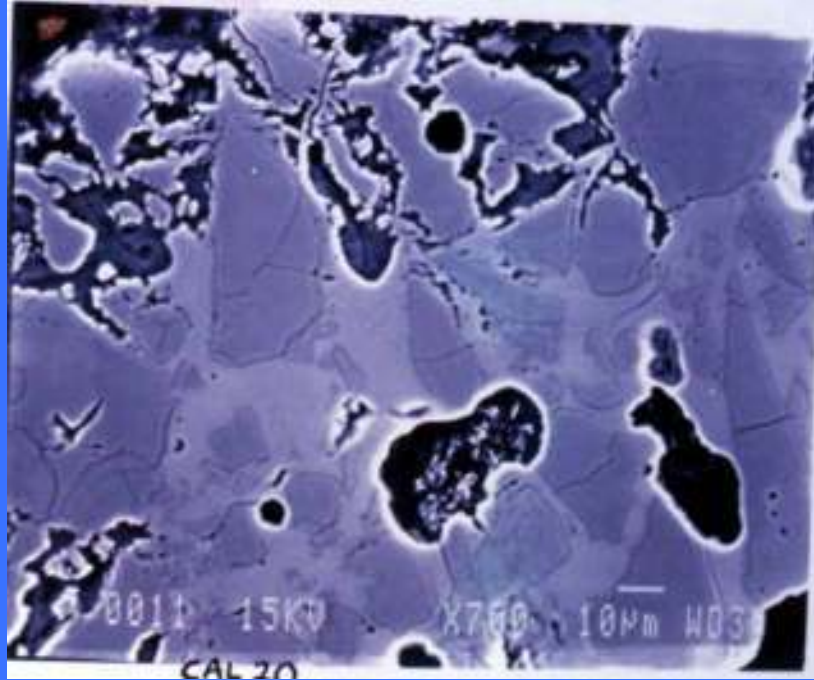


Set the foundation for
glass bangle production

**Turquoise and faience necklace,
with faience replica of turquoise
and eye agate – glassy compact
faience**



**Faience
replication
compact
faience
made from
refired frit**



Indus copper metallurgy produced a wide variety of objects – domestic, utilitarian, symbolic



