

Chapter 3

ANALYSIS

This chapter incorporates the analysis and results of lithic assemblages found from the four major selected sites of study, Loteshwar, Datarana, Shikarpur and Pithad. Different types of tools as well as the associated lithic debitage from these selected sites are analyzed and discussed in this chapter.

The organization of this chapter is as following. The chapter is divided into three sections.

Section I

This first section deals with the Mesolithic lithic assemblage and the Early Chalcolithic/Anarta lithic assemblage. Analyzing the cultural transitions associated with the two periods and the similarities and differences amongst the cultural periods are the main objectives here. The representative site in this case is Loteshwar. As has been mentioned in chapter 2 Loteshwar is a site situated in North Gujarat which was occupied first by the hunter-gatherer communities and in later periods by agro-pastoral communities who cultivated small millets in a very limited extent in the interdunal areas. This site was occupied for over five thousand years, has been dated the earliest of its kind in the region both during the Mesolithic (7000 BCE) as well as Chalcolithic (3600 BCE) periods.

Section II

This section deals with the Early Harappan and Urban Harappan cultural development seen through its associated lithic assemblages. The lithic assemblage recovered from the site of Datarana situated in North Gujarat and dated to 3300-2600 BCE represents the Early Harappan lithic assemblage. The site has given indication of cultural affiliation with Early Harappan Sindh and Pre-Prabhas pottery. The evidence of the beginning of crested guiding ridge technique in this region is also found from this site for the first time. The analysis of lithic assemblage recovered from this earliest dated Chalcolithic period lithic factory site is very important for understanding the transregional interactions and their impact in the adaptation of new technologies in Gujarat.

The lithic assemblage of Datrana is followed by the lithic assemblage from Shikarpur. Shikarpur is an Urban Harappan settlement dated to 2500 BCE and is situated in the eastern edge of Kachchh, which is about 40km southwest of Datrana. The lithic assemblage from Shikarpur therefore provides a body of data that can be compared with the Early Harappans for understanding the technological and cultural adaptations. It also gives information regarding the role played by this small site in the inter-regional trade and exchange network of the Harappan civilization. Bagsara is another Urban Harappan site situated across the Gulf of Kachchh from Shikarpur. The lithic assemblage of Bagsara was analysed by the researcher for her master's dissertation and that data will be used in the fifth chapter to understand the differences between contemporary Urban Harappan assemblages.

Section III

This section deals with the lithic assemblage associated with the Mesolithic period and the Sorath Harappan Chalcolithic period from Saurashtra. The site of Pithad, situated in northern Saurashtra represents both the cultural periods and thus has been taken as the type site for this section. The analysis and results of lithic assemblage belonging to the Mesolithic period of this site has been discussed first. Mesolithic assemblage from the site has not been dated scientifically but relatively it can be said that the Mesolithic period found from here is earlier than the Chalcolithic period (3rd millennium BCE) identified at the site. The Chalcolithic period at Pithad is representative of the Sorath Harappans and is dated to 2200-1700 BC. The lithic assemblage belonging to this Chalcolithic period settlement gives evidence of continued use of lithic tools and changes therein within the assemblage in the later part of the Harappan civilization in Gujarat.

Chapter 3 - Section I

Lithic Assemblages from Mesolithic and Anarta/Early Chalcolithic Contexts

LOTESHWAR

The lithic assemblage at Loteshwar comprises of 1,374 blades, 256 geometric and non-geometric tools and 4,227 fragments of lithic debitage including exhausted cores. As discussed in chapter 2, the site comprises of 4 layers. Layers 1 & 2 represent Anarta Chalcolithic period habitation and are predominated by a number of

subterranean pits, three of which are found within the excavated part of the trench. Layers 3 & 4 belong to Mesolithic period occupation (Ajithprasad *et al.* 2009). A layer wise distribution of the lithic assemblage is presented first (table 3.1).

As is seen clearly from the table 3.1, layer 2 has the highest quantity of lithic assemblage, followed closely by layer 3. Pits all together comprise of 12.5% of lithic assemblage. Since layers 1, 2 and the three pits represent Chalcolithic period occupational deposit, they comprise 64.86% of total lithic assemblage. Mesolithic period (layers 3& 4) is represented by 35.14%. The attempt of this research is to find similarity and differences between Mesolithic period and Chalcolithic period levels and thus from here onwards we will deal with cultural periods and not individual layers. The figure 3.1 describes the distribution of lithic assemblage according to cultural periods.

Table 3.1: Layer wise representation of lithic assemblage found from Loteshwar

Tools	1	2	3	4	Pit 1	Pit 2	Pit 3	TOTAL
Blades (various types)	39	758	363	39	41	43	91	1374
Geometric and non-geometric tools	10	138	72	5	7	4	20	256
Lithic debitage	99	1976	1363	149	120	126	256	4089
Cores	4	58	49	6	5	4	12	138
TOTAL	152	2930	1847	199	173	177	379	5857
Percentage	02.61	50.17	31.71	03.43	02.97	03.04	06.50	100

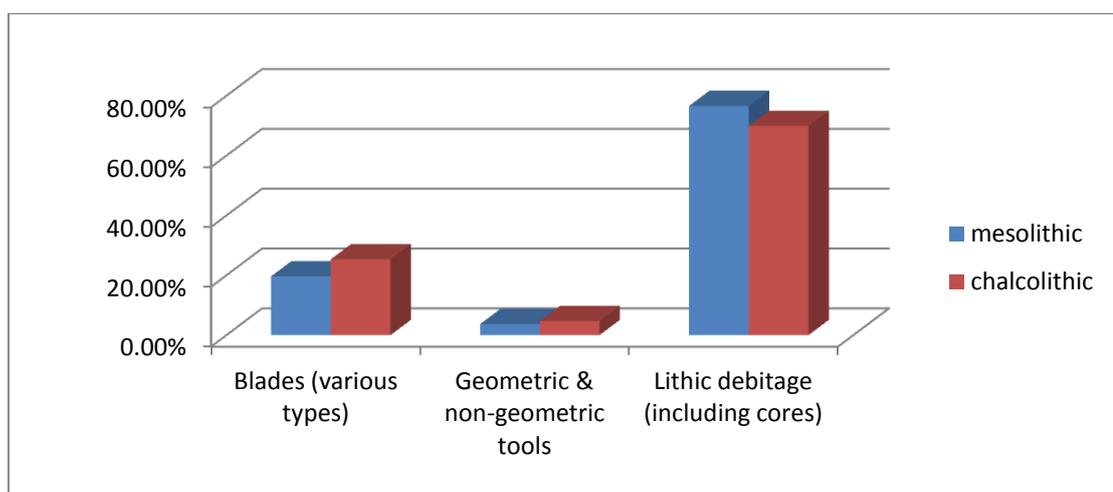


Figure 3.1: Representation of lithic assemblage according to cultural periods at Loteshwar

The lithic assemblage of Mesolithic period and Chalcolithic period was mostly found to be similar to each other. Contrary to popular belief we find that the Mesolithic period lithic assemblage at Loteshwar is dominated by blades. The ratio of blades: geometric & non-geometric tools is found to follow a clear pattern. For Mesolithic period this ratio is found to be 5.3:1 while for Chalcolithic period the observed ratio is 5.4:1 thus showing little distinction between the two periods.

It can also be seen clearly that Chalcolithic period assemblage numerically dominates over the Mesolithic period assemblage. Chalcolithic period deposit was found to consist of a depth of 30-60cm but with pits going as deep as 1.60m while Mesolithic period deposit consisted of a little more than a meter. The number of tools (blades, geometric and non-geometric tools) becomes more than double during Chalcolithic period occupation. This notable increase in lithic assemblage during Chalcolithic period has to be looked into in detail keeping cultural aspects in mind.

Overview of Tool types

Blades

402 blades during Mesolithic period while 973 blades during Chalcolithic period were recovered from the site. Simple blades, backed blades, blade flakes, retouched blades and obliquely blunted blades were the blade categories encountered during both the cultural periods (figure 3.2). The most common type of blades found amongst the Mesolithic period are the blade flakes (184 or 45.7%) while simple blades (501 or 51.5%) are most common during Chalcolithic period. Blade flakes are generally sturdier than simple blades and thus could have been used on their own. Even amongst the Chalcolithic period blades the second most favoured type is found to be the blade flakes (347 or 35.7%). Retouched blades all together are 55(13.5%) during Mesolithic period and 124(13.2%) during Chalcolithic period (figure 3.4). It should also be kept in mind that tools which were intentionally manufactured as hunting and butchering gear might be ill represented in the assemblage as they were meant for tasks carried out away from the site.

Chipped stone artefacts are produced by tool makers who know how to crack off various sizes and shapes of rock from an objective piece. The best kinds of stones for knapping are those that can be cracked in a reliable and predictable manner; such

stones are brittle, homogeneous and isotropic. Cryptocrystalline silicates, including chert, flint or chalcedonies have these necessary properties and thus it is not surprising that these were used to manufacture different types of tools. Chert (200 tools or 49.6% during Mesolithic period and 530 tools or 54.5% during Chalcolithic period), followed by chalcedony (116 tools or 28.8% during Mesolithic period and 269 tools or 27.6% during Chalcolithic period) were the most favoured raw materials to be exploited during both the cultural phases at Loteshwar. The two fragments of Rohri chert blades found from the Chalcolithic period level give evidence of mixing of later materials with the materials belonging to an earlier time (Harris 2011) (figure 3.3).



