

## **Chapter 2**

# **RESEARCH METHODS AND TECHNIQUES**

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Different methods and techniques employed during this research to understand lithic blade implements belonging to the Harappan Chalcolithic cultures of Gujarat have been discussed in this chapter. This includes reasons for site selection for the study, excavation techniques employed, and laboratory analysis techniques for lithic assemblages and finally the statistical analysis of data.

The research methods and techniques followed in this study can be divided into three broad types.

### **1. Literature survey**

The ultimate goal of this research is to understand the Harappan civilization, at the same time giving emphasis to its lithic assemblage. Extensive literature survey was conducted to understand the civilization as a whole and to understand the lithic assemblage and its characteristics. This step covered articles published in various academic journals and conference proceedings; books; published as well as unpublished Doctoral dissertations; excavation reports etc., one source led to the other and the list kept multiplying. Harappan lithic assemblage is generally not given due attention resulting in the lack of published material on Harappan lithic assemblages. Thus a lot of reading was done to understand various lithic assemblages. An effort was made to learn about the modern approaches to lithic studies being conducted throughout the world.

### **Site selection**

The method adopted in the study comprises of analyzing carefully selected lithic assemblages from cultural periods spanning from Mesolithic to the end of Chalcolithic phase in detail. In view of this, lithic assemblages recovered from Loteshwar in Patan District, Datrana in Patan district, Bagasra in Rajkot district, Shikarpur in Kutchh district and Pithad/Jaidak in Jamnagar district were selected for detailed study (figure 1.1). Geographically the sites are located in North Gujarat, Kuchchh and Saurashtra. These sites were excavated by the Department of Archaeology and Ancient History, The Maharaja Sayajirao University of Baroda,

Vadodara and therefore the artefacts are easily accessible for study. Besides, lithic assemblages from several other sites in Saurashtra and Kachchh are also referred to for a comprehensive understanding.

Amongst the selected sites, Loteshwar and Pithad/Jaidak have both Mesolithic and Chalcolithic assemblages. Thus a comparison between them can help in understanding the changes brought about by the discovery of the use of copper during the early stages of civilization. Tools from Datrana, being an Early Harappan/Chalcolithic site, are expected to throw light on early stages of urbanization. A Comparative study between Datrana (early Chalcolithic) and Bagasara (Mature Harappan) can help us to know more about technological and functional variations amongst the tools, besides economic and cultural differences reflected within the two assemblages. Shikarpur and Bagasra are two contemporary coastal sites. The lithic assemblage from Bagasra was analyzed for master's dissertation by the researcher, the results of this study are incorporated in the comparison chapter for a better understanding of Urban Harappan period. A comparative study between Bagasra and Shikarpur will give useful information regarding technological adaptation and trade practices. Similarly assessment between Pithad/Jaidak (Sorath Harappan site) and Shikarpur and Bagasra (Classical Harappan sites) will help to understand the lithic exploitation pattern between various regions of Gujarat.

Following are brief introductions of the sites selected for the study.

### **Loteshwar**

The site of Loteshwar (23° 36' 1.8" N; 71° 50' 11.8" E), locally known as Khari no timbo is located on top of a stabilised dune about 500m from the Khari River. It was first excavated by the Department of Archaeology and Ancient History, The Maharaja Sayajirao University of Baroda during 1990-91 (IAR 1991-92). The site was re-excavated in December 2009 jointly by the Department of Archaeology and Ancient History, the Maharaja Sayajirao University of Baroda, Vadodara and Department of Archaeology and Anthropology, Institutio Mila I Fontanals (IMIF), Spanish National Research Council (CSIC), Spain. The excavation unearthed two cultural periods namely Mesolithic (dated between the end of the eighth millennium cal BCE and the

middle of the sixth millennium cal BCE) and Chalcolithic (dated to around 3600-3000 BCE)(figure 2.1). The Mesolithic level is one of the earliest of its kind. The Mesolithic deposits provided geometric and non-geometric microlithics, faunal remains and palette stones. The Chalcolithic was characterised by shallow deposits not more than 0.9m below the current surface and rather conspicuous pits (figure 2.2) with Anarta pottery; terracotta objects (including a figurine); steatite micro-beads; terracotta, faience, shell and amazonite beads; terracotta and shell bangle fragments; clay lumps with reed impressions; charred wood and animal bones as well as a copper punch and some other copper objects (Madella et al 2010).

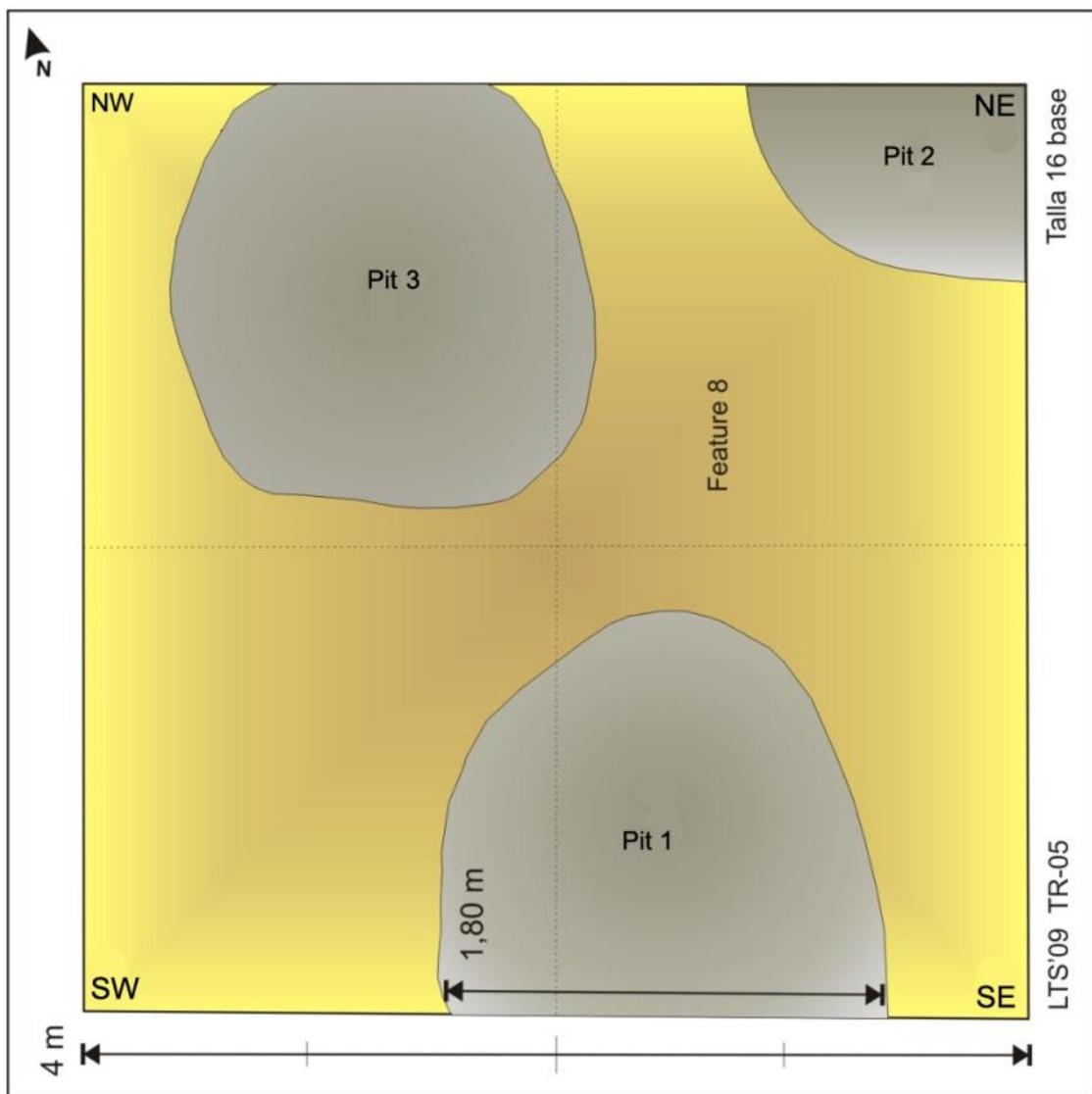


**Figure 2.1: Section at the site of Loteshwar 2009** (courtesy: NoGAP)

Among the two skeletons unearthed from the site during the 92 excavation one belonged to the Chalcolithic period (Ajithprasad 2009). The analysis of grinding stones from both the levels of the site have shown that they were probably used to grind both food and non-food plant materials. Researchers working on phytoliths from these grinding stones have been able to identify grasses and non-grasses including small millets, sedges and a single banana leaf phytolith (Garcia-Granero 2012).

Analysis of skeletal remains of both wild and domestic varieties of cattle has shown that North Gujarat was one of the probable centres for local domestication of zebu

cattle (*Bos indicus*) (Patel 2009). Patel further states that the absence of wild sheep and goat from both the levels and presence of domestic sheep and goat from later Chalcolithic levels at Loteshwar suggest that they were probably brought to the site from areas of Northwest (*ibid*). She has concluded that long span of Chalcolithic phase at Loteshwar and the ephemeral nature of the settlement can be interpreted as representing periodic visits by mobile pastoralists who travelled to the area seasonally (Patel 2008).



**Figure 2.2: Plan of the excavation at Loteshwar 2009** (courtesy: NoGAP)

Thus it can be seen that Loteshwar has capability to answer various types of questions related to small scale settlements having long span of habitational deposits, social contacts, resource use, early food production as well as early domestication of plants and animals.

## **Datrana**

The site of Datrana (23° 46' 14.7" N 71° 07' 26.2" E), locally known as Hadka valo timbo, meaning mound of bones, is located on a large crescent shaped stabilized dune (figure 2.5) about 2 km north east of Datrana village in Santalpur taluka of Patan district Gujarat. There are four different concentrations of artifact assemblages on this large dune, whose cultural history ranges from the Mesolithic to the Harappan Chalcolithic. The site was first excavated by the Department of Archaeology and Ancient History, the M.S.University of Baroda during years 1994-95. This excavation had resulted in the discovery of a two-fold cultural sequence: period I and period II.

Period I was represented by Mesolithic assemblage comprising microlithic geometric and non-geometric tools associated with the microlithic industry debitage, “palette stones” of sandstone, along with a number of different skeletal remains of the exploited animals. Otoliths belonging to this level have been dated to 7550 cal BC to 7600 cal BC by AMS estimation.