Major Copper Deposits in South Asia & Adjacent Regions

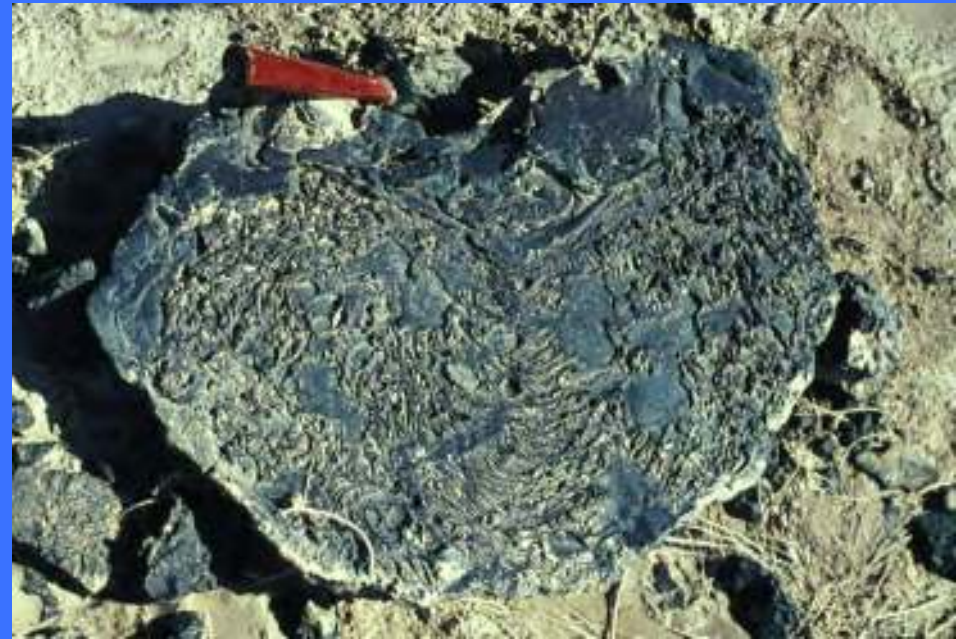




**Dasht-I-Margo,
Afghanistan copper ore
and smelting slag, and
pottery wasters**



Photos by G. F. Dales