Figure 3.2: Blades and blade flakes from Mesolithic and Chalcolithic period at Loteshwar (courtesy: NoGAP)

Condition of blades

During both the periods, maximum numbers of blades were seen to be of either intact [142 blades (35.3% of blade assemblage) during Mesolithic period and 327 (33.6% of blade assemblage) blades during Chalcolithic period] or proximal condition (158 fragments during Mesolithic period period and 370 fragments during Chalcolithic period) (figure 3.4). Mesial fragments may have been produced during detachment or they may have been produced intentionally by the tool maker. It is not uncommon to find detached pieces, such as blades, that have been snapped into several fragments

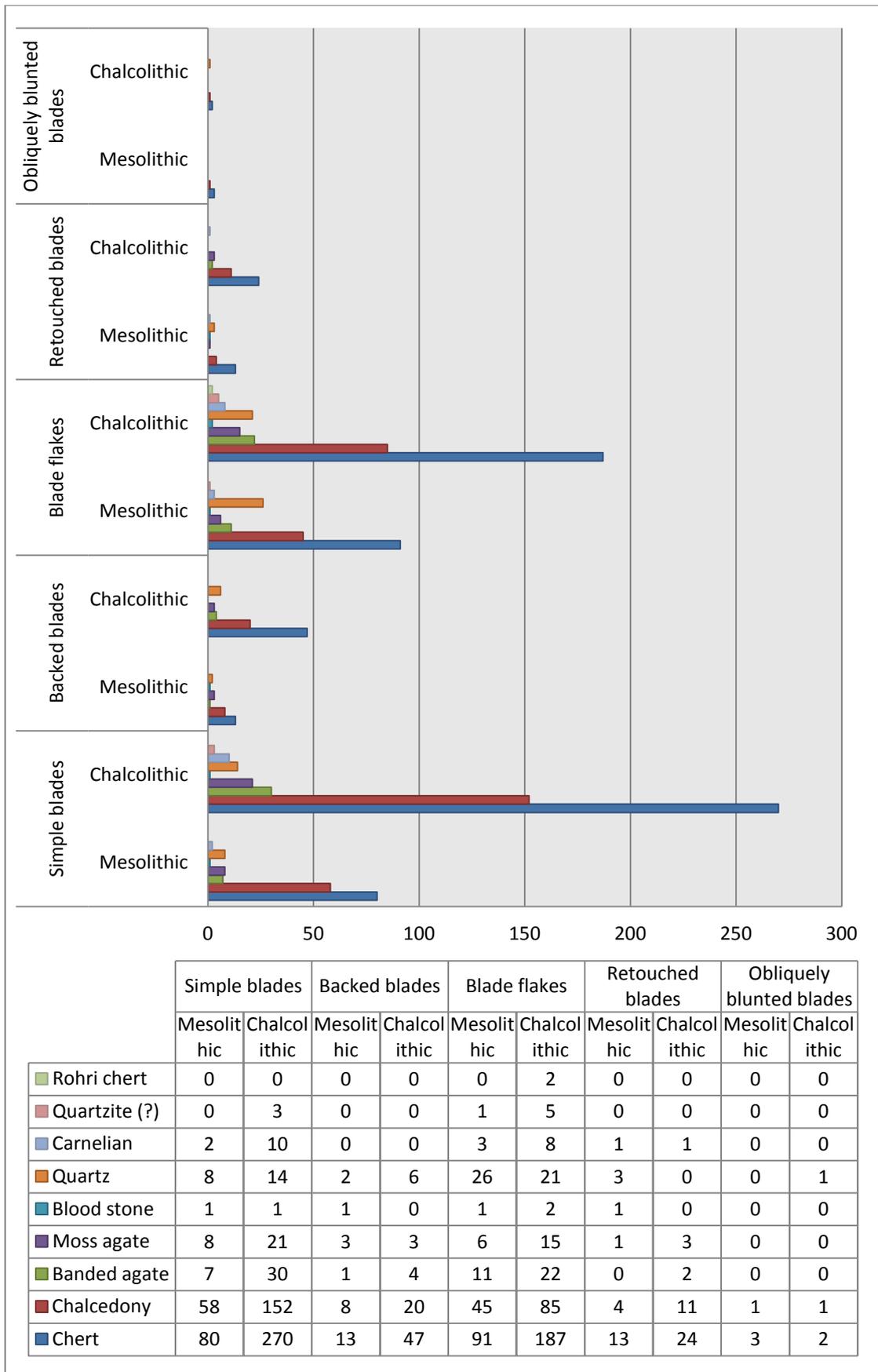


Figure 3.3: Representation of different types of blades according to their raw materials during Mesolithic and Chalcolithic periods of Loteshwar

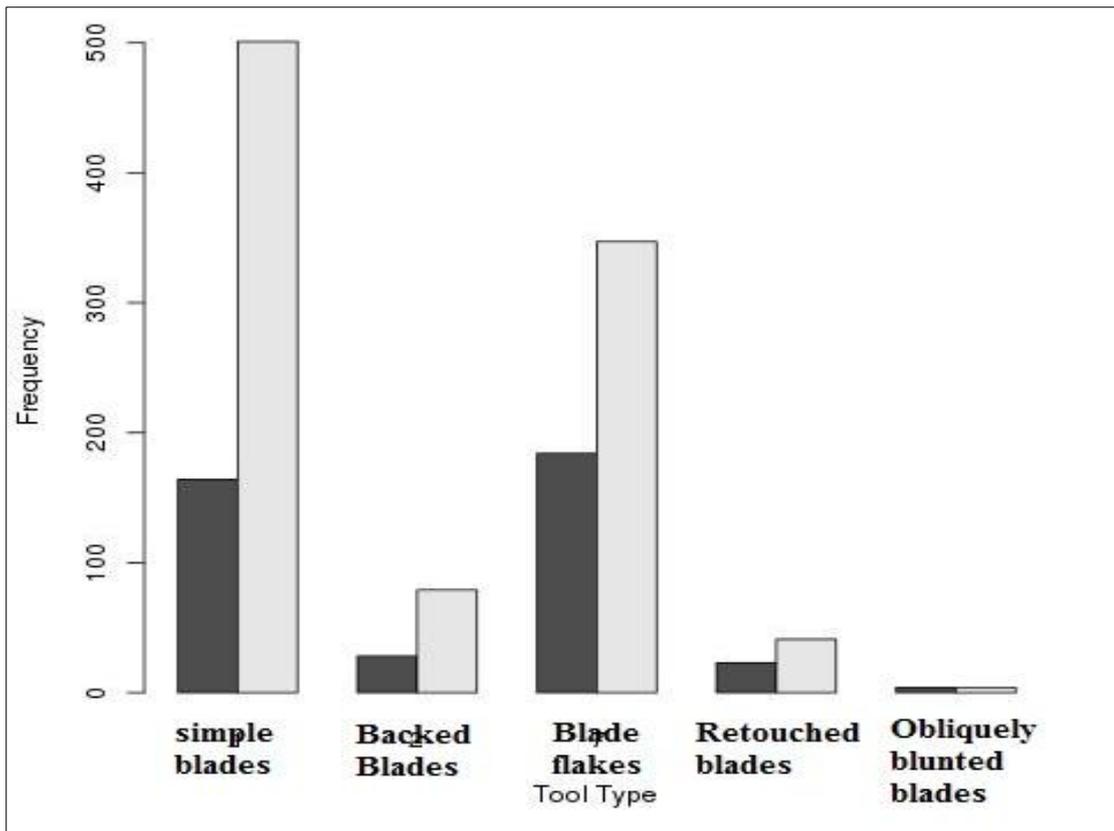


Figure 3.4: Representation of different types of blades during Mesolithic and Chalcolithic periods at Loteshwar

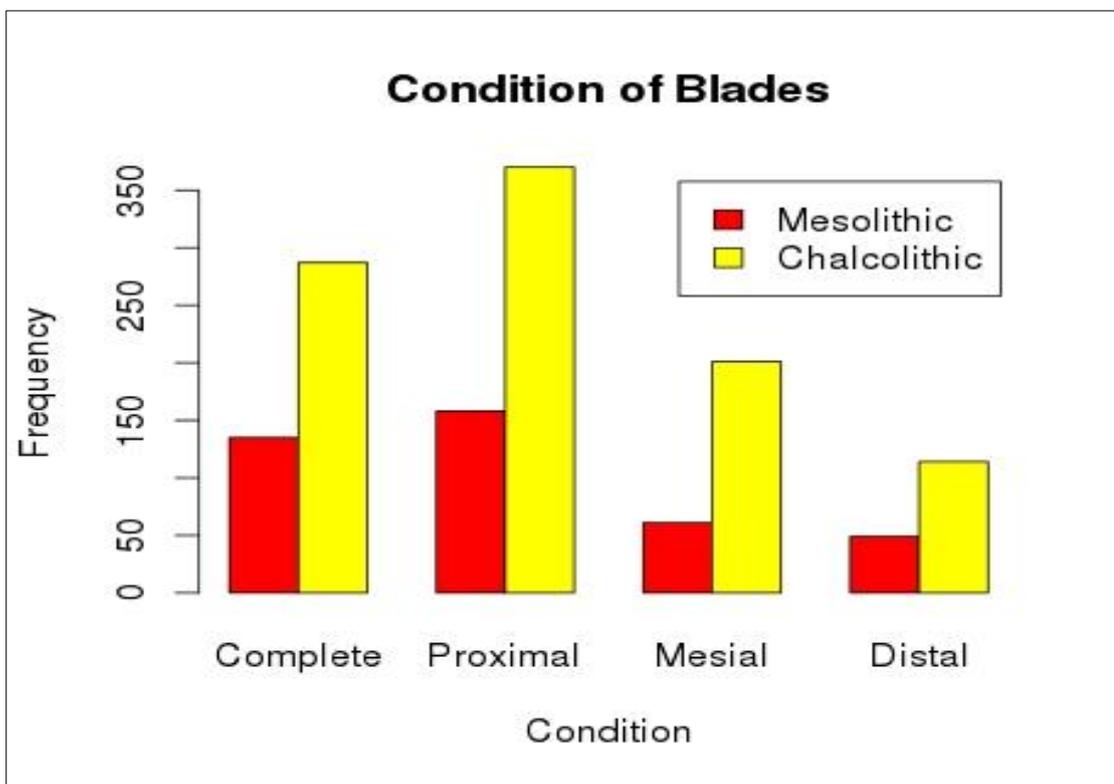


Figure 3.5: Condition of blades during Mesolithic and Chalcolithic periods at Loteshwar

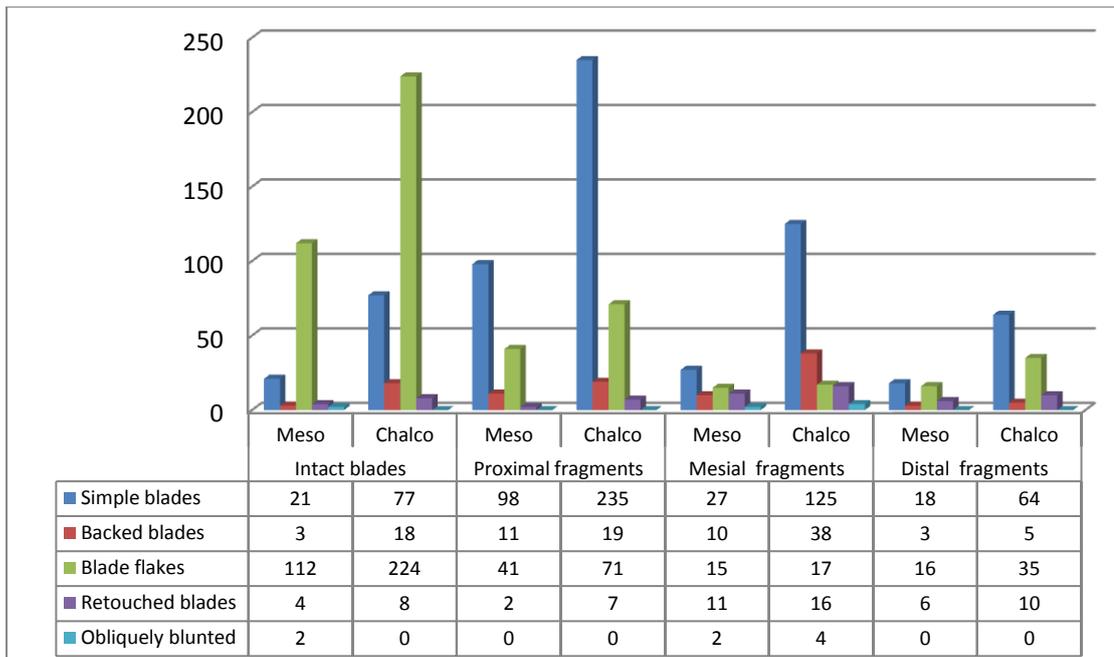


Figure 3.6: Condition of blade types according to cultural periods at Loteshwar

for insertion into a composite too. Microliths from Mesolithic period sites are frequently interpreted as intentionally broken or snapped to fit hafting context (Andrefsky 2005: 89). Blade flakes were mostly found in intact condition. Very few blade flakes (15 or 8.15% during Mesolithic period and 19 or 5.48% during Chalcolithic period) were found to have been retouched. Can this be attributed to their being sturdier than normal blades? Maximum proximal portions were seen of simple blades. Most probably they broke while in use and were discarded or this portion of a blade was intentionally removed for better utility. Mesial or middle portion of blades are maximum in the simple blade category (figure 3.6).