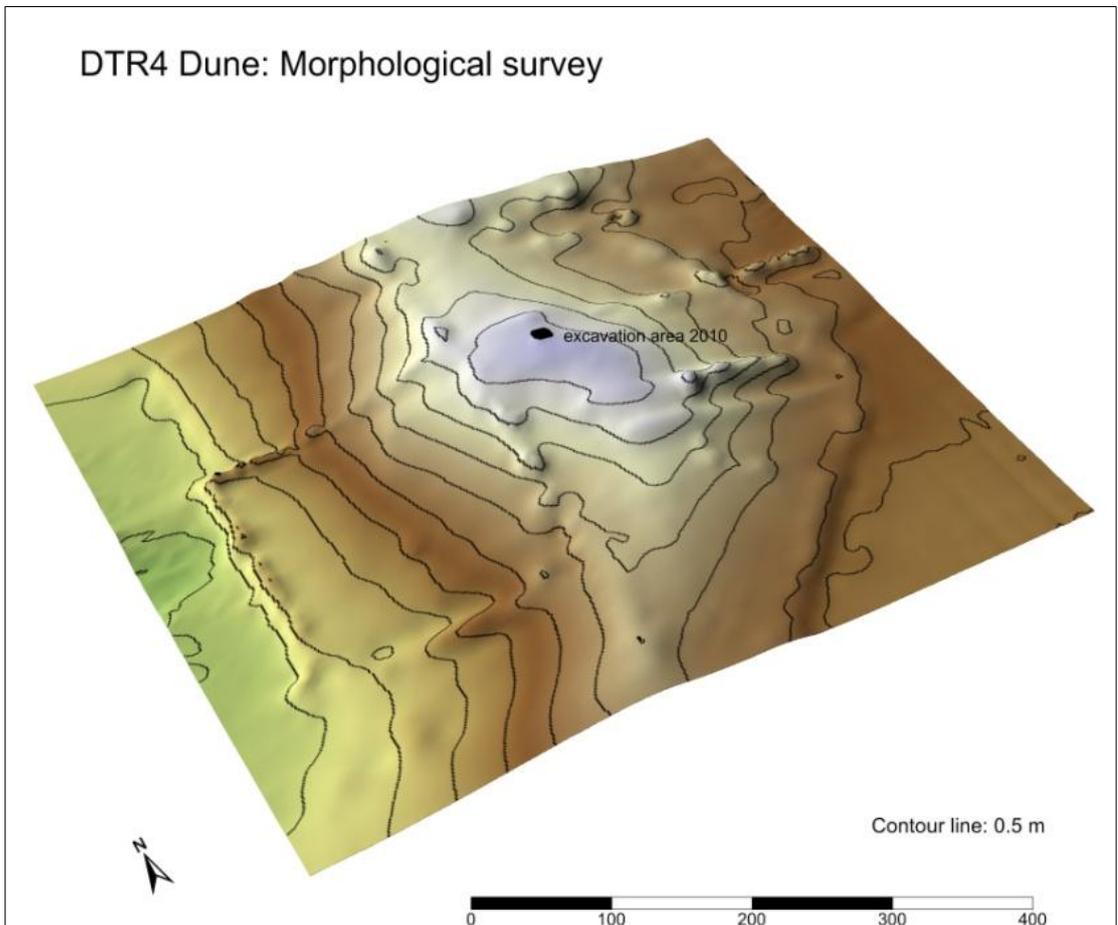


**Figure 2.3: Excavation at Datrana 2010** (courtesy NoGAP)

Period II was represented by Chalcolithic ceramic assemblage showing cultural affiliation to the Pre-Prabhas and Early Harappan Sindh which has been dated from 3300 to 2600 BCE. This Chalcolithic period is also represented by long crested ridge blades, prismatic blade cores, stone beads and roughouts, drill bits and copper punch point. (IAR 1993-94, IAR 1994-95, Sonawane and Ajithprasad 1994, Ajithprasad 2002:135, Ajithprasad 2011).



**Figure 2.4: Section at Datrana 2010 (courtesy NoGAP)**



**Figure 2.5: Contour of Datrana (courtesy NoGAP)**

The site was re-excavated during 2010 November-December under the project NoGAP (figure 2.3). The recent excavation revealed a 70cm cultural deposit belonging to two fold cultural sequence: the Mesolithic followed by the Chalcolithic (figure 2.4). The Mesolithic deposit is found to be very thin and poor in relative abundance of lithic blade tools and other Mesolithic artefacts. This most probably suggests that the location of the new trench is almost at the southern edge of the Mesolithic habitation. The Chalcolithic period habitation had concentration in the southwestern part of the mound. Material remains from the site incorporated extremely rich remains of blade production, disc shaped stone bead production, fine copper/bronze punch points, palette stone and Pre-prabhas and early Harappan Sindh type pottery fragments (Ajithprasad 2011).

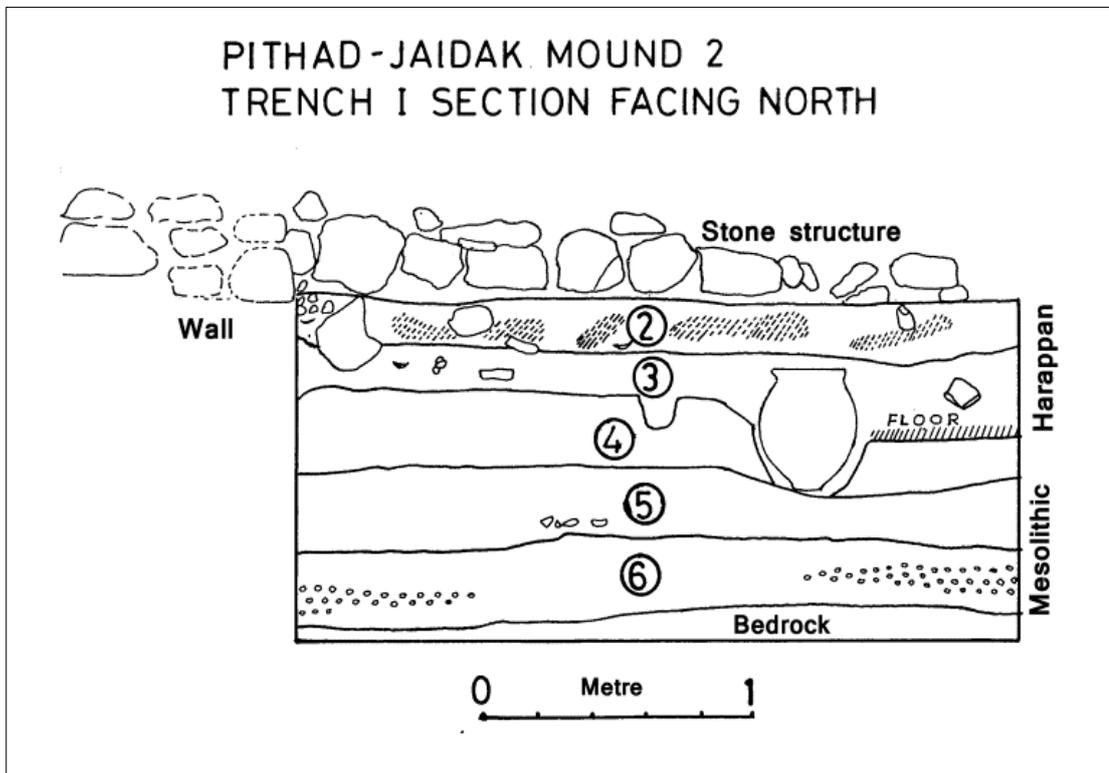
The Chalcolithic level also included clusters of bones often mixed with potsherds. The bones found in these clusters appear quite fragmentary with rare instances of intact long bones. None of these clusters produced skeletal elements in articulate position suggesting that the bones were accumulated at the place rather than being instantaneous burial after butchery. Tiny pieces of charcoal were also found distributed throughout the trench (Ajithprasad 2011).

Datrana gives evidence for being the earliest site in western India where crested ridge blade technique for long blade production has been identified. As this technique becomes one of the major blade production techniques during the Mature Harappan, its beginning and spread are crucial for understanding the chalcolithic cultural development in the region. The site also gives evidences of residents using Pre-Prabhas pottery (Dhavalikar and Possehl 1992) coming in contact with the people using Early Harappan pottery, which in turn shows early contact with contemporary settlements of the middle Indus valley, especially the Sindh region in Pakistan.

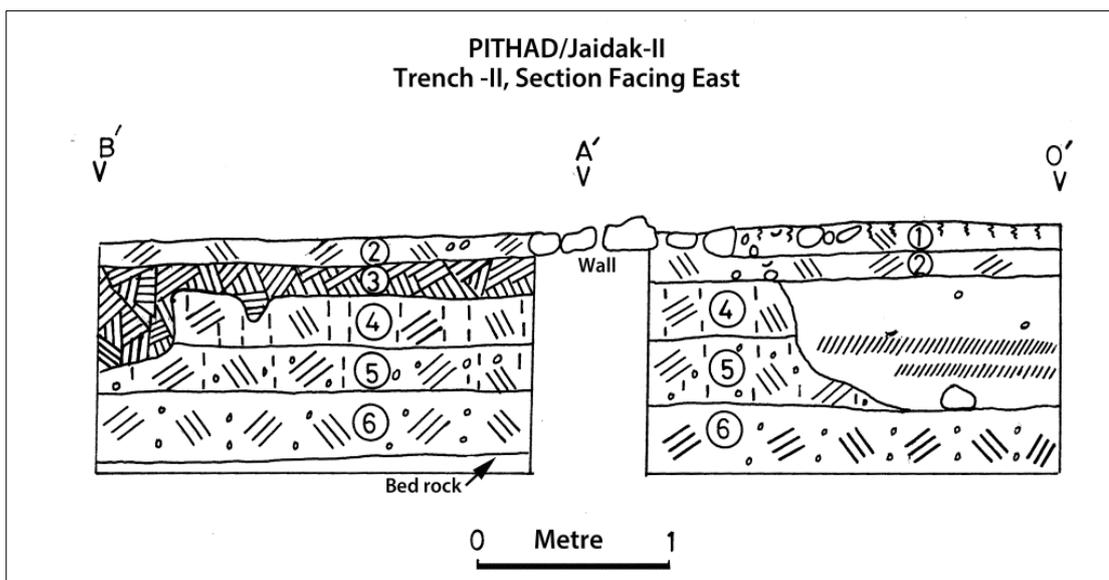
### **Pithad/Jaidak no Timbo**

The site, locally known as the Jaidak Timbo (23<sup>0</sup> 39.5' N; 70<sup>0</sup> 34.43' E), situated 4km south of Pithad/Jaidak village on the eastern bank of the Aji river has two mounds. Jaidak 1, is the larger one measuring about 300X150m with a height of about 5m from the surrounding plain. The second mound, Jaidak 2, probably an extension of the first mound, but now separated by deep erosional *nullah* is at about 50m south-east and