Ambaji Copper Slag and Ore collection and processing



Ambaji Copper Mine Samples 2015



Chalcocite



Chrysocolla/ Bronchonite/ Atacamite



**Malachite
Azurite**

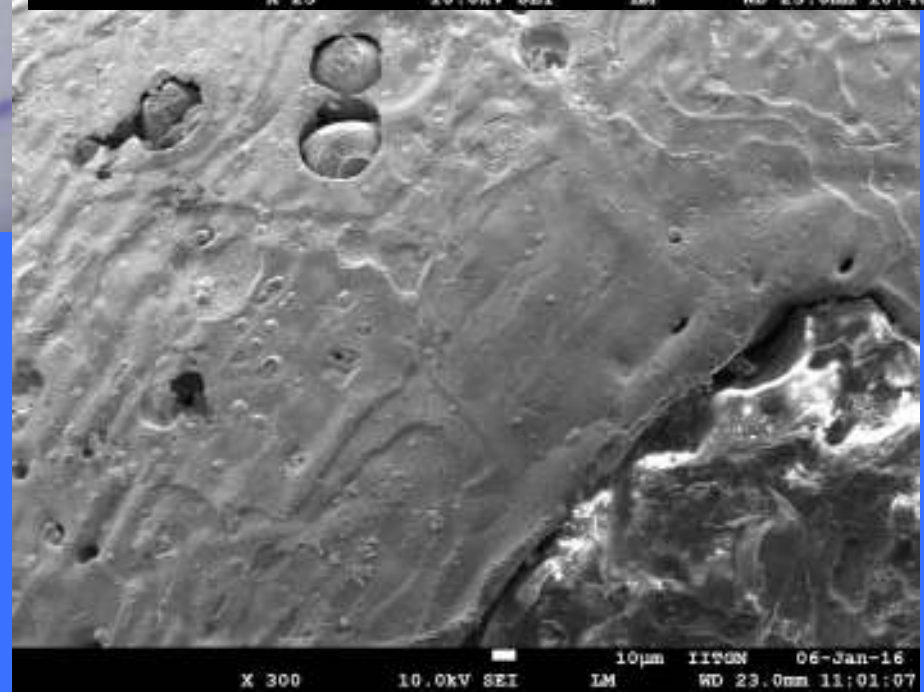
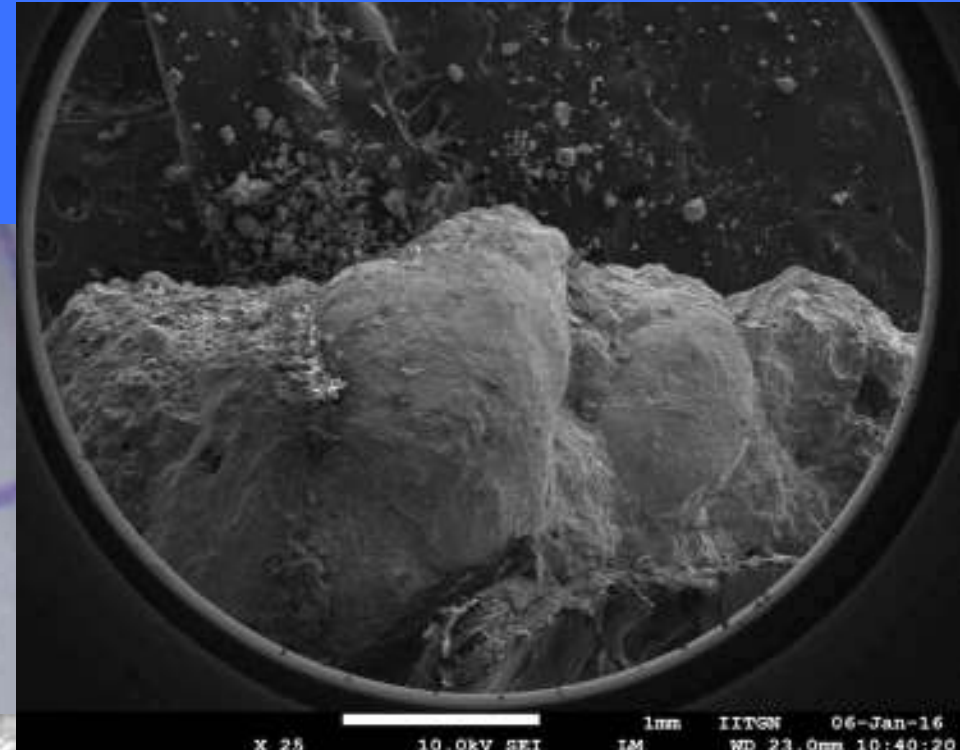