Proximal conditions

Proximal fragments include all the specimens that contain a striking platform (Andrefsky 2005: 89). Thus all the intact blades (142 blades of Mesolithic period and 327 blades of Chalcolithic period) as well as the broken blades containing proximal ends (152 blades of Mesolithic period and 332 blades of Chalcolithic period) have been included in this analysis.

Proximal end forms

11 different types of proximal end forms were noted for all intact as well as proximally broken blades. Categories 9, 10 and 11 represent 'retouched', 'difficult to

see' and 'not prepared' respectively. Amongst these 'difficult to see with naked eye' has been represented the most time. A combined percentage of these three is similar during both the periods, 41.8% during Mesolithic period and 40.3% during Chalcolithic period. Irregularly lenticular form is the most frequent during both the periods. The form gull winged becomes less than half during Chalcolithic period times (table 3.2).

Table 3.2: Proximal end forms during Mesolithic and Chalcolithic periods at Loteshwar

	Proximal end forms	Mesolithic period	Percent	Chalcolithic period	Percent
1	Rectangular	25	8.5%	52	7.8%
2	Lenticular	14	4.8%	42	6.3%
3	Irregularly lenticular	43	14.6%	119	17.8%
4	Triangular	29	9.9%	80	12.0%
5	Irregularly triangular	20	6.8%	55	8.2%
6	Gull winged	22	7.5%	15	2.2%
7	Semi-circular	3	1.0%	16	2.4%
8	Irregularly shaped wide platform	15	5.1%	20	3.0%
9	Retouched	50	17.0%	123	18.4%
10	Difficult to see	67	22.8%	138	20.7%
11	Not prepared	6	2.0%	8	1.2%
	Total	294	100.0%	668	100.0%

Proximal end types

Five different varieties of proximal end types were noted for all intact as well as proximally broken blades having proximal end forms numbered from 1 till 8. Type single dominates both the assemblages at 84.8% and 82.2% (table 3.3). It has been observed by scholars that flat or single striking platform is formed when flakes are removed from unidirectional cores (Andrefsky 2005: 164). This fits perfectly with our data from Loteshwar as most of these blades were made out of unidirectional cores.

Proximal end shapes

Three different types of shapes were noted for all intact as well as proximally broken blades. Blades/flakes with a diffuse bulb of force and a pronounced lip have been called soft hammer percussion flakes (Crabtree 1972: 74). However not all

researchers agree on this. Hard hammer percussion is believed to produce flakes with pronounced bulbs of force, no lipping, and slightly crushed striking platform areas (Crabtree 1972: 44). Even though soft-hammer and hard hammer flaking techniques produce detached pieces that over-lap in their range of bulb morphology and amount of lipping, these characteristics may be effective discriminators in most cases (Andrefsky 2005: 119). During Chalcolithic period lipping of proximal end has increased (table 3.4), can we take this as a more standardized way of blade manufacturing with soft hammer or a metal punch? We have evidences of metal punch from Chalcolithic period period at the site.

Table 3.3: Proximal end types during Mesolithic and Chalcolithic periods at Loteshwar

Proximal end type	Mesolithic period	Percent	Chalcolithic period	Percent
Single	145	84.8%	328	82.2%
Dihedral	14	8.2%	43	10.8%
Multiple	7	4.1%	20	5.0%
Cortex/patina	2	1.2%	8	2.0%
Crushed/snapped	3	1.8%	0	0.0%
Total	171	100.0%	399	100.0%

Table 3.4: Proximal end shapes during Mesolithic and Chalcolithic periods at Loteshwar

Proximal end shape	Mesolithic period	Percent	Chalcolithic period	Percent
Lipped	61	35.7%	188	47.1%
Pointed	46	26.9%	66	16.5%
Bulb scar	64	37.4%	145	36.3%
Total	171	100.0%	399	100.0%

Platform width and thickness

Table 3.5 gives the metric measurements of proximal end width and thickness. As can be clearly seen from this table, proximal width varies a lot between blades while the thickness was more or less of standardized size. We can also see that both the proximal end platform width and proximal end platform thickness are slightly bigger and thicker during Chalcolithic period.

Table 3.5: Proximal end metrics in mm during Mesolithic and Chalcolithic periods at Loteshwar

		Mean	Median	Mode	Std dev	Variance
Mesolithic period	Width	4.62	3.88	4.00	2.64	7.00
171	Thickness	1.81	1.54	1.48	0.96	0.93
Chalcolithic period	Width	4.72	3.89	3.89	2.99	8.99
399	Thickness	1.97	1.63	1.57	1.24	1.55

Types of distal end terminations noted

The distal end of the flake is where the force of the original point of impact terminates. Distal portion of intact blades and distally broken blades have been classified for different distal end terminations such as feathered, hinged, stepped, plunging, retouched, used or both retouched as well as used (specially in the case of end scrapers). Feathered, hinged and plunging terminations indicate that the blade or flake is intact while step terminations indicate a broken blade (Andrefsky 2005: 99). Retouched, used and retouched plus used can be assigned to both intact as well as broken blade categories.

Intact Blades and Distal Blade Fragments

More than half (94 blades or 50.5%) of intact and distal fragment of blades during Mesolithic period seem to have feathered termination (figure 3.7). Feathered termination is the proof of a smooth termination that gradually shears the flake from the objective piece (Andrefsky 2005: 87). According to Crabtree (1972: 15) pressure force applied only in a downward direction will cause the flake to be removed tangentially to the direction of the applied force and the flake generated thus will have a feathered termination. Plunging termination has been associated with tool making, especially with blade flaking (Cotteral & Kamminga 1987) thus their presence in 52 blades (24.3%) is not surprising. The most common type of distal end termination during Chalcolithic period was feathered 156 blades (35.4%), followed by plunging type of termination in 137 blades (31.1%). The only difference during Chalcolithic period is that here both these terminations are almost in equal quantity. Both of these are common terminations for blades and thus their high presence is not surprising. Not many blades were either utilized or retouched from their distal ends.

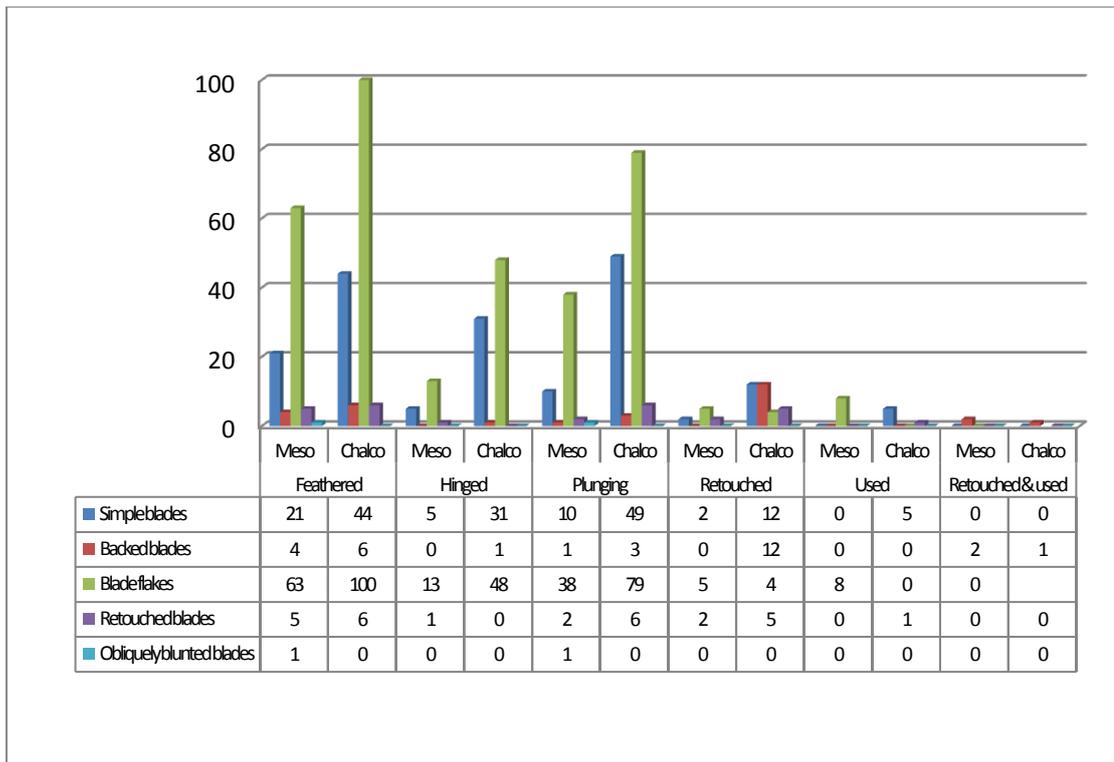


Figure 3.7: Distal end terminations of intact blades and distal end fragments for Mesolithic and Chalcolithic periods at Loteshwar

Proximal Blade Fragments and Mesial Blade Fragments

Simple blades seem to have a clean break/snap most of the time during both the periods (95 blades during Mesolithic period and 274 blades during Chalcolithic period show this termination). Since more than 70% of broken blades have edge damage, can we presume that they broke while they were in use and were discarded? Or were these intentionally broken? Intentional breakage does not seem the plausible answer as these blades are quite small in measurement. We will see that when we have a look at the measurements. Retouched distal end [23 blades or 10.5% during Mesolithic period and 58 blades (10.9%) during Chalcolithic period] and stepped distal end [22 blades (10%) during Mesolithic period and 62 (11.7%) during Chalcolithic period) are present almost in equal quantity. Very few blades (9 (4.1%) during Mesolithic period and 25 (4.7%) during Chalcolithic period] were used by their distal ends (figure 3.8).