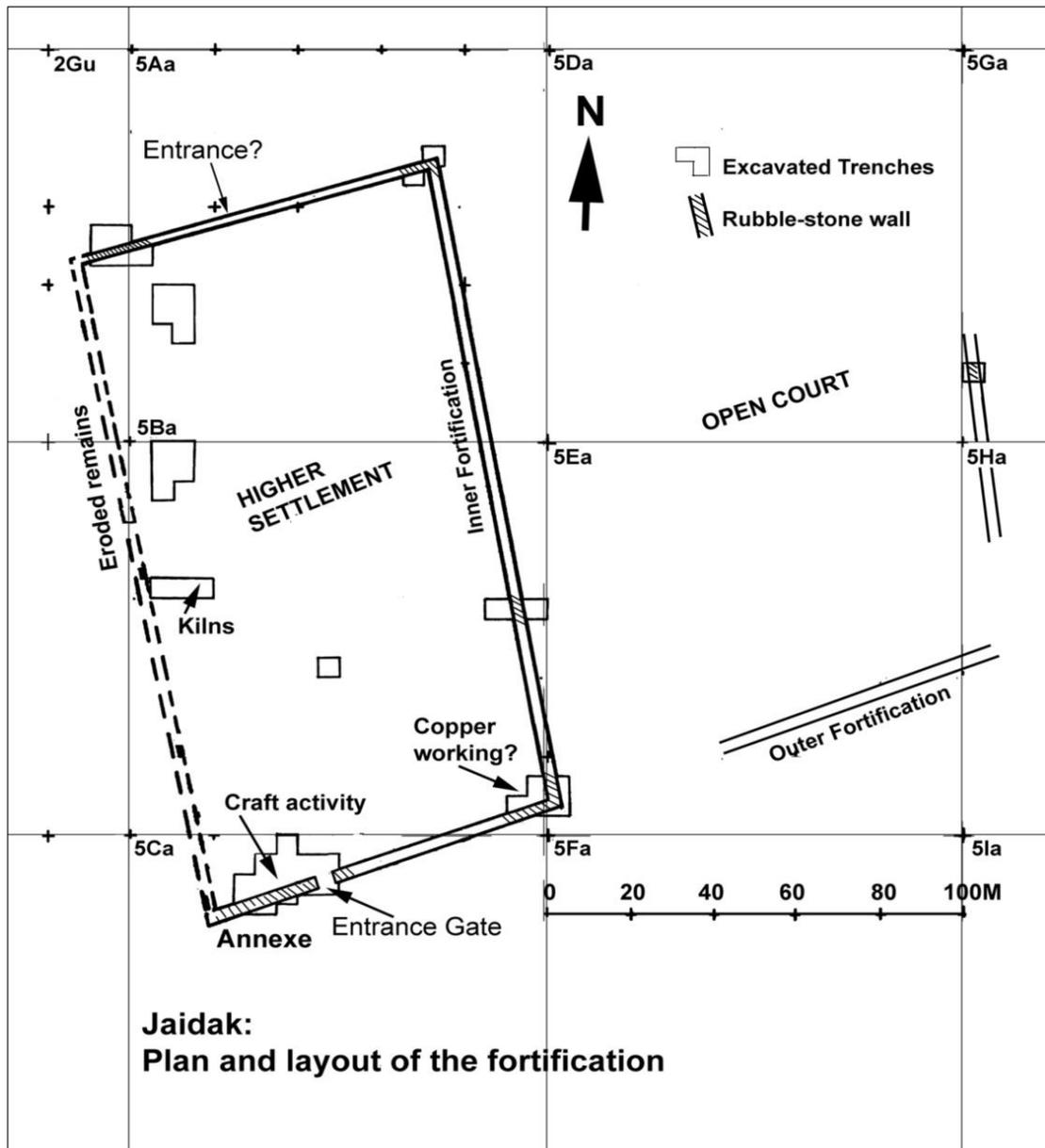
measures 140X90m (figure 2.9). Excavation was carried out on Jaidak 2 at its north-western corner where structural features were clear on the surface by the Department of Archaeology and Ancient History, the Maharaja Sayajirao University of Baroda during years 1991-92 (IAR 1991-92).



**Figure 2.6: Section facing north of trench I, 1992 excavation at Pithad** (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)



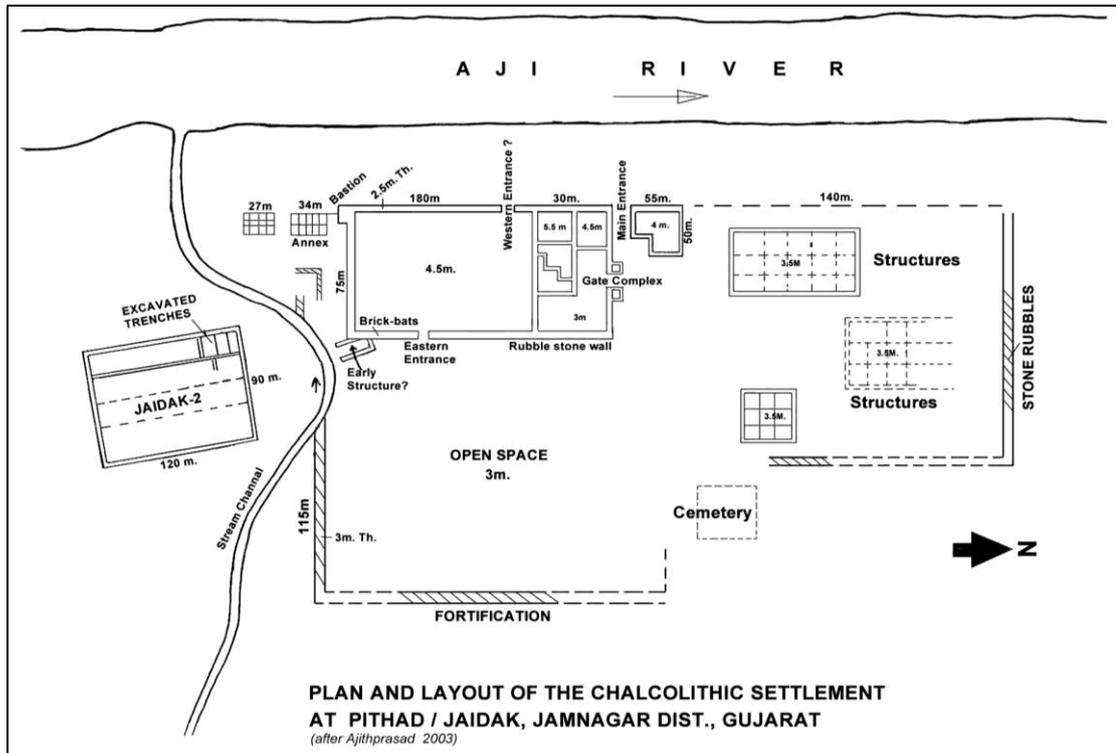
**Figure 2.7: Section facing east trench II, 1992 excavation at Pithad** (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)



**Figure 2.8: Plan and layout of the fortification at the Pithad mound** (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)

The excavation revealed a 1.40m habitational deposit having five different layers belonging to two distinct periods. Period I belongs to the Mesolithic culture and Period II to the Sorath Harappan (figures 2.6 & 2.7). Period I or Mesolithic is represented by 80-90cm deposit. It has yielded a large number of microlithic implements and other artefacts like pieces of flat sandstone “palette” and hammer stones. The lithic industry includes geometric and non-geometric tool-types along with simple blades and flakes and other lithic waste. A temporary break in the occupation at the site during this period is indicated by about 10m thick sterile deposit in the middle of the strata. A probable Mesolithic working floor has been traced at this

level, on the basis of the regular arrangements of large, flat stone slabs and clustering or artefacts around these slabs. No substantial quantity of faunal remains is found from this deposit. A noteworthy find from the excavation consists of a few pieces of ostrich egg-shell. It is for the first time that ostrich egg-shell pieces are found from a stratified Mesolithic context in Gujarat (IAR 1991-92).



**Figure 2.9: Plan and layout of the Chalcolithic settlement at Pithad** (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)

The Sorath Harappan occupation, Period II, is lying directly over the Mesolithic deposit. This shows two phases of structural activity. The first phase of structures at the site is represented by a long rubble stone wall, with remains of a few more small walls in the second layer. Associated with this structure was found a large pot, buried underneath the floor level (figure 2.6). Structures of second phase were, built after levelling the debris of the earlier structures. Fine red ware, buff ware, buff and cream-slipper wares, course red ware and course grey ware are the important pottery types recovered from this deposit. Bowls, pots and jars with various types of rim and body features, dishes and dish-on-stand are the important shapes in pottery. A large number of small terracotta biconical beads and a few beads of chert, agate and carnelian, microlithic blade tools and bits and pieces of copper/bronze objects are the other important antiquities recovered from the excavation (IAR 1991-92).

<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Period -IIB</p>			<p><b>Period IIB</b>  <b>Late Sorath Harappan</b></p> <p>Late Sorath Harappan Pottery: Concave bowls, bowls with elongated stud-handle, dishes with drooping rim, pots with elongated neck, Coarse wares with incised decoration, lamps, TC beads, copper implements. (Rangpur IIC, Rojdi C, Bagasra IV)  Date: 1800BC</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Period -IIA</p>		<p style="writing-mode: vertical-rl; transform: rotate(180deg);"><b>FORTIFICATION</b></p>	<p><b>Period IIA</b>  <b>Sorath Harappan</b></p> <p>Sorath Harappan pottery: Convex bowls, bowls with short stud handle, dishes, dish-on-stand, basins, large pots, Coarse wares with incised and scored decorations, perforated jars, pedestal base vases. Copper artefacts, beads of agate, carnelian, amazonite, faience, steatite, and shell. TC beads, pottery discs, humped bull figurine. Lithic blades and flakes. Fortification wall (Rangpur IIB, Rojdi B, Kuntasi -I, Bagasra -III)  Date: 2200BC</p>
<p style="writing-mode: vertical-rl; transform: rotate(180deg);">Period I</p>			<p><b>Period I</b>  <b>Mesolithic</b>  <b>Microlithic tools</b>  Date: earlier than 2200BC</p>

Figure 2.10: Schematic cultural sequence at Pithad (courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)

Faunal remains from this period include fragments of bone, horn-core, antler and teeth of exploited animals. The collection incorporated a large number of bivalve shells which indicates a wider and intense exploitation of aquatic resources by the Sorath Harappan occupants of the site (IAR 1991-92).