Ambaji Copper Smelting 2016

Palaj, IITGN



Ambaji Copper Smelting 2016 Palaj, IITGN



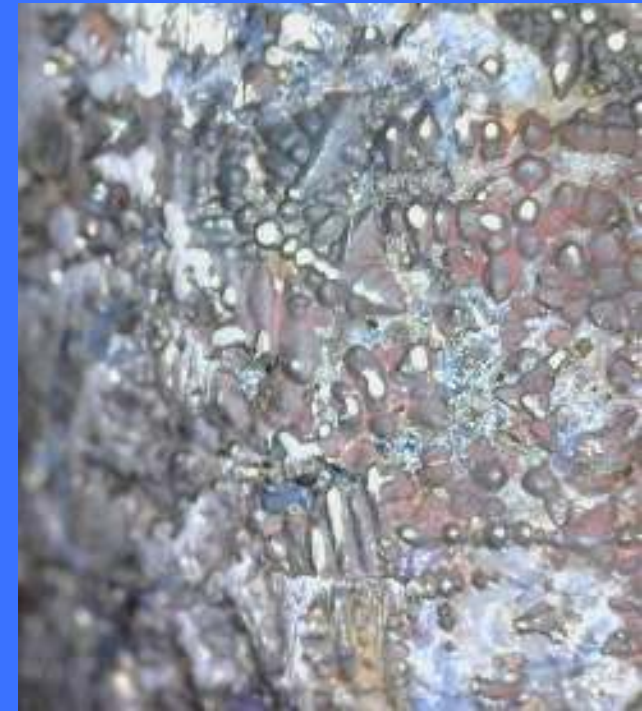
Wootz Steel Manufacture

2016 Palaj, IITGN



Wootz Steel Manufacture 2016

Palaj, IITGN



Wootz Steel Manufacture 2016 Palaj, IITGN

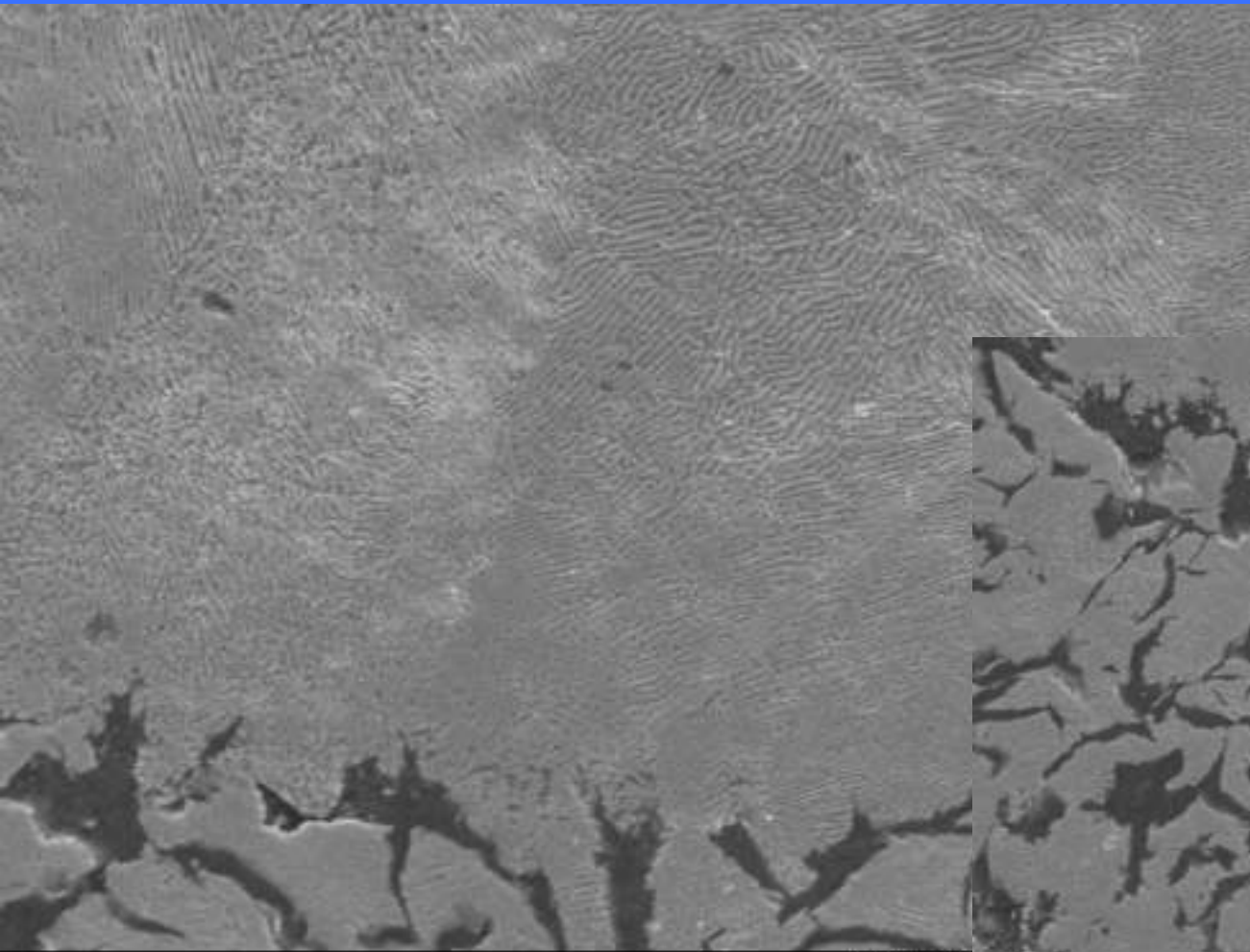
1st melting unsuccessful



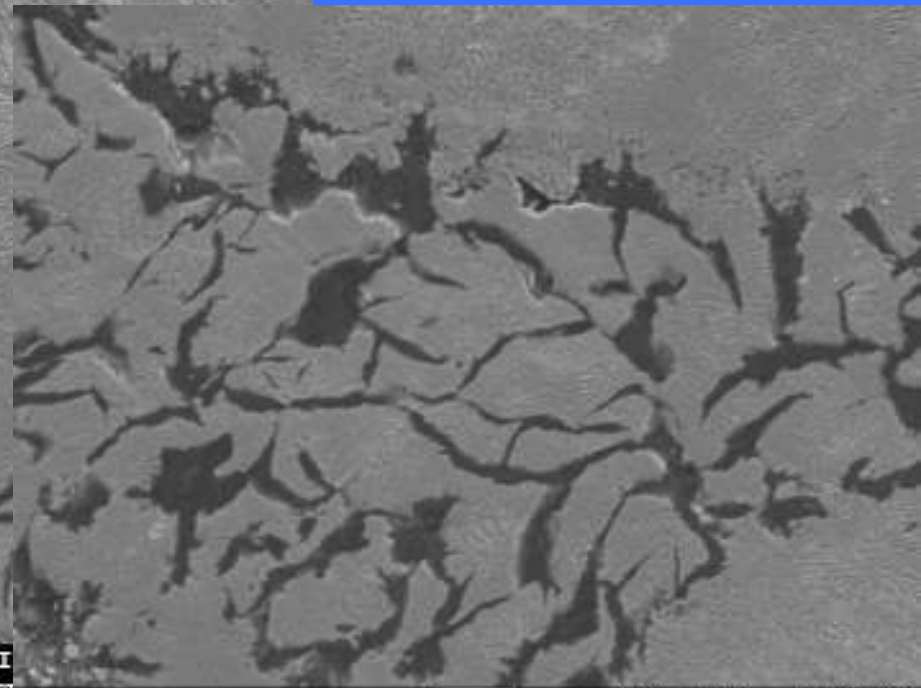
2nd melting
partly
successful



The potential for modern use of wootz steel has not been fully explored. Nanofilaments of cementite in museum weapons as well as carbon nanotubes have been identified and could have modern applications (cf. Almén et al 2007).



X 1,000 15.0kV SEI LM 10µm II



X 1,000 15.0kV SEI LM 10µm II 12-Jan-16 WD 23.0mm 12:30:22

How did Indus master artisans transfer knowledge? Through apprenticeship and oral traditions. **Narrative scenes** appear on Indus seals possibly at the very beginning of the Harappa Phase, circa 2600 BC and they seem to be an attempt to codify and advertise specific ideologies and stories or knowledge.