Presence of cortex on blades

The amount of cortex present on the dorsal surface of flake has been used as an indicator of the reduction stage for tools and non tools (Andrefsky 2005: 115). As all the categories of blades show some amount of cortex (figure 3.9), we can say that all

the tools were manufactured on the site itself. Though it was also seen that majority of the flakes which were converted into tools or selected as tools were devoid of cortex during both the periods.

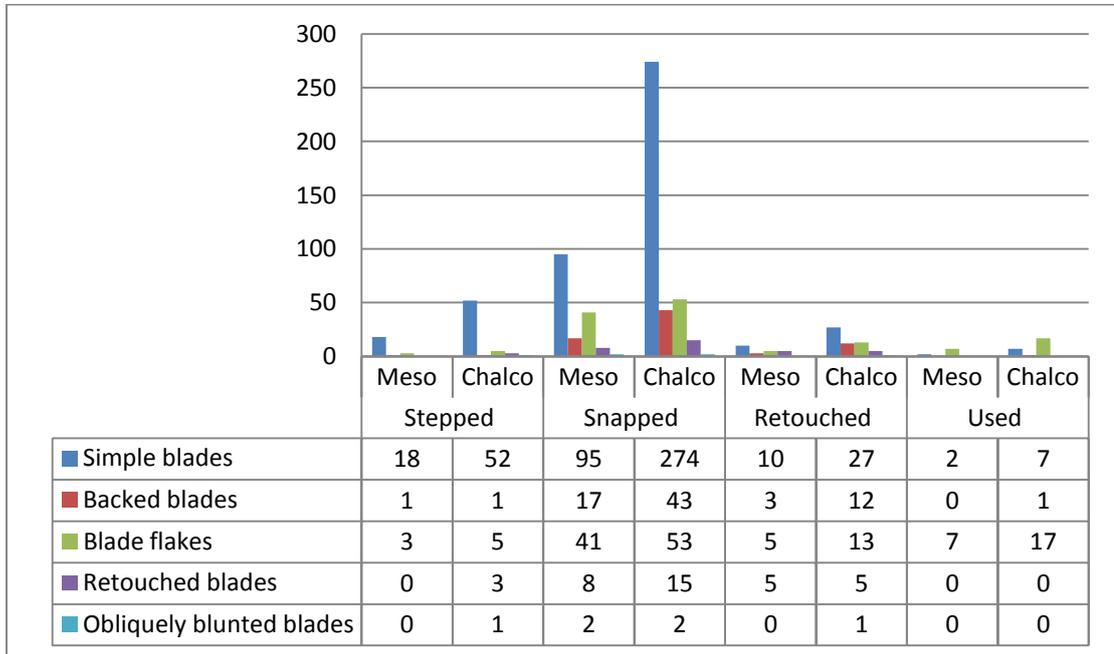


Figure 3.8: Distal end terminations for proximal and mesial blade fragments of Mesolithic and Chalcolithic periods at Loteshwar

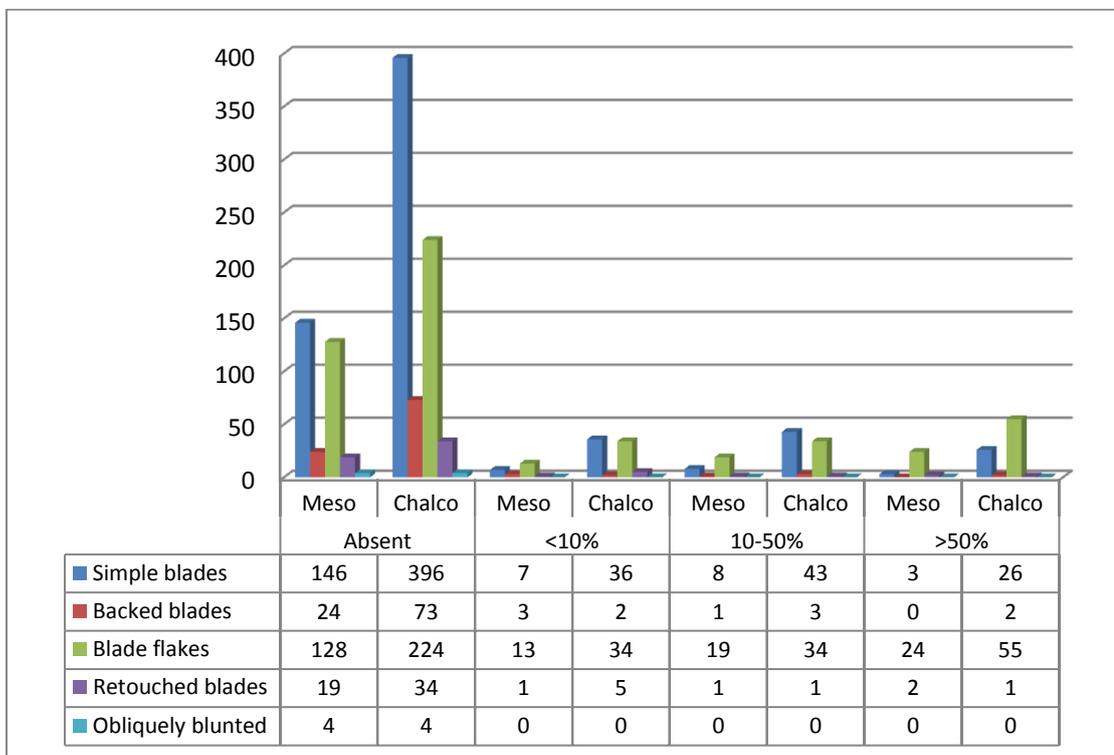


Figure 3.9: Representation of cortex on blade types from Mesolithic and Chalcolithic periods at Loteshwar

Edge damage and retouches

Conditions of both right and left edges were noted for all the blades. It was found that 73.9% blades show light to heavy edge damage leading to the conclusion that they were used for some or the other purpose during Mesolithic period. It can be seen very clearly that a high proportion of blades (86.1%) show slight to heavy damage during Chalcolithic period (figure 3.10). It was also easier to identify the edge damages on blades of the Chalcolithic period than the Mesolithic period.

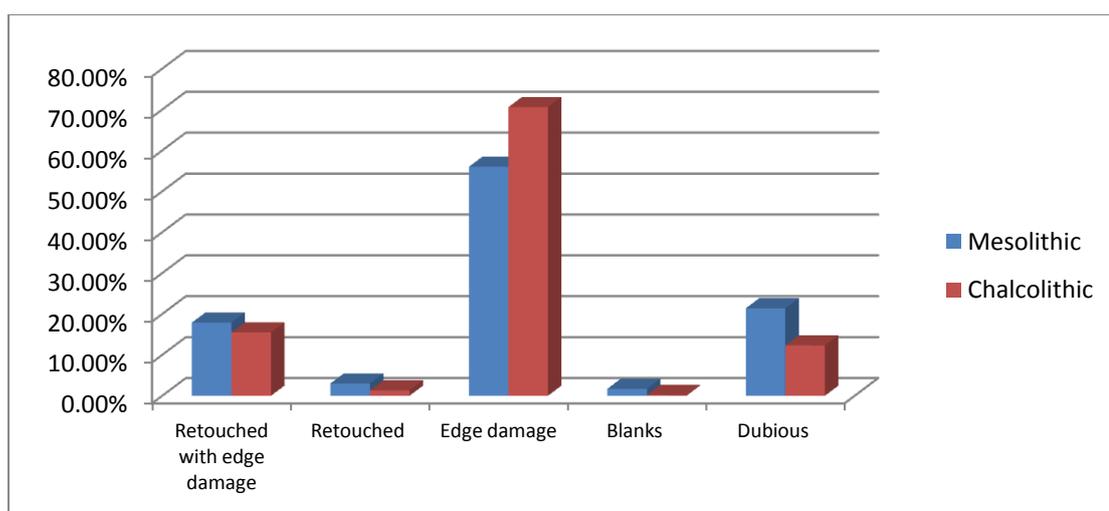


Figure 3.10: Edge condition of blades during Mesolithic and Chalcolithic periods at Loteshwar

Edge condition-utilization

It was seen that during Mesolithic period 186 out of 403 blades show edge damage on their right edges. While 176 show edge damage on their left edges (table 3.6). In both the cases dorsal surface shows damage which contrasts with some interpretations which suggest that it would have been easier to utilize a blade from its ventral surface. During Chalcolithic period too dorsal utilization of blades was the most common. It can also be seen that during Chalcolithic period bifacial utilization was more than Mesolithic period times.

Edge condition-retouches

Retouches too were mostly (60 blades) seen on the dorsal side of a blade. Notching (11 blades) was a common form of retouching (table 3.7). Blunting here denotes complete and clean removal of one edge, as if the blade was snapped vertically into two parts. Cleland has called this type of backing as vertical backing and has

described it as, ‘a blow is struck on the edge of the platform to remove a sliver of material along one edge of the blade, thus blunting the blade’ (Cleland 1977). This results in a blunted edge with the same thickness of a traditionally backed blade. Only 3 blades show evidence of retouching on both edges. Dorsal backing was the most common type of retouching from Mesolithic period. Alternate retouches were not seen during Chalcolithic period but dorsal retouches of both edges increase during this period. Notching of blades was also increased during Chalcolithic period.

Table 3.6: Use marks on blades during Mesolithic and Chalcolithic periods at Loteshwar

	Mesolithic period				Chalcolithic period			
	Edge damage -R	Percent	Edge damage -L	Percent	Edge damage -R	Percent	Edge damage -L	Percent
Dorsal	173	93%	162	92.0%	561	95.6%	456	92.1%
Ventral	9	4.8%	12	6.8%	17	2.9%	25	5.1%
Bifacial	4	2.2%	2	1.1%	9	1.5%	14	2.8%
Total	186	100.0%	176	100%	587	100.0%	495	100.0%

Table 3.7: Retouches during Mesolithic and Chalcolithic periods at Loteshwar

	Mesolithic period				Chalcolithic period			
	Retouches-R	%	Retouches-L	%	Retouches-R	%	Retouches-L	%
Dorsal	32	71.1	28	63.6	49	62.0	77	78.6
Ventral	4	8.9	4	9.1	6	7.6	6	6.1
Alternate	0	0.0	1	2.3	0	0.0	0	0.0
Notched	5	11.1	6	13.6	21	26.6	11	11.2
Blunted	4	8.9	5	11.4	3	3.8	3	3.1
Total	45	100.0	44	100.0	79	100.0	97	100.0

Metric comparison between different types of intact blades

Length

Retouched blades and backed blades are the longest blades while obliquely blunted blades appear to be the shortest during Mesolithic period (table 3.8). Amongst the Chalcolithic period blades backed blades are the longest while simple blades are the shortest (table 3.9). All the types have high values of standard deviations making their values very diverse. It is puzzling that blades which have been retouched are longer than the blades which do not have retouches. Even blade flakes have a lower value

than them. Can it be correct to hypothesize that longer blades were selected for retouching while comparatively smaller blades were utilized on their own?