The site was re-excavated by the Department of Archaeology and Ancient History, The Maharaja Sayajirao University of Baroda, Vadodara during 2005-2006 and 2006-2007 field seasons. This excavation revealed two distinct phases in the Harappan occupation at the site: a. Period IIA, culturally and chronologically affiliated to the Rangpur IIB, Kuntasi I and Rojdi B and b. Period IIB that is affiliated to Rangpur IIC and Rojdi C (figure 2.10). Period IIA is contemporary to the terminal stages of the Mature Harappan and can be dated to around 2200/2100BC. The main planning and layout of the settlement and the construction of the fortification wall were all carried out during this phase (figure 2.8). This is followed in the upper layers by the second phase, which showed an assemblage similar to Rojdi C, Kuntasi II and Rangpur IIC. The approximate date of this phase may fall within the bracket 1900 to 1700 and therefore belong to the Post-Urban phase of the Harappa culture.

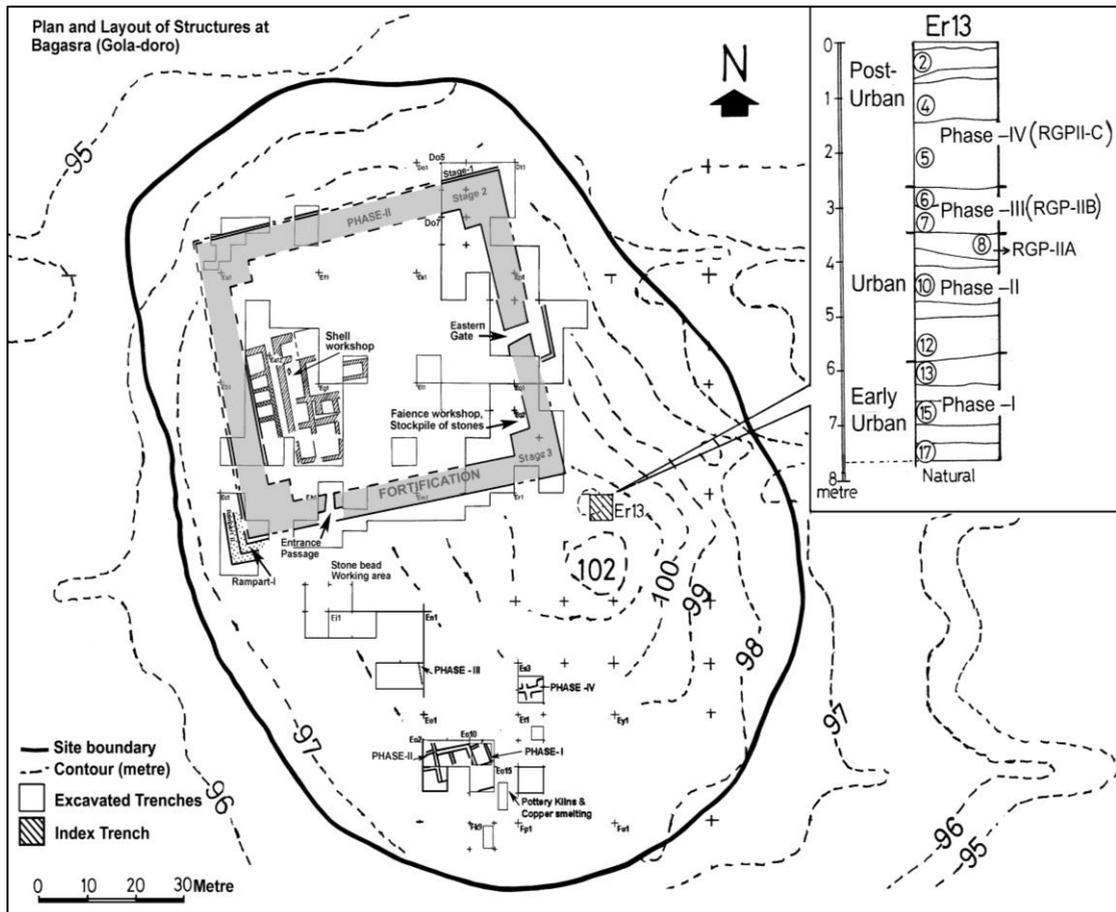
### **Bagasra**

Bagasra, (23° 3' 30"N; 70° 37' 10"E) is a small (160 x 120 m) fortified Harappan industrial site situated on the southeastern shore of the Gulf of Kachchh in Maliya taluka of Rajkot district, Gujarat. The site is known locally by the name *Gola Dhoru* which means a circular mound (figure 2.11). The site has been excavated by the Department of Archaeology and Ancient History, The M. S.U. of Baroda, Vadodara for nine consecutive years starting from the 1995-96 field season. (Sonawane *et al.* 2003).

The excavations revealed 7.75m thick habitational deposit (figure 2.12) belonging to four distinct developmental phases. The classification of the developmental phases is based on the stratigraphic context and quantitative distribution of distinct, diagnostic artefacts and also by considering architectural constructions at the site (figure 2.13) (*ibid*).

Phase I represents the early stages of the Urban Harappan occupation at the site and it is represented by 1.00-1.75m habitational deposit. The date for this phase is about

2450 B.C. Phase II was the most prosperous period during the entire history of the site. The construction of a massive fortification wall in three different stages is the most conspicuous feature of this phase. Flourishing of craft activities like shell bangle manufacture, semiprecious stone bead fabrication, faience bead industry, etc. boosted trade and prosperity. The cultural debris representing this period has a thick accumulation measuring more than 5m. The date is about 2400-2100 B.C.

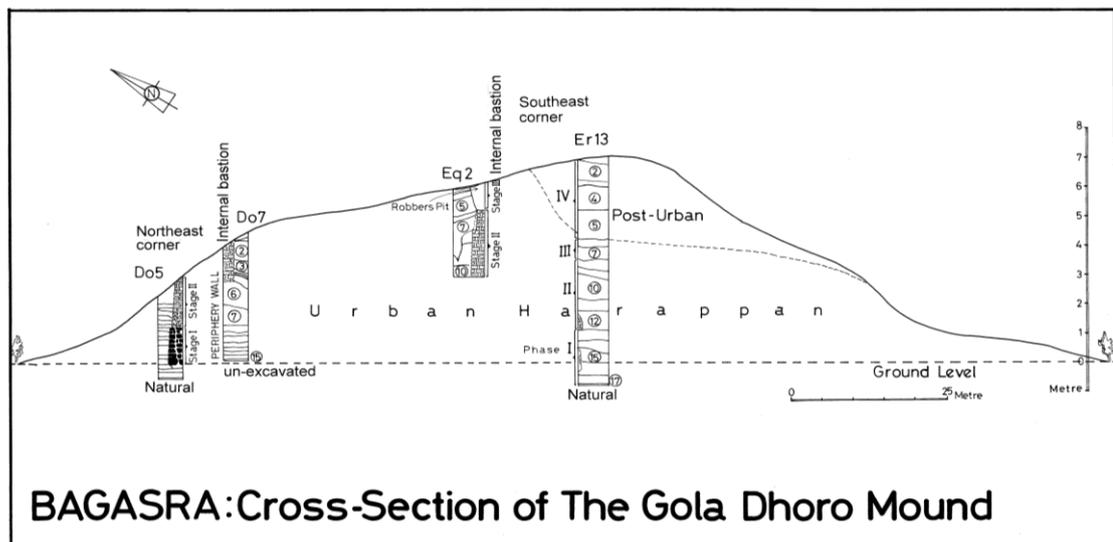


**Figure 2.11: Plan and layout of structures at Bagasra** (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)

Phase III was the declining stage of the Urban Harappan occupation. It is distinguished from the preceding phase by the preponderance of Sorath Harappan artifacts along with the Classical Harappan. The deposit has an average thickness of about 1.20m. This phase can be dated to about 2100-1900 B.C.

Phase IV represents the Late or Post-Urban Harappan occupation of the site. The deposit is found directly overlying the Phase III deposit without any stratigraphic break. The dates suggested are 1900-1700 B.C. (*ibid*).