Banawali, sealing,
excavated by R. S. Bisht

Bull-Human Attack motif

Some motifs depict humans being destroyed by animals,

Mohenjodaro, excavated by John Marshall



Mehrgarh, excavated by J. F. Jarrige

Banawali, by R. S. Bisht



Five bodies tossed by a water buffalo



**Harappa - Horned Deity
in yogic position but
combined with a
narrative on both sides
of the terracotta
molded tablet.**

**Akkadian Water
buffalo sacrifice
in Mesopotamia**

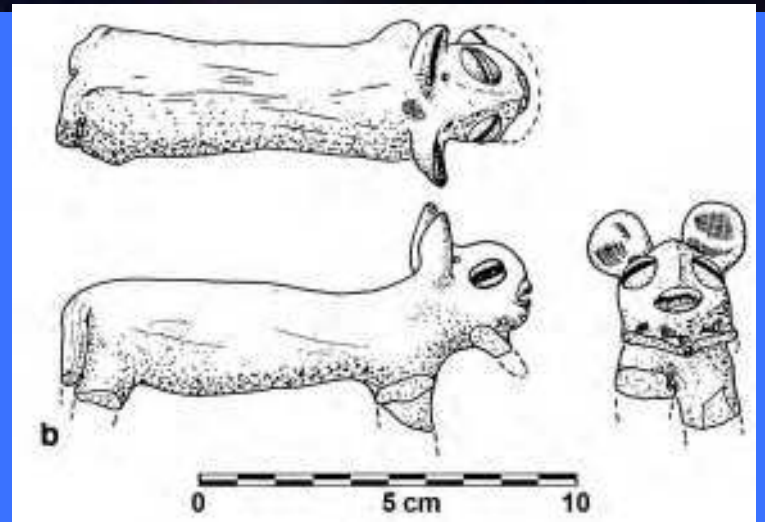


-deity strangling two tigers -
seal from Mohenjo daro, and
tablet found on the internet and
reportedly from Haryana

- deity between two unicorns,
Harappa



Human-Animal or Animal Human Deities or Spirits





Harappan horned deities, human-bull-tiger



Tukaji Rao
Maharajah
of Indore





Patan, Rani ki Vav

Tribal amulet



Door knockers from Mosque at Al Mansura



Meenakshi Temple, Madurai