Table 3.8: Metrics of length of various types of intact blades in mm of Mesolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	21	13.47	13.7	6.59	4.92	24.2
Backed blades	3	17.04	17.45	9.19	7.65	58.57
Blade flakes	112	15.29	14.08	10.85	5.70	32.55
Retouched blades	4	17.05	16.85	10.78	6.21	38.62
Obliquely blunted blades	2	12.39	12.39	10.52	2.65	7.03

Table 3.9: Metrics of length of various types of intact blades in mm of Chalcolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	77	11.25	10.87	8.95	4.43	19.70
Backed blades	18	16.59	15.73	7.06	6.63	44.01
Blade flakes	224	14.02	13.07	15.5	5.78	33.46
Retouched blades	8	14.69	14.03	8.2	4.29	18.48

Breadth

Standard deviations of breadth values are not very large, showing that there was no significant difference of breadths in different types of blades, except amongst blade flakes of both the periods (table 3.10 & table 3.11). Blade flakes are also the broadest blades amongst all the different types. Since there is not a significant difference in the breadth of backed blades versus simple blades, it appears that only broad blades were being chosen for retouches during both the periods.

Thickness

Thicknesses of different blades seem not to differ too much. Though simple blades do show values which are less than others types of blades. Blade flakes are the thickest while simple blades are found to be the thinnest blades amongst both the periods. Backed blades, retouched blades as well as obliquely blunted blades show more or less similar values during Mesolithic period while backed blades and retouched blades show similar values during Chalcolithic periods (tables 3.12 & table 3.13).

Table 3.10: Metrics of breadth of various intact blades in mm of Mesolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	21	5.71	5.49	3.37	1.42	2.02
Backed blades	3	6.2	5.8	4.84	1.61	2.58
Blade flakes	112	9.99	8.84	6.09	4.75	22.63
Retouched blades	4	5.71	5.56	4.39	1.3	1.68
Obliquely blunted blades	2	5.98	5.98	4.7	1.81	3.30

Table 3.11: Metrics of breadth of various intact blades in mm of Chalcolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	77	5.57	5.31	6.35	1.84	3.41
Backed blades	18	5.94	5.32	3.84	2.4	5.73
Blade flakes	224	9.62	8.77	6.68	4.18	17.53
Retouched blades	8	7.17	6.25	3.33	3.12	9.76

Table 3.12: Metric of thickness of various intact blades in mm of Mesolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	21	1.64	1.28	0.79	0.76	0.58
Backed blades	3	1.98	1.96	1.81	0.19	0.04
Blade flakes	112	2.89	2.42	2.75	1.62	2.64
Retouched blades	4	2.05	1.87	0.97	1.16	1.34
Obliquely blunted blades	2	1.91	1.91	1.10	1.14	1.31

Table 3.13: Metric of thickness of various intact blades in mm of Chalcolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	77	1.67	1.4	1.18	0.89	0.80
Backed blades	18	2.46	2.29	1.21	0.96	0.92
Blade flakes	224	2.82	2.4	1.01	1.88	3.56
Retouched blades	8	2.44	2.34	1.09	1.07	1.14

Metric comparison between broken blades

Length

Length values, as expected are found to be very varied between different types of broken blades during both the cultural periods. Obliquely blunted blades found from Chalcolithic period, however, seem to be more standardized than other blade types (table 3.15). They also appear to be the longest of blades during Mesolithic period (table 3.14) but since the sample size is very small, this result needs to be taken with caution. Blade flakes are longest of blades during both the periods. It seems that blades had become smaller during Chalcolithic period.

Table 3.14: Metrics of length of various broken blades in mm of Mesolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	148	9.73	9.13	7.78	3.4	11.59
Backed blades	24	11.42	10.11	4.93	4.54	20.6116
Blade flakes	75	12.85	12.01	9.93	4.53	20.5209
Retouched blades	19	11.11	10.88	5.21	2.90	8.41
Obliquely blunted blades	2	16.24	16.24	10.03	8.78	9.7458

Table 3.15: Metrics of length of various broken blades in mm of Chalcolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	449	8.72	8.25	6.69	2.94	8.6436
Backed blades	64	9.87	9.29	4.36	3.29	10.8241
Blade flakes	135	12.15	11.23	8.61	4.57	20.8849
Retouched blades	33	10.39	9.48	8.02	3.57	12.7449
Obliquely blunted blades	4	9.17	9.28	7.7	1.22	1.4884

Breadth

Breadth values of all the blades, except that of blade flakes during both the periods and that of retouched blades during Chalcolithic period seem more or less standardized (table 3.16 & table 3.17). Here again it was observed that all the types of retouched blades have breadth values larger than simple blades, reinforcing the

interpretation that broader blades were being deliberately selected for retouching. It also seems as if the blades had become narrower during Chalcolithic period (table 3.17).

Table 3.16: Metrics of breadth of various broken blades in mm of Mesolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	148	6.05	5.57	5.1	1.8	3.26
Backed blades	24	6.43	5.83	5.04	1.91	3.6481
Blade flakes	75	9.49	8.8	8.8	3.48	12.1104
Retouched blades	19	6.01	6.1	3.37	1.44	2.0736
Obliquely blunted blades	2	6.37	6.37	5.21	1.64	2.6896

Table 3.17: Metrics of breadth of various broken blades in mm of Chalcolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	449	5.58	5.26	4.28	1.55	2.4025
Backed blades	64	5.22	4.78	4.33	1.46	2.1316
Blade flakes	135	9.79	8.62	5.49	4.23	17.8929
Retouched blades	33	6.22	5.84	3.68	2.13	4.5369
Obliquely blunted blades	4	4.79	4.56	3.01	1.68	2.8224

Thickness

Thickness values of different blades is also found to be comparatively standardized, exception being that of blade flakes (table 3.18 & table 3.19). The trend of blades becoming smaller and narrower during Chalcolithic period is observed in thickness too. Blades were found to be thinner during Chalcolithic period (table 3.19).

Table 3.18: Metrics of thickness of various broken blades in mm of Mesolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	148	1.54	1.38	1.43	0.74	0.5476
Backed blades	24	2.26	1.74	1.6	1.11	1.2321
Blade flakes	75	2.81	2.55	1.91	1.62	2.6244
Retouched blades	19	2.04	1.76	2.16	0.77	0.5929
Obliquely blunted blades	2	2.21	2.21	1.3	1.29	1.6641

Table 3.19: Metrics of thickness of various broken blades in mm of Chalcolithic period at Loteshwar

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	449	1.58	1.4	1.14	0.71	0.5041
Backed blades	64	1.96	1.53	1.24	1.37	1.8769
Blade flakes	135	2.6	2.14	0.65	1.64	2.6896
Retouched blades	33	1.94	1.81	1.63	0.65	0.4225
Obliquely blunted blades	4	1.41	1.48	1.15	0.17	0.0289

Geometric and non-geometric tools

Geometric tools such as Isosceles triangles, scalene triangles, lunates and trapeziums (figure 3.12) and non-geometric tools such as points (figure 3.13) and various types of scrapers were discovered from Mesolithic period as well as Chalcolithic period level (figure 3.11). Amongst the geometric variety of tools, lunates are the most common during both the periods (45 during Mesolithic period and 84 during Chalcolithic period). Lunates have been associated with projectile points as well as cutting tools, thus giving them a larger functional territory. Since Loteshwar is primarily a hunting-gathering settlement this could precisely be their function. Trapeziums, triangles and points are associated with hunting gear too. The surprising element is the almost absence of scrapers during Mesolithic period. Different types of scrapers have been generally found from a Mesolithic period lithic assemblage. The scarcity of these at this level of Loteshwar is puzzling. Chert (41 tools 53.9% during Mesolithic period and 99 tools 55% during Chalcolithic period), followed by Chalcedony (22 tools, 28.9% during Mesolithic period and 49 tools 27.2% during Chalcolithic period) was the favoured raw material to make different tools during both the periods. Carnelian gives proof of heat treatment given to raw materials to facilitate in knapping which seems to be practiced at Loteshwar. Banded agate (5 tools, 6.6% during Mesolithic period and 12 tools 6.7% during Chalcolithic period) and moss agate (1 tool, 1.3% during Mesolithic period and 4 tools 2.2% during Chalcolithic period) show their presence but are rare. Both were exploited to make geometric tools. Quartz is very rare too and was utilized exclusively for the manufacturing of geometric tools of both the periods.