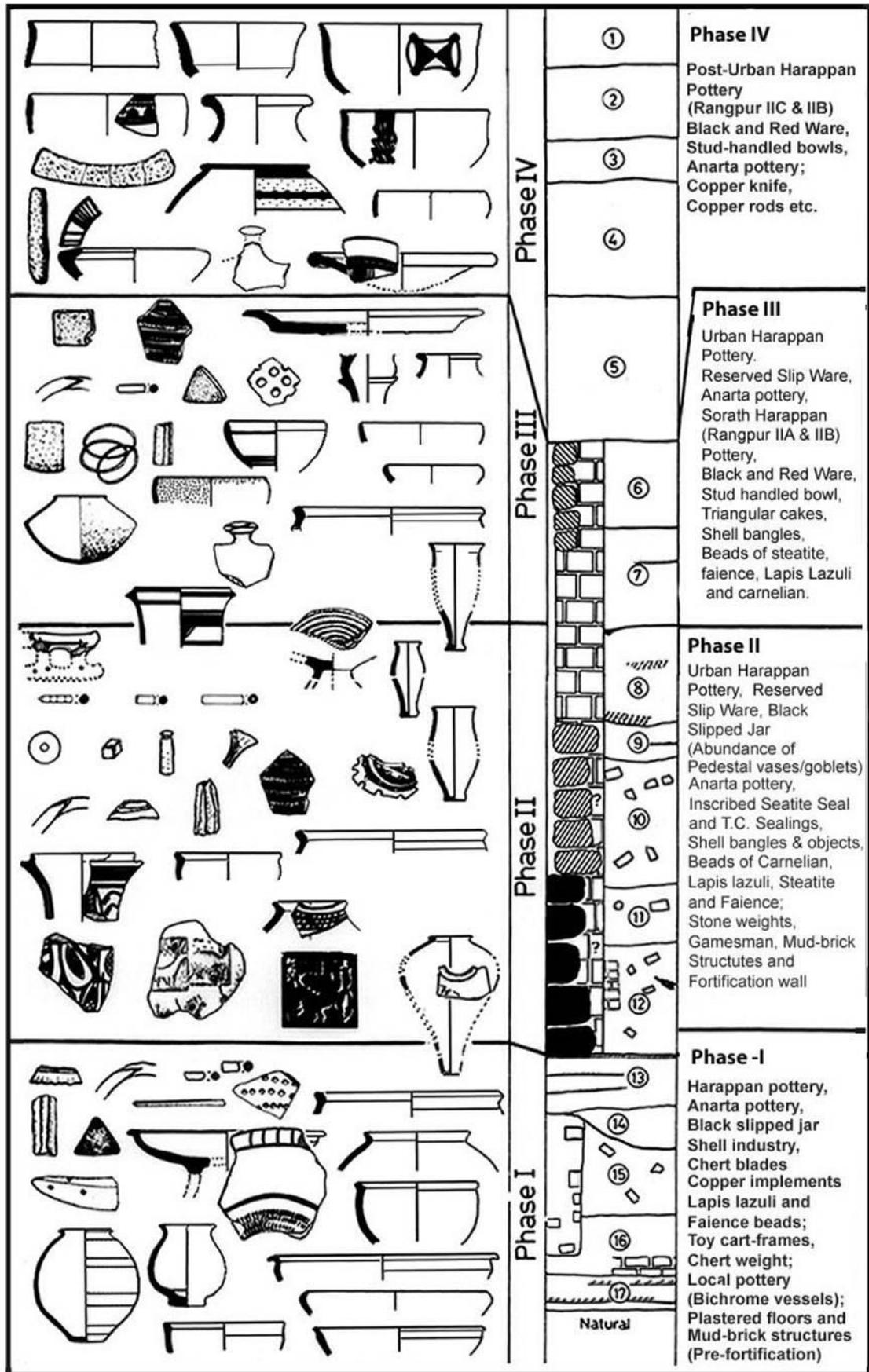
The settlement incorporated cultural traits of the Sorath Harappan of Saurashtra and the regional Chalcolithic/Anarta assemblage of North Gujarat. Moreover the site is located equidistant from North Gujarat and Kachchh region of Gujarat. Due to its specific geographical location, the site appeared to be a connecting link between these three major geo-cultural regions and therefore an important centre for the movement of Chalcolithic communities during Harappan period (*ibid*).



**Figure 2.12: Cross-section of Bagasra (Gola Dhoro) mound** (Courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

The settlement follows a simple plan having two distinct segments in its layout- a fortified area measuring 65 x 57m confined to the northern half of the settlement, and the southern half which does not show the evidence of a fortification. Within the fortified area craft activities such as shell bangle manufacturing, production of faience and stone beads and copper implements flourished. Structures unearthed within the fortification are mostly associated with these craft activities. Evidence of bead working and pottery production is also found outside the fortification in the southern segment but in lesser concentration (Sonawane *et al.* 2003).

Artefacts like beads of carnelian, amazonite, steatite, faience, lapis lazuli and other semi precious stones; terracotta and shell bangles; inscribed terracotta sealings and seals; stone weights; gamesman; toy cart frames; copper/bronze spearhead/arrowheads and chisels as well as a large number of blade implements, geometric and non-geometric tools made of crypto-crystalline siliceous stones, were recovered during the excavations (Sonawane *et al.* 2003).



**Figure 2.13: Cross-section of Bagasra (Gola Dhoru) mound** (Courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

## Shikarpur

The site (figure 2.14), locally known as Valmio Timbo ( $23^{\circ} 14' 15''$  N;  $70^{\circ} 40' 39''$  E) is located about 4.5km south of the Shikarpur village at the edge of the narrow creek extending eastward from the Gulf of Kutch. The rectangular mound approximately measures 3.4 hectares covering the entire elevated top of the stabilized sand dune. The overall height of the mound is about 7.5 to 8m from the surrounding ground (Bhan and Ajithprasad 2008).



**Figure 2.14: The site of Shikarpur** (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda)

The site has a bipartite plan with a massive fortification encompassing an inner area a little over 1.00 hectare. A slightly different planning in the organization of space was discovered where the structures are built close to the fortification wall leaving the central part open, probably to facilitate broad based economic activities and common, communal ceremonies. The excavations have revealed entrance gate in eastern as well as western wall.

The excavations have revealed a total of 6.40m deposit showing three fold sequence in the Harappan occupation at the site (figure 2.5). The early phase, Phase I is entirely belonging to the Classical Harappan represented by about 3.00m cultural deposit.



wheels, terracotta bangles, terracotta animal and human like figures. Several stone beads and bead roughouts along with 'erectite' drill heads were also found.

Phase II is the Urban Harappan phase. The total habitation of this phase is about 1.40 to 1.60m. The artefacts from this phase incorporate Harappan and Sorath Harappan potteries. Chert blades of Rohri type chert, shell bangles, stone beads, copper implements, terracotta bangles, beads, triangular cakes, cart frames and wheels continue in this phase too.

Phase III is thin and patchy and is generally confined to the top 10 to 20cm. The deposit is marked by Post-Urban Harappan material. Very few artefacts except ceramics have been reported from this phase. This phase also shows absence of craft activity. Structures belonging to this phase are meagre, except for the remains of flimsy, circular and apsidal stone structures.

## **2. Field research**

### **Excavation methods**

As all the sites selected for this research are excavated by the Department of Archaeology and Ancient History, The Maharaja Sayajirao University of Baroda, Vadodara, they follow a uniform pattern of excavation. The plan and layout of the trenches follow the Topographical Survey Map scheme. One trench measures 5x5m. Each dig in a trench consists of a 5-10cm thick deposit. Mesh screens are used to sieve the excavated earth and artefacts are collected from these sieves. The artefacts collected from each dig are recorded systematically by recording the number of the trench, number of the layer, number of the lot (where artefacts from each dig were considered as belonging to a lot) measurement of the depth etc.

### **Sample**

The entire lithic assemblages belonging to the five type sites have been analyzed systematically in this research. It is very important to keep in mind that numbers of trenches dug vary between these sites and thus any conclusion based only on represented numbers of antiquities is erroneous. Big settlements such as Bagasra, Shikarpur and Pithad/Jaidak have been excavated for more than one field seasons and naturally have many excavated trenches. Bagasra was excavated for 8 seasons and has over a hundred trenches. Shikarpur was excavated for 7 seasons and has over 80

trenches. Pithad/Jaidak was excavated for three seasons and has more than 40 trenches. The sites (Loteshwar and Datrana) which were re-excavated under the NoGap were excavated for a single season and consist of single trenches. Table 2.1 demonstrates the sample size from each site.

**Table 2.1 Distribution of excavated trenches across sites**

Site	No of trenches	Tools	Lithic debitage + cores
Loteshwar	1	1,652	1,772
Datrana	1	10,581	77,239
Pithad/Jaidak	>40	552	2,532
Bagasra	>100	1,100	6,770
Shikarpur	>80	769	4,465

Researcher was fortunate enough to be present during most of the excavations. She has attended excavations for one field season at each site. She herself collected the research material during Loteshwar and Datrana excavations. Participations in all these excavations have been very educative as the researcher now has a firsthand understanding about the sites, their geographical surroundings, their stratigraphical features and their material assemblages.

As soon as they were excavated, artefacts were cleaned with water, dried and put in plastic bags. These bags were then labelled with trench, lot, layer and feature number as well as the depth from which they have been excavated. These plastic bags were next put in brown paper bags which bear the identical context details. These were then registered in department antiquity register and each bag was given an antiquity number. All the antiquity packets were then packed in antiquity boxes, labelled with site name and year. Once back in department, antiquities were sorted and taken to lab according to a researcher's area of study. If needed the artefacts were cleaned again in the lab.

During the data collection phase, coded attributes were recorded on data sheets by hand. These were then uploaded into Microsoft office excel sheets. This way if an error had been made it was immediately noted, checked and corrected. Measurements of all the tools were taken with a precision of 0.01mm with Schlenker Enterprises Lts digital calliper. AWS Digital weighing machine with a lower range of 0.01g was used to weigh the assemblages.

### 3. Method of lithic analysis

#### Classification

The first step in the classification was the identification of different raw materials.

The raw materials were classified as:

<b>Crypto crystalline siliceous materials</b>	<b>Non crypto crystalline siliceous materials</b>
Chert, Chalcedony, Banded agate, Moss agate, Rohri chert, Blood stone, Quartz, Carnelian, Jasper, “Ernestite”.	Quartzite, Sandstone, Basalt, Mica, Amazonite, Calcite, Zeolite.

The classification of the lithic assemblages into tools and lithic debitage or the manufacturing waste was done according to their morphological features. The basic classification is given in the table 2.2.

**Table 2.2 Classification of the lithic assemblage**

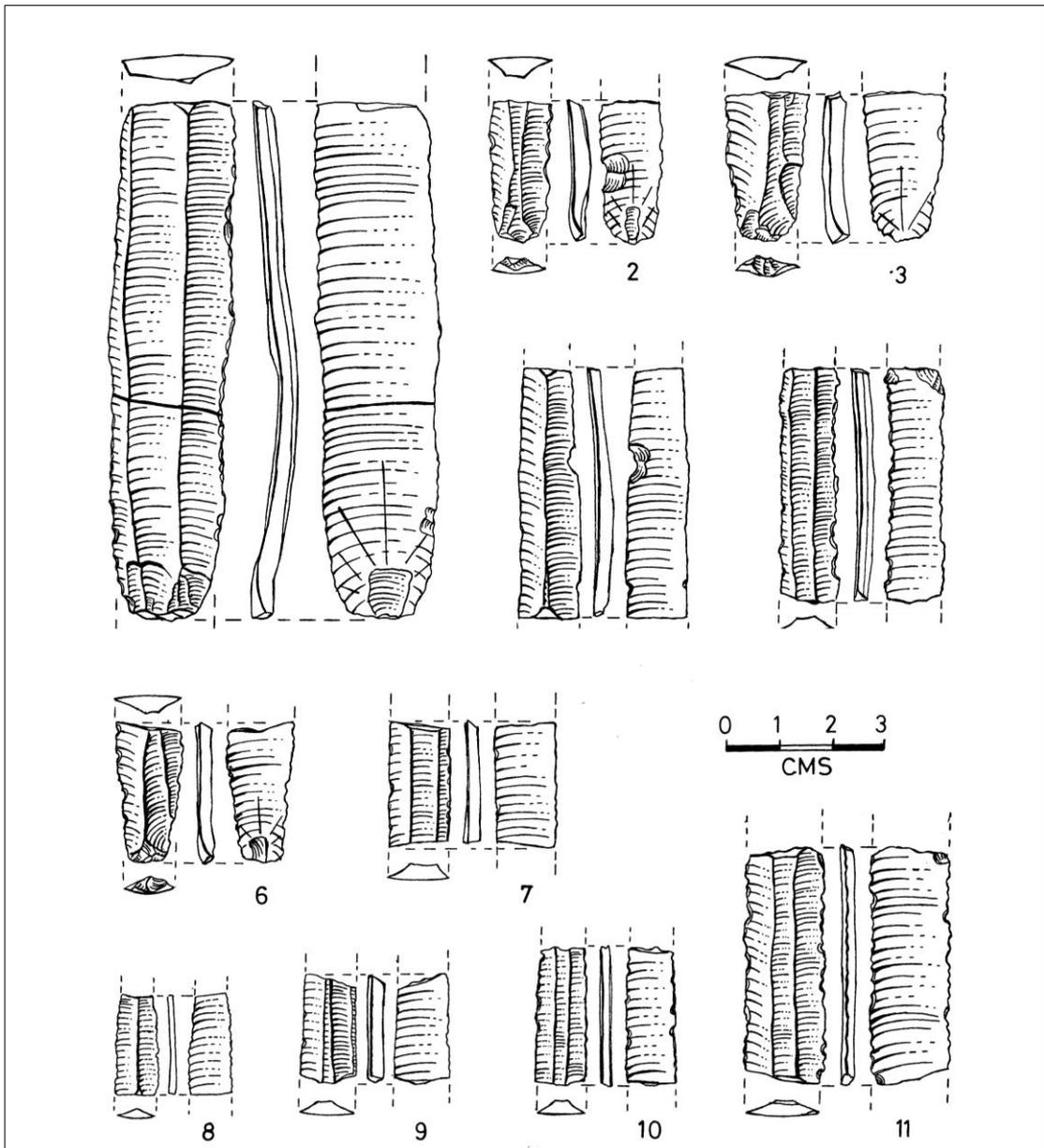
<b>Blades</b>	<b>Geometric and non-geometric tools</b>	<b>Lithic debitage</b>
1. Simple blades	1. Isosceles triangle	1. Flakes
2. Backed blades	2. Scalene triangle	2. Chips
3. Obliquely blunted	3. Lunate	3. Nodules
5. Strangulated	4. Trapezium	4. Cores
6. Crested ridge	5. Point	5. Core rejuvenation flake
7. Blade flakes	6. Burin	6. Waste
8. Flakes	7. Borer	7. Core fragment
9. Retouched blades	8. Scrapers: End, Side, Double sided, Concave, Convex, Side and end, Notched, Round	8. Grinding stone fragment

A typological study is only relevant if the types are well defined and understood by all the scholars. Each type mentioned here also describes the attributes which were considered to define a particular type (table 2.3).

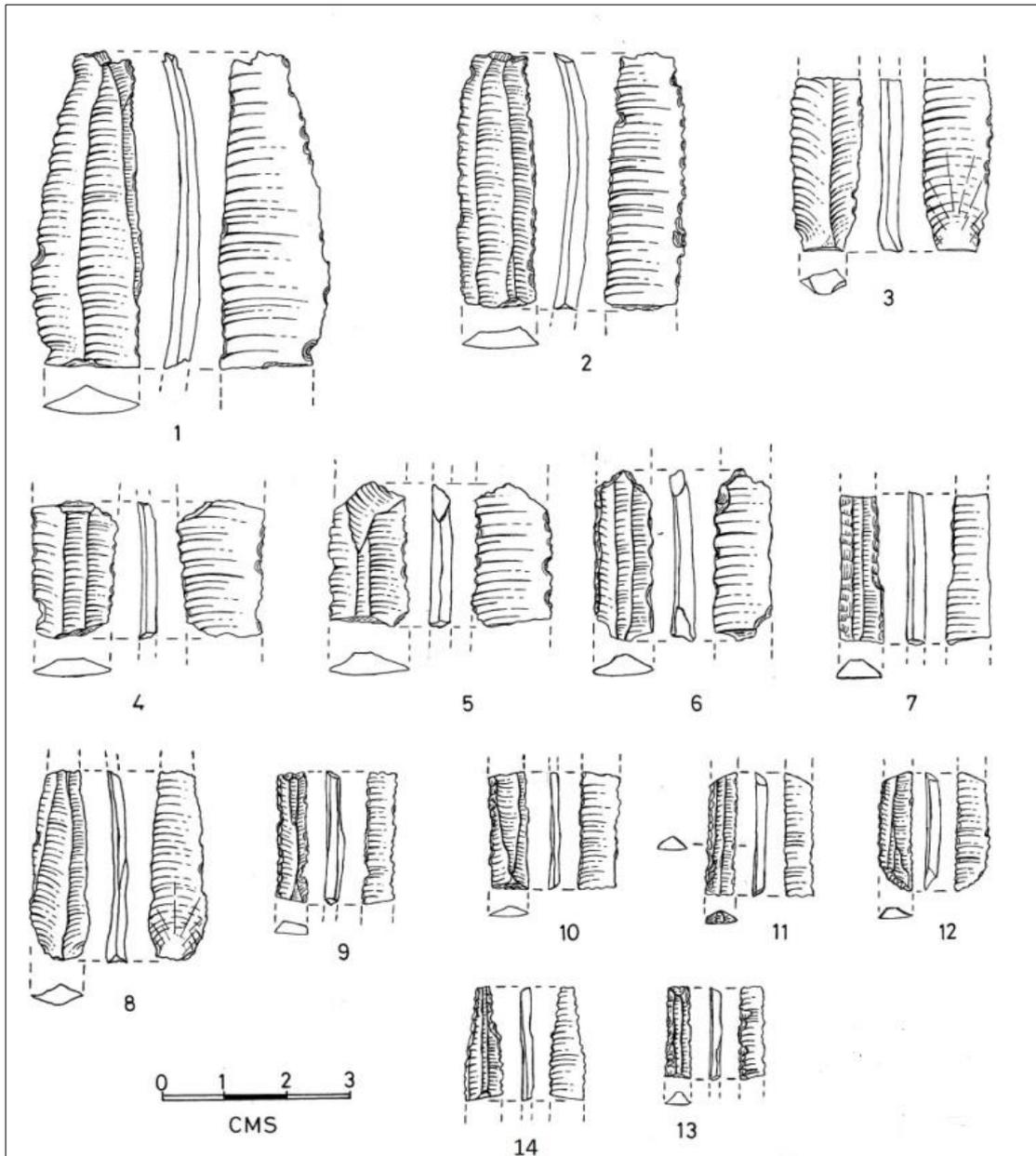
**Table 2.3 Characteristics of various tool types**

Tools	Characteristics	
Blades (figures 2.16, 2.17, 2.18, 2.19)	Having parallel sides and the length double than the breadth. They also have either one or two mid ridges.	
	Simple blades	Blades without any retouches but with use marks are categorized into this.
	Backed blades	Blades having retouches along one longitudinal side. These retouches were done to facilitate hafting.
	Obliquely blunted blades	A blade with oblique retouches on one of the traverse side and sometimes also all along one side.
	Strangulated blades	A blade with retouch on both the longitudinal sides which gives it the appearance as if notched from both the sides.
	Crested guiding ridge blades	A blade which retains the crested guiding ridge of the core preparation.
	Blade flakes	A flake with characteristics of a blade but not all of them.
	Blade blanks	Blades without use marks.
	flakes	Normal flakes either with retouches or bearing utilization marks
	Retouched blades	Blades with minimal retouches
Triangles (figure 2.20)	Two longitudinal sides are steeply blunted	
	Isosceles triangles: having two equal sides	
	Scalene triangles: without any equal sides	
Lunates (figure 2.20)	Tiny microlith having the shape of a crescent. Usually the arch (round back) is thick and intentionally blunted.	
Trapeziums (figure 2.20)	Having two parallel horizontal sides and two non parallel shorter sides. The non parallel or the transverse sides are retouched.	
Points (figure 2.21)	Have a pointed end which is achieved by retouching two sides of a blade/flake.	

Borers (figure 2.21)	Have a thick projecting point which is carefully retouched.
Burins (figure 2.21)	One side of the pointed end is a result of a vertical blow whereas the other side is made by deliberate notch.
Scrapers (figure 2.22)	Made from a flake generally without having parallel sides. Nature of the secondary retouch determines the different types like side scraper, end scraper, concave scraper, convex scraper, double sided scrapers, side and end scrapers, notches scrapers, round scrapers etc.



**Figure 2.16: Proximal (1,2,3,6) and mesial (4,5,7,8,9,10,11) blade fragments**  
 (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