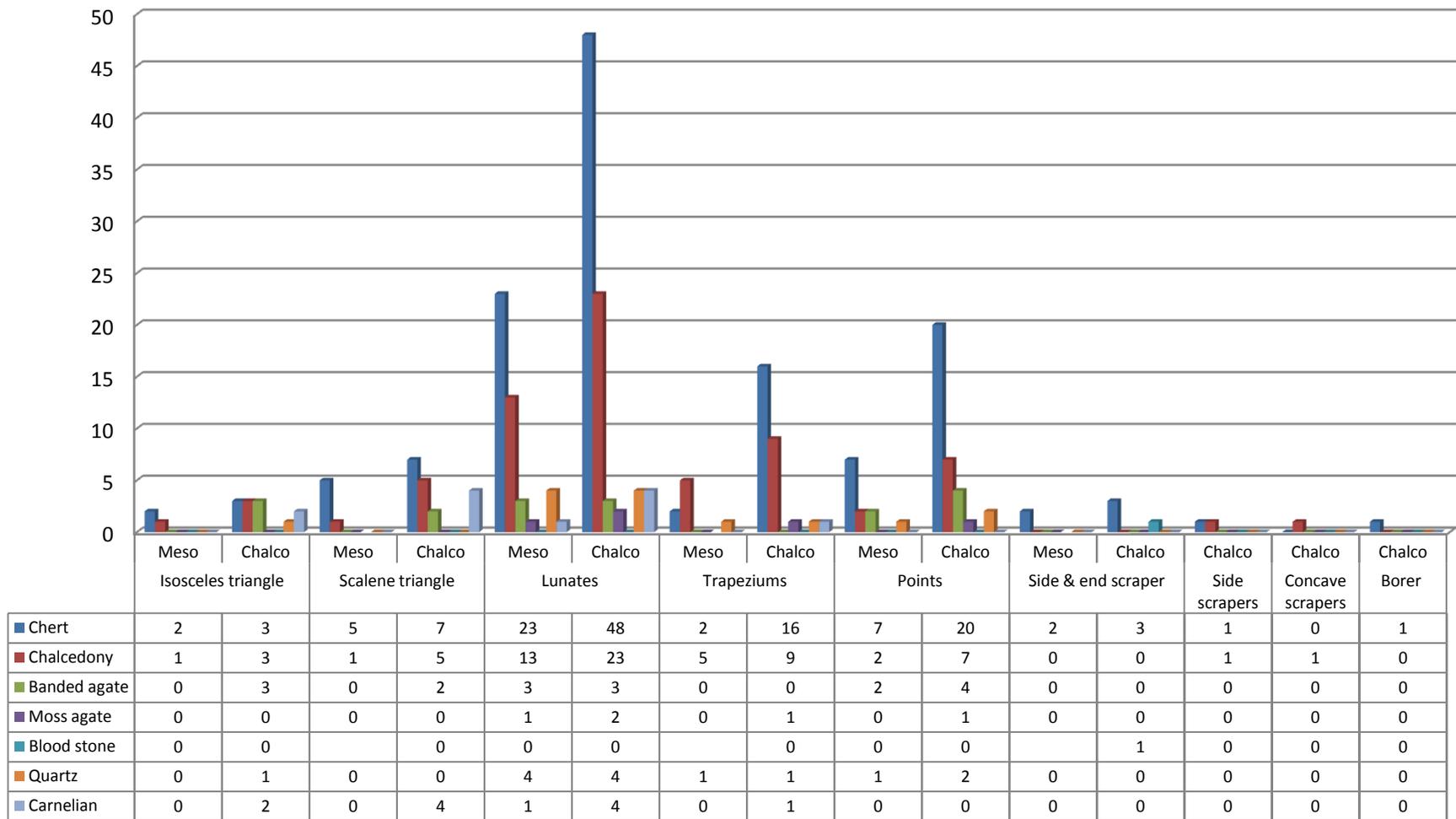


Figure 3.11: Representation of geometric and non-geometric tools during Mesolithic and Chalcolithic periods at Loteshwar

Metric analysis of geometric and non-geometric tools

Isosceles triangles

Isosceles triangles or the triangles with equal sides were found to be shorter, thinner and narrower than scalene triangles during both the periods. Amongst the three Mesolithic period isosceles triangles, one was found to be in broken condition while amongst the Chalcolithic period isosceles triangles, three were found to be in broken condition. Though we have very few artefacts in this category, low standard deviation and variance values of these tools suggest standardization in their manufacture (table 3.20). One from Mesolithic period while three triangles from Chalcolithic period were found to be devoid of any edge damage leading to the conclusion that they might have been prepared for future use. All the triangles were made from secondary flakes thus were devoid of any cortex.

Table 3.20: Metric analysis in mm of the isosceles triangles of Mesolithic and Chalcolithic periods at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
Mesolithic period	Length	7.58	7.81	6.86	0.42	0.64
3	Breadth	5.01	4.58	4.54	0.60	0.77
	Thickness	1.55	1.59	1.22	0.10	0.31
Chalcolithic period	Length	9.81	9.9	7.17	2.49	1.57
12	Breadth	5.4	5.00	4.54	1.39	1.18
	Thickness	2.07	1.86	1.57	0.43	0.65

Scalene triangles

All 6 scalene triangles from Mesolithic period and 12 from Chalcolithic period were found to be in intact condition. One shows the presence of a little cortex (<10) while other 5 were cortex-less during Mesolithic period while no cortex was seen on Chalcolithic period scalene triangles. The high values for standard deviation and variation in their length during Mesolithic period suggests non standardization of artefacts (table 3.21), they appear to have been given shape to suit needs whenever one arose, which is in contrast with the measurements noted for Chalcolithic period. All show heavy edge damage leading one to conclude that they were utilized heavily for some purpose. Triangles have been associated with point tips and point barbs or even as barbs or points for projectiles (Andrefsky 2005: 207).

Table 3.21: Metric analysis in mm of the scalene triangles of Mesolithic and Chalcolithic periods at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
Mesolithic period	Length	12.65	11.74	8.21	18.83	4.34
6	Breadth	5.56	5.31	3.98	2.31	1.52
	Thickness	1.61	1.41	0.76	0.53	0.73
Chalcolithic period	Length	11.00	11.35	11.93	3.82	1.95
14	Breadth	4.97	4.98	5.13	0.38	0.61
	Thickness	2.13	1.74	1.21	0.84	0.92

Lunates

The most popular artefacts amongst the geometric tool variety during both the periods are the lunates. 40 lunates were made out of secondary blades, while the other 5 show different degree of cortex on their dorsal surface during Mesolithic period while 12 show different degree of cortex on their dorsal surface during Chalcolithic period. Very interestingly and surprisingly, one lunate during Mesolithic period was formed out of a primary blade, thus challenging the theory that only secondary blades were made into different variety of tools. Their lengths vary quite a lot during both the periods (table 3.22). During Mesolithic period 7 (15.5%) were found to be in broken condition which increases during Chalcolithic period where 28 (34.6%) were found broken. Very broad and thick flakes seem to have been chosen to make lunates of Mesolithic period. All the lunates have shown heavy to slight edge damage, concluding that all were utilized. The possibility that these were used as arrowheads or harpoon barbs, as suggested by Sankalia (1967) seems appropriate as during both the periods hunting was the major activity at the site.

Table 3.22: Metric analysis in mm of the lunates of Mesolithic and Chalcolithic periods at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
Mesolithic period	Length	13.97	13.83	16.93	16.12	4.01
45	Breadth	6.43	6.09	5.57	2.32	1.52
	Thickness	2.79	2.65	2.33	1.2	1.09
Chalcolithic period	Length	11.3	10.5	11.11	14.4	3.8
84	Breadth	5.81	5.53	4.61	2.32	1.52
	Thickness	2.63	2.34	1.6	1.27	1.13

Trapeziums

8 trapeziums belonging to Mesolithic period and 28 trapeziums belonging to Chalcolithic period have been identified from the tool assemblage. The high standard deviation and variance values in their sizes (table 3.23) could be explained by the condition in which these were found. Half of these tools were intact while the other half were found in broken condition during Mesolithic period and a little less than half (42.9%) were found to be in broken condition during Chalcolithic period. All have slight to heavy edge damages, leading to the conclusion that all were utilized. Sankalia (1967) has suggested similar mode of use for trapeziums as that of lunates for these tiny tools. 7 out of the 8 trapezes discovered were made on secondary blades while one was made out of a primary blade during Mesolithic period. Similarly 27 were made out of secondary blade while 1 was made out of a primary blade during Chalcolithic period. Could this use of primary blades to form specialized tools suggest inaccessibility of raw material sources? So that one has to utilize the available raw material to a maximum? Or does it just suggest manufacturing of these tools at the site where the raw material was utilized at its greatest.

Table 3.23: Metric analysis in mm of the trapeziums of Mesolithic and Chalcolithic periods at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
Mesolithic period	Length	9.76	8.61	6.46	7.67	2.77
8	Breadth	5.25	5.18	3.63	1.76	1.33
	Thickness	2.45	1.99	1.09	1.19	1.09
Chalcolithic period	Length	9.56	9.43	3.66	6.66	2.58
28	Breadth	4.85	4.77	4.87	0.93	0.96
	Thickness	1.52	1.49	0.98	0.19	0.44

Points

Out of 12 points, 4 were found in intact condition, 8 were broken during Mesolithic period period while 10 were found to be intact and 24 broken during Chalcolithic period. The high standard deviation and variance values (table 3.24) during both the periods could be due to the fragmentary condition of these tools. 10 points were made on secondary blades while 2 were made out of primary blades during Mesolithic

period while only 1 was made out of a primary blade during Chalcolithic period. Points were most probably being used as hunting gear. If this was the case then their low number could suggest some getting lost during hunting practices. Out of 12 points found during Mesolithic, 10 were found to be devoid of any kind of edge damage while 2 show heavy edge damage. This contrasts with Chalcolithic period where 18 (52.9%) were found without noticeable edge damages. This might suggest that these tools were being manufactured and kept aside for future use.

Table 3.24: Metric analysis in mm of points of Mesolithic and Chalcolithic periods at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
Mesolithic period	Length	13.3	12.07	7.58	21.81	4.67
12	Breadth	5.07	4.93	1.68	1.98	1.40
	Thickness	2.23	1.69	0.99	1.63	1.27
Chalcolithic period	Length	11.83	9.97	9.02	32.38	5.69
34	Breadth	5.02	4.46	4.21	2.77	1.66
	Thickness	1.85	1.63	1.63	0.62	0.78

Side and end scraper

Scrapers are multifunctional tools. But mostly scholars associate them with working of animal skins, hides or wood (Andrefsky, 2005: 62). All of the scrapers were found to be in intact condition. Both the scrapers found from Mesolithic period were made out of secondary flakes since cortex was not present on either of them. While 3 out of the 4 scrapers of Chalcolithic period were made on secondary flakes, one was made on a primary flake. The sizes of Mesolithic period scrapers have a lot of variations as can be seen from their metric measurements (table 3.25). Chalcolithic period scrapers appear to be more standardised. All of these scrapers have edge damages leading to the conclusion that they were utilized either at the site itself or at the site of hunt but were brought back to the camp.

Side scraper

Two side scrapers discovered from Chalcolithic period have more or less similar lengths but are very varied in their breadths and thicknesses. Flakes of various sizes have been retouched to manufacture these scrapers (table 3.26).

Table 3.25: Metric analysis in mm of side and end scraper belonging to Mesolithic and Chalcolithic periods at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
Mesolithic period	Length	19.98	19.98	17.24	15.07	3.88
2	Breadth	15.39	15.39	14.79	0.72	0.84
	Thickness	3.77	3.77	3.85	0.11	0.10
Chalcolithic period	Length	13.27	13.04	12.57	0.66	0.82
4	Breadth	13.93	14.38	11.99	1.78	1.33
	Thickness	4.33	4.23	2.95	1.65	1.28

Table 3.26: Metric analysis in mm of side scrapers belonging to Chalcolithic period at Loteshwar

No.		Mean	Median	Mode	Variance	Std dev
2	Length	33.00	33.00	32.52	0.46	0.67
	Breadth	23.94	23.94	18.53	58.64	7.65
	Thickness	6.88	6.88	4.3	13.36	3.65

Concave scraper

A concave scraper made on a flake was discovered from Chalcolithic period. Its measurements are as following, 7.88mm length, 9.82mm breadth and 4.61mm thickness.



Figure 3.12: Geometric tools from the Mesolithic and Chalcolithic periods
(Courtesy: NoGAP)



Figure 3.13: Geometric and non-geometric tools from Mesolithic and Chalcolithic periods (courtesy: NoGAP)

Borer

Single borer has been discovered from the Chalcolithic period. Its measurements are as following, 23.92mm length, 6.26mm breadth and 3.23mm thickness.

Lithic debitage

Lithic debitage includes all the waste produced during tool making. Since cores are end products of blades and most of the time not re-used, they have been included in this category (figure 3.14).