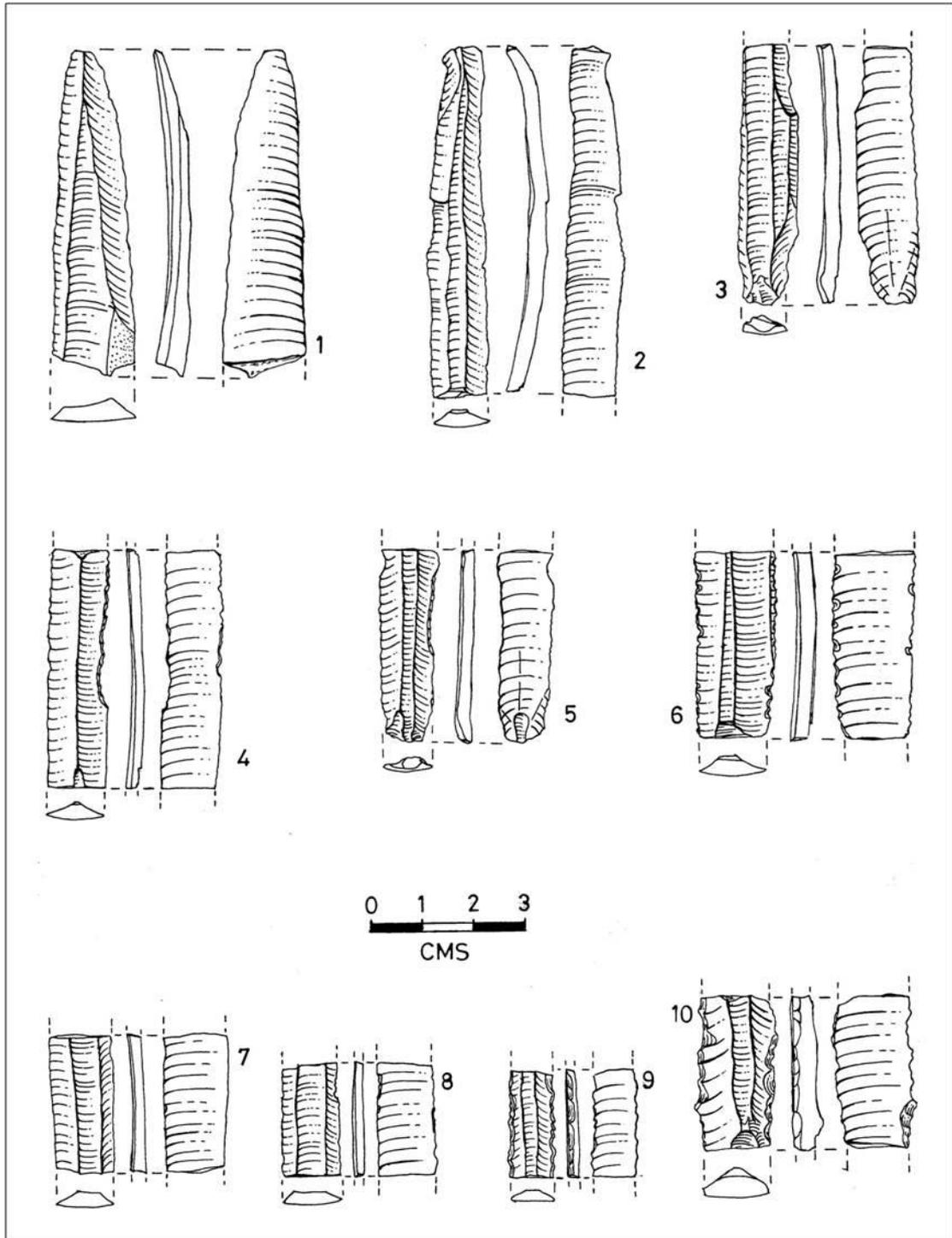


**Figure 2.17: Simple (1,2,3,4,5,8) and Retouched (6,7,9,10,11,12,13,14) Blade fragments** (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

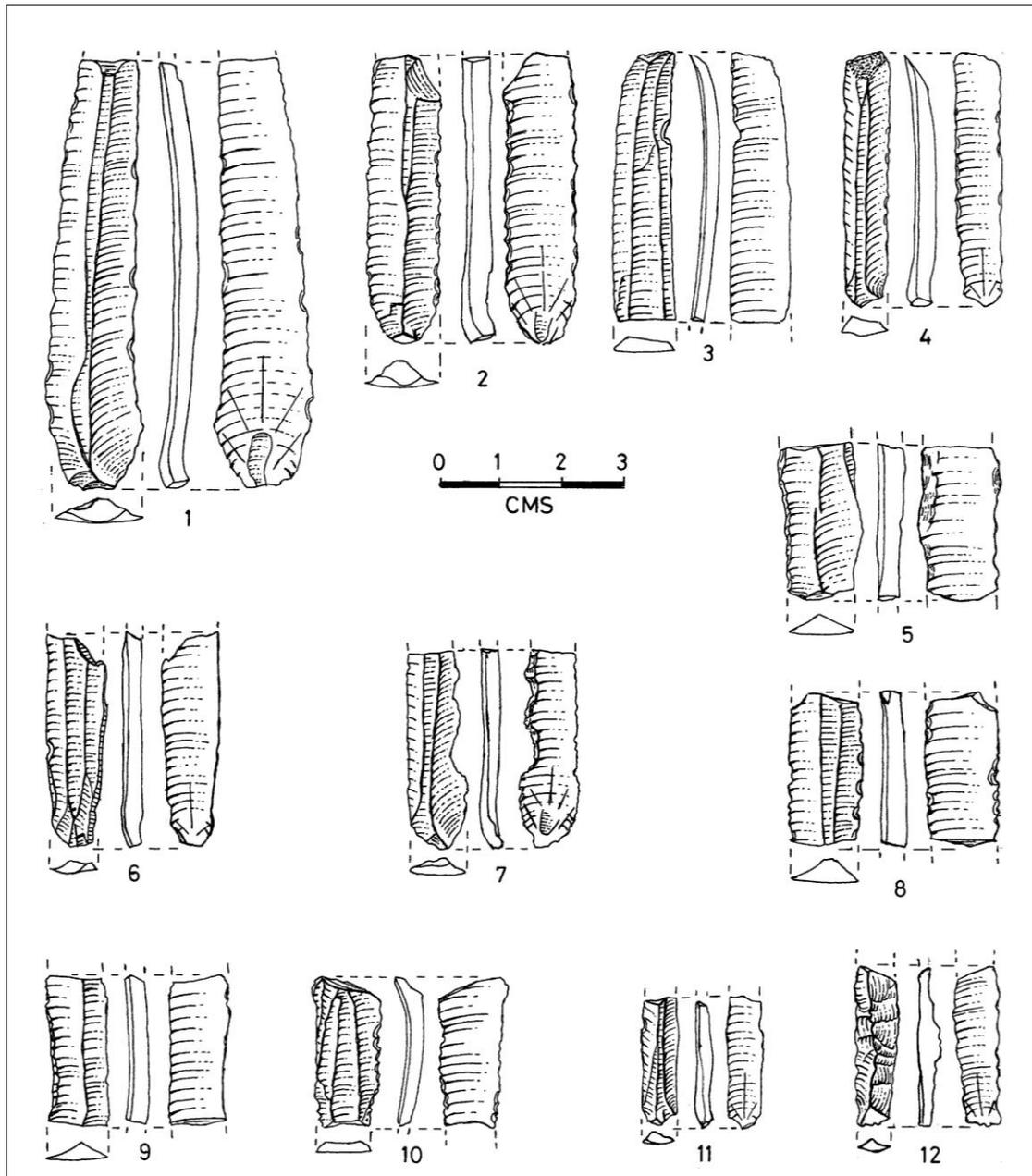
## Tools

Deliberately made by man to be used for some function. The researcher has examined each and every piece of lithic assemblage belonging to the five type sites. Attributes recorded for all the tools, broken as well as intact, are the same. These include condition, cortex percentages, edge attributes such as retouches, backings and utilization marks, condition of polish if present, description of platforms, condition of distal ends, dorsal ridges and the raw material. These attributes were recorded so that they can provide basis of comparison for present as well as future researchers.

Measurements of length, breadth and thickness were taken of all the tools. Length was measured from the proximal end to the furthest possible end. Width was taken at the mid- point of the length. Thickness was measure by rotating the artefact 90<sup>0</sup> from the width point. Table 2.4 describes the attributes recorded for tools.



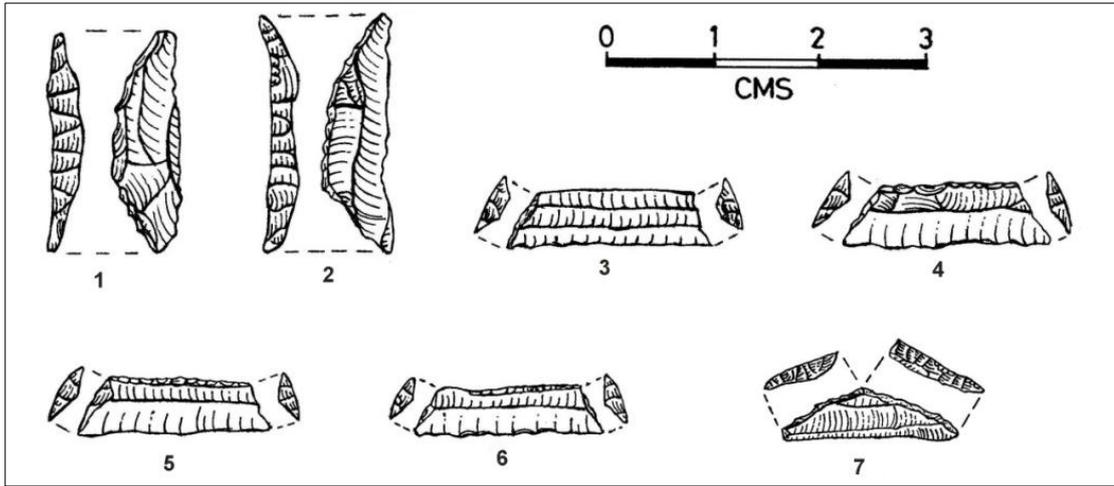
**Figure 2.18: Proximal (3,5), Mesial (4,6,7,8,9,10) and Distal (1,2) blade fragments**  
 (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda, Vadodara)



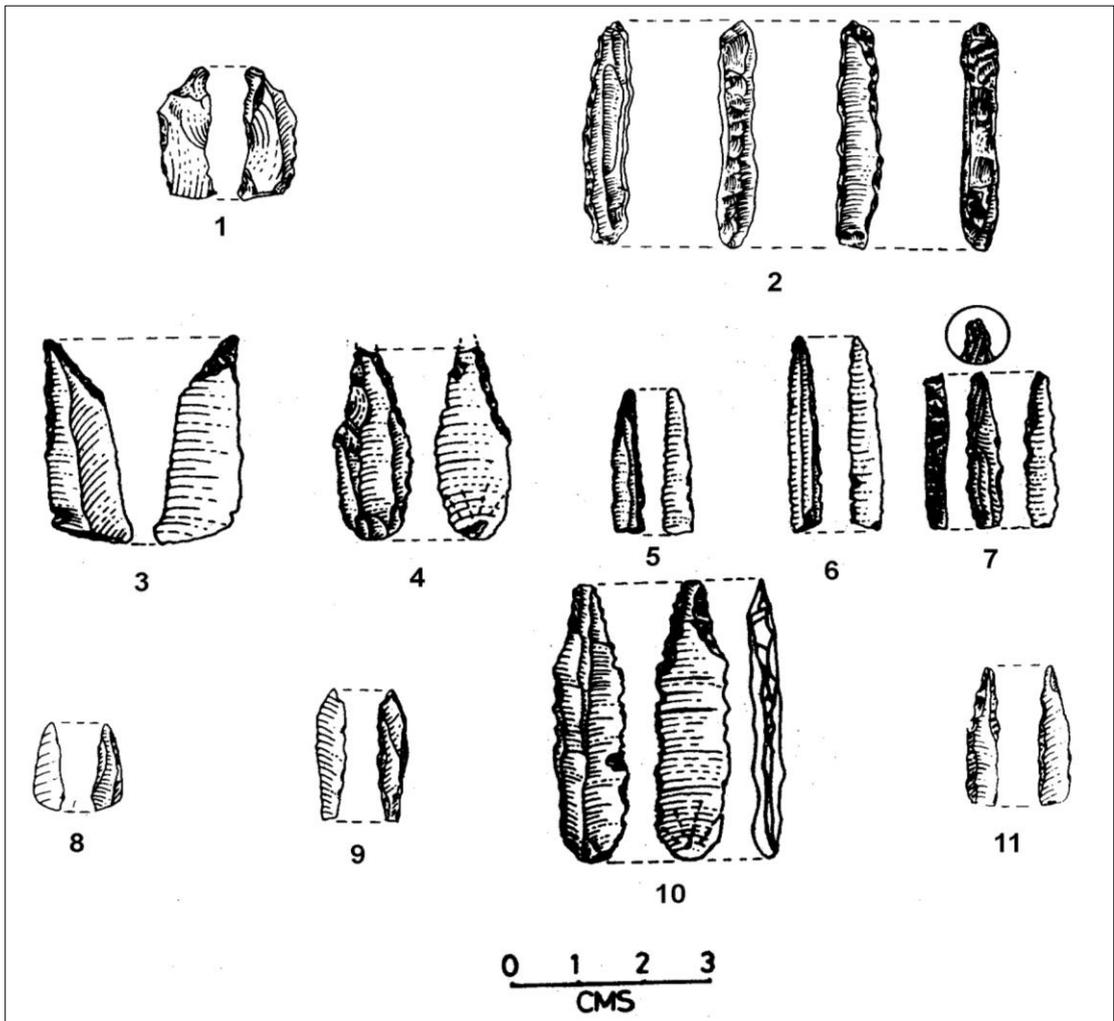
**Figure 2.19: Simple blade (1,2,3,4,5,6,7,8,9,10,11) and crested ridge (12) blade fragments** (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