Flakes

A total of 1196 flakes of different raw materials have been recovered from Mesolithic period while 1727 flakes of different raw materials have been recovered from Chalcolithic period. 992 or 82.9% were found to be intact while 204 or 17.1% were found to be broken during Mesolithic period. 1326 or 76.8% were intact and 401 or 23.2% were broken during Chalcolithic period. The percentages of raw materials observed between Mesolithic period and Chalcolithic period do not vary (figure 3.15).

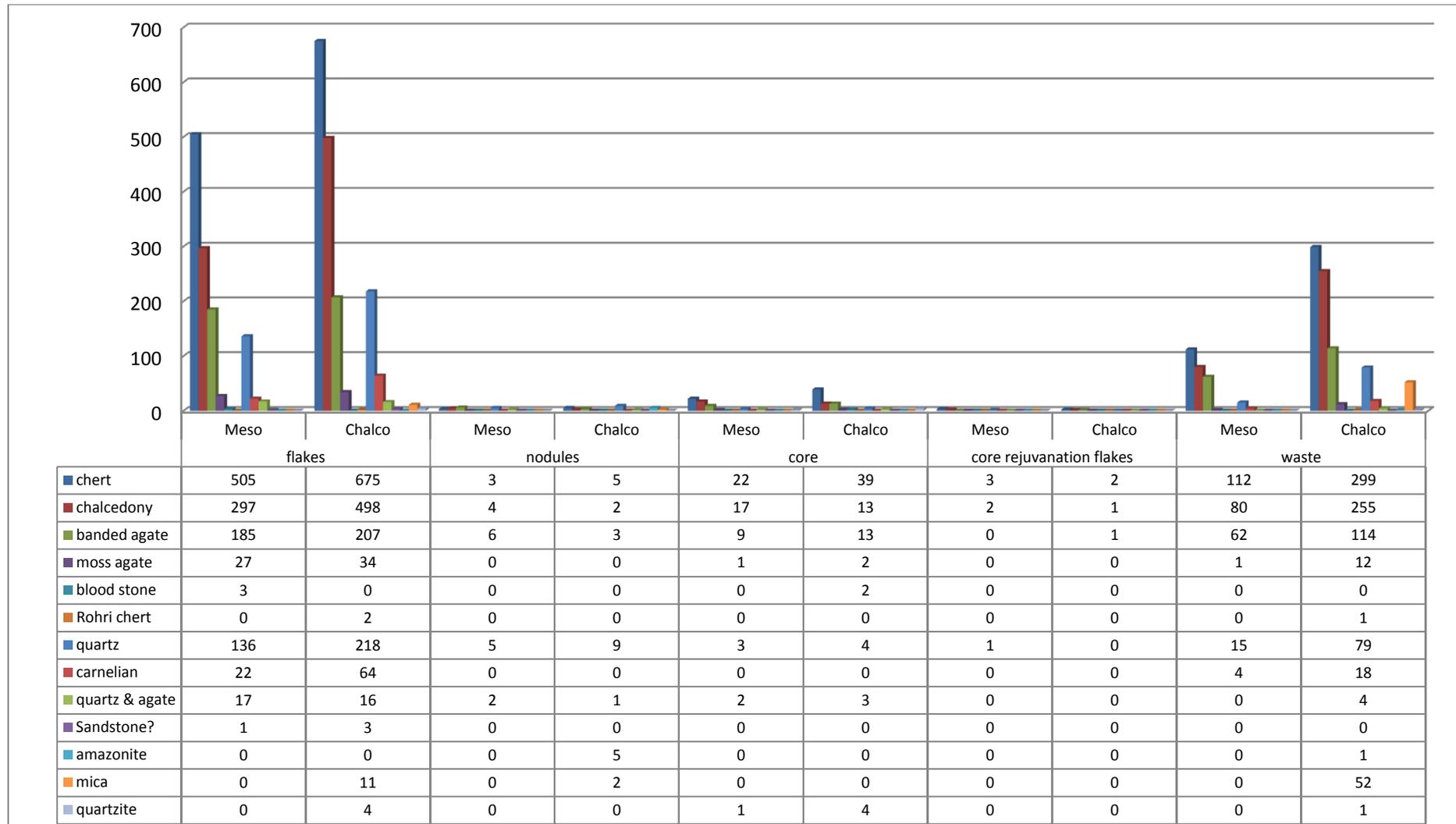


Figure 3.14: Representation of lithic debitage of Mesolithic and Chalcolithic periods at Loteshwar

Edge condition

During Mesolithic period 1182 or 98.8% flakes were neither utilized nor retouched, which is expected from flakes found amongst the lithic debitage. But 1.2% does seem to have some indication of their having either edge damage leading to the conclusion that they were utilized for some purpose or show some amount of retouching, again leading to the conclusion that they were utilized for something. Almost the same results can be seen for the flakes of Chalcolithic period. Here too, 1696 or 98.2% do not show any kind of edge damages or retouches on their edges. However, 1.1% flakes show evidence of edge damage while 0.4% shows evidence of retouches (figure 3.15).

Cortex

The presence and absence of cortex has been noted for all the flakes. It was seen that 506 or 42.3% were primary flakes while 690 flakes or 57.7% were secondary flakes in Mesolithic period assemblage. The ratio changes during Chalcolithic period where 637 or 36.9% flakes were primary while 1090 or 63.1% flakes were secondary. All the stages of cortex were observed on flakes of various raw materials except of blood stone, where only secondary flakes were observed during either period at the site (figure 3.16).

Nodules

Not many nodules (16 from Mesolithic period and 22 from Chalcolithic period) were found either from Mesolithic period lithic assemblage or from Chalcolithic period lithic assemblage. Most of the nodules recovered were broken in half (11 or 68.8% during Mesolithic period and 14 63.6% during Chalcolithic period). Others were found to have been flaked randomly (5 or 31.3% during Mesolithic period and 8 or 36.4% during Chalcolithic period), sometimes only a couple of flakes were removed from them (figure 3.17). Low presence of nodules from the site encourages the interpretation that raw material was being brought at site from far away sources and thus was utilized to a maximum.

Core rejuvenation flakes

A total of 10 core rejuvenation flakes were found from the excavations. 6 were found from Mesolithic period, 4 of these were made out of chert, 1 out of chalcedony and 1

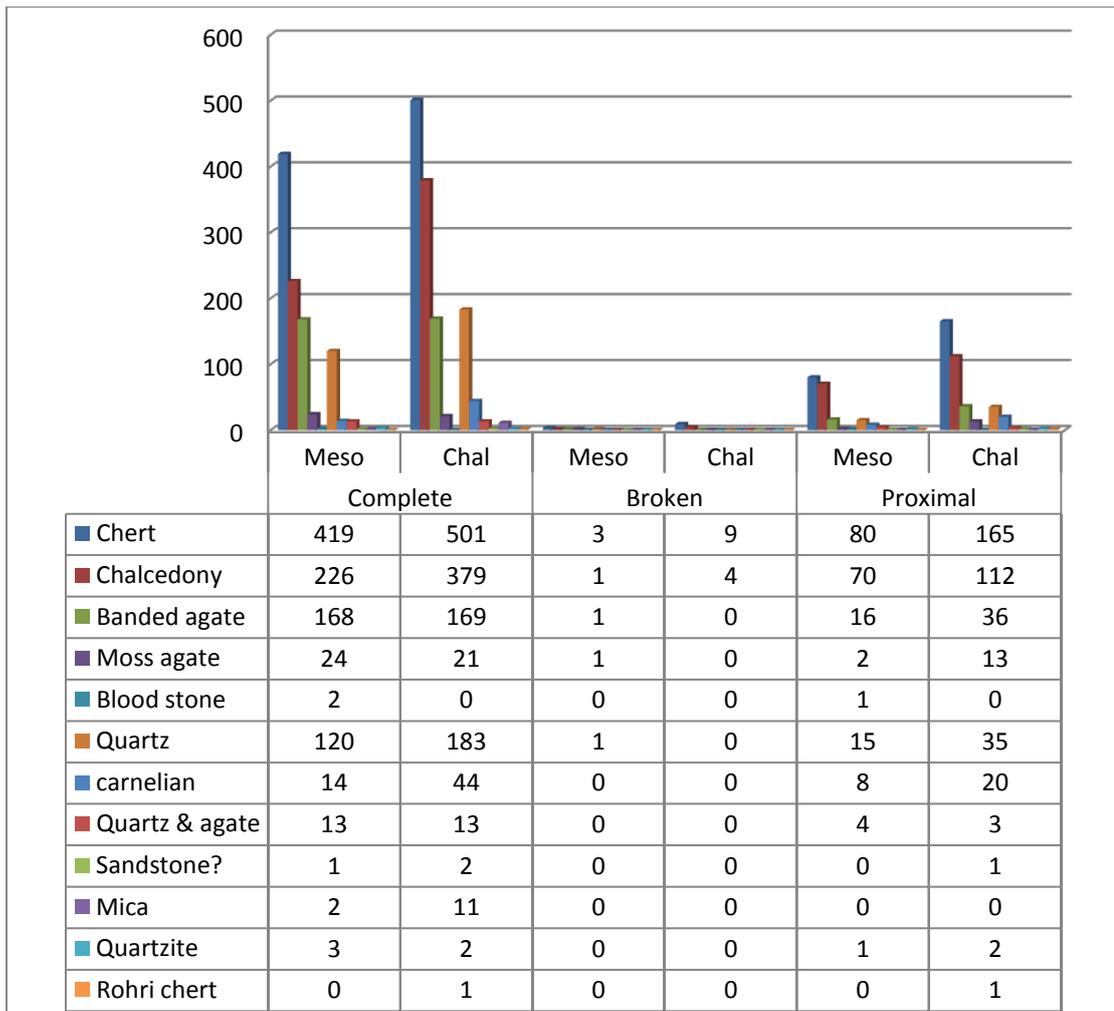


Figure 3.15: Condition of flakes during Mesolithic and Chalcolithic periods at Loteshwar

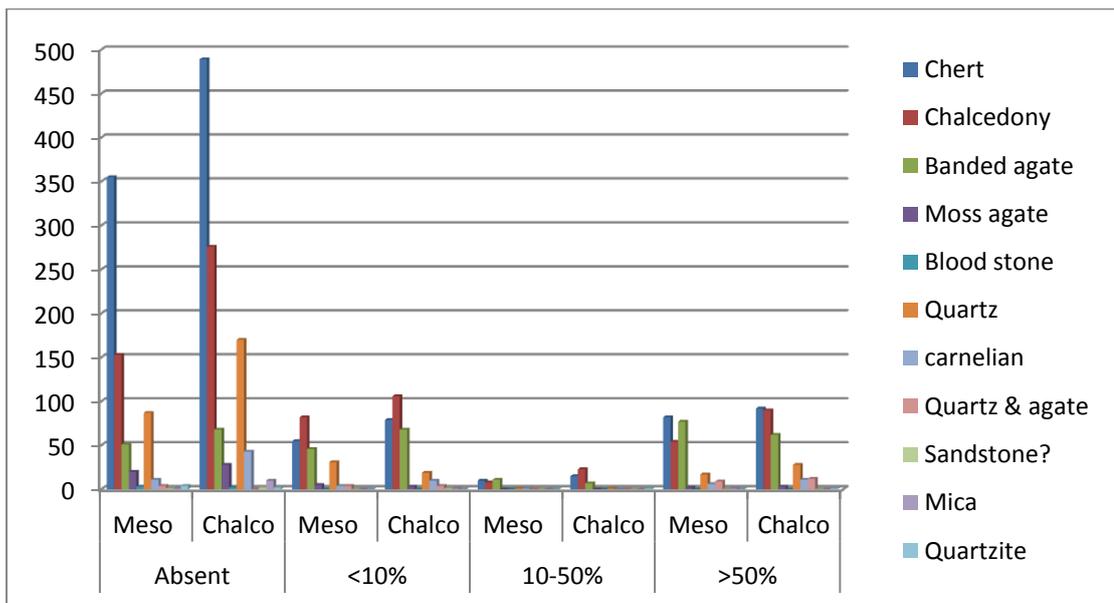


Figure 3.16: Representation of cortex on flakes of Mesolithic and Chalcolithic periods at Loteshwar

from quartz. 4 from Chalcolithic period; 2 of these were made out of chert, 1 from chalcedony and 1 from banded agate.