### **Lithic debitage**

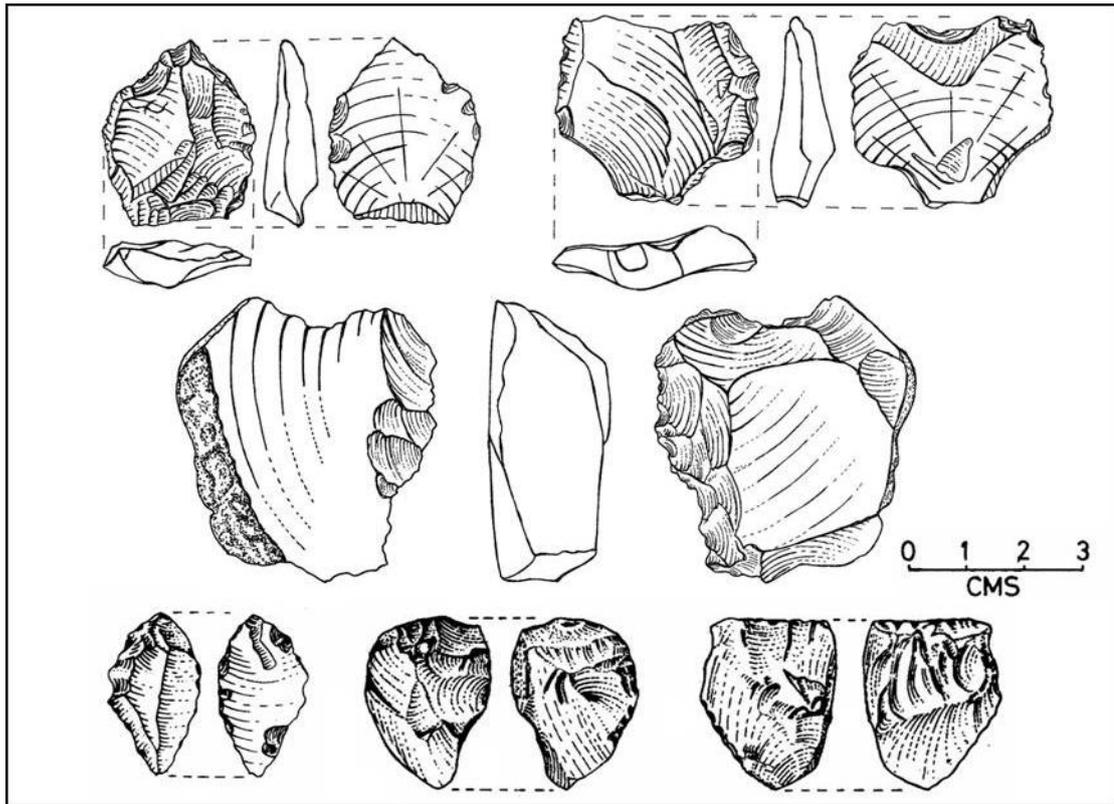
Lithic debitage of all sites was analyzed separately. Different attributes described in table number 2.6 were recorded for lithic debitage. Lithic debitage analysis follows a different method than tools. The intact and proximal flakes were measured by placing them on a graph sheet and noting the closest value of .5cm (adapted from Ahler 1989). Thus a flake with the length of 2.34cm would be recorded as having a length of 2.5cm. Proximal end and distal end attributes were not noted for lithic debitage flakes.



**Figure 2.20: Geometric tools: lunates (1,2), trapeziums (3,4,5,6) and triangle (7)**  
 (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)



**Figure 2.21: Non-geometric tools: burin (1), borer (2,11), points (3,4,5,6,7,8,9,10)**  
 (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)



**Figure 2.22: Various type of scrapers** (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

This method was necessary as it was impossible to record the precise attributes of all the flakes belonging to lithic debitage category. All the categories of lithic debitage however were weighed. All the other fragments of lithic debitage, the ones without proximal ends, were considered as shatter and they were counted and weighed, not measured. Care was taken to record any evidence of retouches or utilization on flakes and if found these were duly noted.

### **Cores**

The cores were analyzed separately. The attributes described in table 2.5 recorded for them closely follow the attributes recorded for cores by T. Raczek (Raczek 2007). A few modifications were necessary to suit the cores under study and thus a few new attributes were added and a few were removed from her original list of recorded attributes for cores. Length of cores was taken from the side of the removal of longest flake. Width of the core was measured keeping the flaked surface of the core (if it was flaked from one side) facing front. If it was a core which was flaked all over, the width was taken from the widest side. Thickness was measured by rotating the core 90° from the position in which width was measured.

**Table 2.4 Attributes recorded for tool**

<b>Condition</b>	1. Complete	2. Proximal	3. Mesial	4. Distal	5. Fragment	6. Tip broken		
<b>Cortex</b>	1. Absent	2. 10% and below	3. 10-50%	4. 50% and above				
<b>Use Marks and retouches</b>	1. used and retouched	2. retouched, but not used	3. used but not retouched	4. not used, not retouched	5. dubious			
<b>Edge condition-retouches</b>	Right	1. Dorsal retouch	2. Ventral retouch	3. Bifacial retouch	4. notched	5. Denticular retouch		
	Left	1. Dorsal retouch	2. Ventral retouch	3. Bifacial retouch	4. notched	5. Denticular retouch		
<b>Edge condition-use marks</b>	Right	1. Dorsal utilization	2. Ventral utilization	3. Bifacial utilization	4. Bifacial utilization			
	Left	1. Dorsal utilization	2. Ventral utilization	3. Bifacial utilization	4. Bifacial utilization			
<b>Polish</b>	Right	1. light	2. medium to heavy	3. sickle sheen				
	Left	1. light	2. medium to heavy	3. sickle sheen				
<b>Proximal end</b>	Butt form	1. Rectangular	2. lenticular	3. irregularly lenticular	4. triangular	5. irregularly triangular	6. gull winged	7. semi-circular
		8. irregularly shaped wide platform	9. retouched	10. difficult to see	11. not prepared			
	Butt type	1. single	2. dihedral	3. multiple	4. cortex/patina	5. part cortex	6. crushed /snapped	
	Butt shape	1. lipped	2. pointed	3. bulb scar				
<b>Distal end</b>	1. feathered	2. hinged	3. stepped	4. plunging	5. snapped	6. crushed	7. retouched	8. used

**Table 2.5 Attributes recorded for cores**

Core type	1. blade core	2. flake core	3. core cum scraper	4. core blank				
Core shape	1. conical	2. cylindrical	3. wedge	4. amorphous	5. block	6. flat	7. semi conical	
Blade removal pattern	1. sliced	2. rotated	3. flexible					
Blade removal direction	1. unidirection	2. bi-direction	3. multiple-direction					
Platform preparation	1. none	2. single flake	3. multiple flakes	4. broken	5. chipped			
Platform count	1. 1	2. 2	3. 3	4. multiple				
Core butt	1. wear-no	2. wear-yes	3. cortex	4. retouch	5. broken	6. flake removed	7. platform	8. crest
cortex	1. Absent	2. 10% and below	3. 10-50%	4. 50% and above				
Preparation of the back	1. unprepared (with cortex)	2. blades/flakes	3. multiple flakes (without order)	4. single flake (diagonally removed)	5. ventral of a flake	6. unprepared (without cortex)	7. big flake removed to make back flat	9. dorsal of a flake
	10. multiple flakes (with cortex)	11. crest						
Potential cause of discard	1. exhausted	2. hinge	3. platform damaged	4. R.M. flow	5. flows			
Crested ridges	1. absent	2. 1 ridge	3. 2 ridges	4. 3 or more ridges				

**Table 2.6 Attributes recorded for Lithic Debitage**

<b>Condition</b>	1. complete	2. broken	3. Proximal	4. shatter	5. flaked	6. end broken
<b>Cortex</b>	1. Absent	2. 10% and below	3. 10-50%	4. 50% and above		
<b>Use Marks and retouches</b>	1. used and retouched	2. retouched, but not used	3. used but not retouched	4. not used, not retouched	5. dubious	
<b>Edge condition-retouches</b>	Right	1. Dorsal retouch	2. Ventral retouch	3. Bifacial retouch	4. notched	5. Denticular retouch
	Left	1. Dorsal retouch	2. Ventral retouch	3. Bifacial retouch	4. notched	5. Denticular retouch
<b>Edge condition-Use marks</b>	Right	1. Dorsal utilization	2. Ventral utilization	3. Bifacial utilization	4. Bifacial utilization	
	Left	1. Dorsal utilization	2. Ventral utilization	3. Bifacial utilization	4. Bifacial utilization	
<b>Size categories (cm)</b>						