Core rejuvenation flakes (CRF) during Mesolithic period

Chert CRFs are broad and thick, while chalcedony CRFs are long and narrow. Quartz CRF is falling in between the other two, the only difference being its thickness which was more than the thickness of CRF of chalcedony (table 3.27).

Core rejuvenation flakes (CRF) during Chalcolithic period

CRF of chert are longer, broader and thicker. Chalcedony CRF is longer than Banded agate CRF but is more or less similar in other two categories (table 3.27).

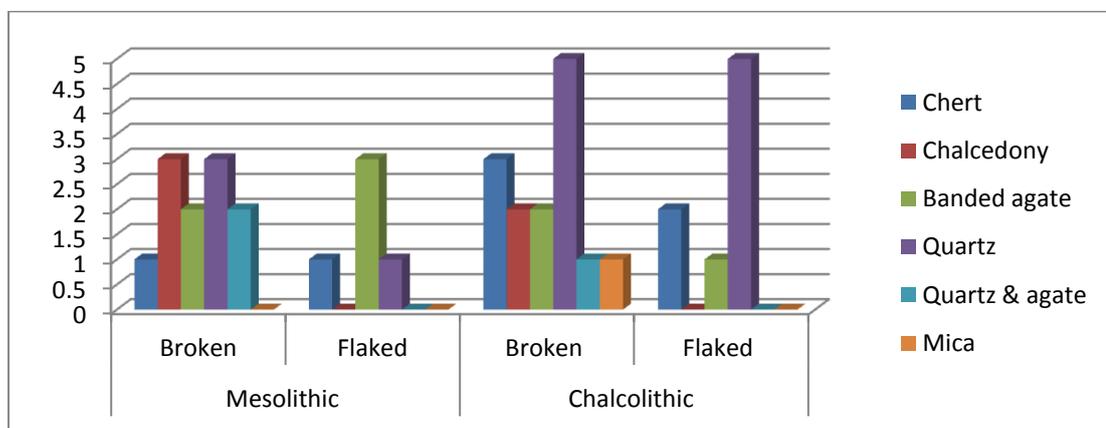


Figure 3.17: Nodules from Mesolithic and Chalcolithic periods at Loteshwar

Table 3.27: Metric analysis in mm of core rejuvenation flakes of Mesolithic period and Chalcolithic period of Loteshwar

	R.M.	Mesolithic period (n)	Mean	R.M.	Chalcolithic period (n)	Mean
Length	Chert	3	10.67	Chert	2	16.93
	Chalcedony	2	16.03	Chalcedony	1	7.54
	Quartz	1	11.07	Quartz	0	
	Banded agate	0		Banded agate	1	10.63
Breadth	Chert	3	13.8	Chert	2	11.82
	Chalcedony	2	8.7	Chalcedony	1	5.1
	Quartz	1	10.05	Quartz	0	
	Banded agate	0		Banded agate	1	5.93
Thickness	Chert	3	5.77	Chert	2	6.16
	Chalcedony	2	2.23	Chalcedony	1	2.15
	Quartz	1	3.27	Quartz	0	
	Banded agate	0		Banded agate	1	2.77

Waste/shatter

Undiagnostic broken fragments or tiny debitage pieces without any specific shape or form have been classified in this category. 289 fragments of waste/shatter belonging to different raw materials were identified from the Mesolithic period lithic debitage whereas 838 fragments of waste/shatter belonging to different raw materials were identified from the Chalcolithic period lithic debitage. Figure 3.18 shows that most of the shatter has some amount of cortex present, reinforcing the interpretation that tools were made at the site itself.

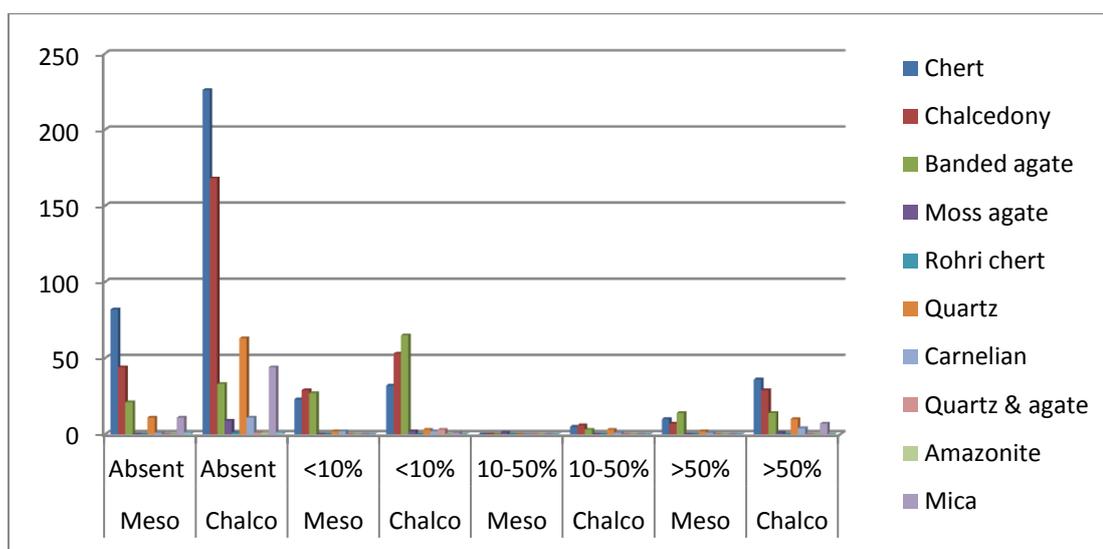


Figure 3.18: Representation of cortex on waste/shatter during Mesolithic and Chalcolithic periods at Loteshwar

Cores

A core is a mass homogenous lithic material that has had flakes removed from its surface. The primary purpose of a core is to supply flakes that can be used for the production of various tools. As flakes are removed from the core it gets progressively smaller until it is finished or exhausted (Andrefsky 2005: 14). Exhausted cores, if studied properly, can give a lot of information regarding preparation and blade removal techniques.

Core type

Core type is the first and easiest classification of a core. In this research cores have been classified primarily as blade cores and flake cores. One core was found to have been used as a scraper and thus was classified under a different category of core cum scraper. As can be seen from the figure 3.19 almost 84% (46) cores are blade cores

during Mesolithic period, this increases during Chalcolithic period where we have 93% (77) blade cores (figure 3.23 and figure 3.24). This preponderance of blade cores confirms the findings of formal tools such as blades and geometric tools made out of blades during both the periods. Majority of cores belong to the raw material chert (22 cores during Mesolithic period and 39 cores during Chalcolithic period), followed by chalcedony (17 during Mesolithic period and 15 during Chalcolithic period) and banded agate (9 during Mesolithic period and 14 during Chalcolithic period). The only difference being the presence of blood stone blade cores (2) during Chalcolithic period (figure 3.19). These findings too support the distribution of raw material found amongst various tools as well as other lithic debitage.

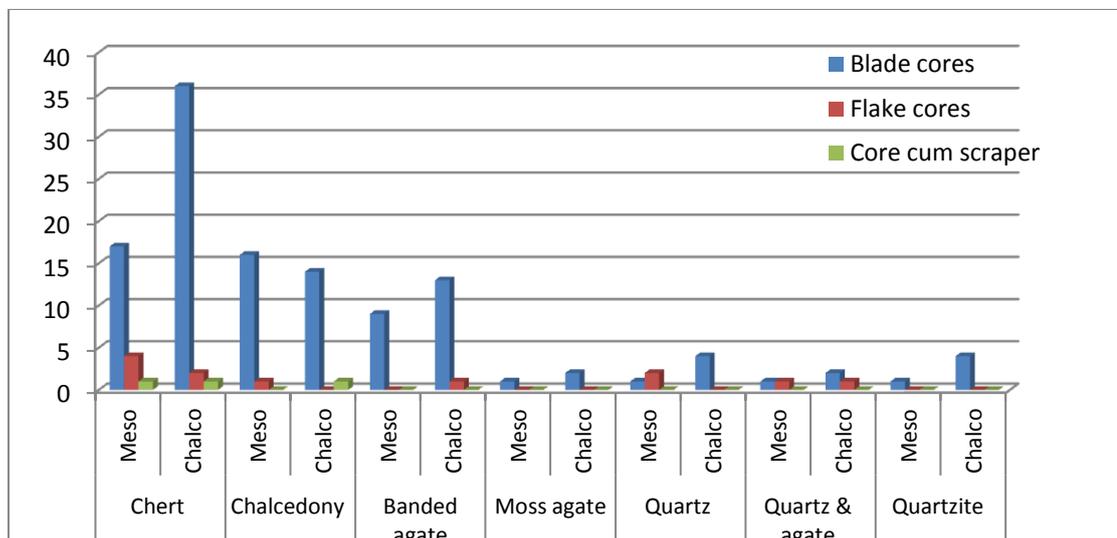


Figure 3.19: Core types according to raw materials during Mesolithic and Chalcolithic periods of Loteshwar

Core shape

Core shape is one of the features that can provide a great deal of information about the production technique employed (Raczek 2007). Majority of the cores (15 during Mesolithic period and 10 during Chalcolithic period) were found to have conical shape (figures 3.20 and 3.21). Conical shape is formed due to unidirectional removal of blades and thus is end results of blade technology. Cylindrical cores too are end results of blade technology but here blades have been removed bidirectionally. A wedge shaped core is generally formed when a nodule is broken into four parts and then flaked only from one face, thus viewed from a side have wedge silhouette. Block cores have a cubical look where generally blades are removed from all the sides. Flat cores are cores which have a very flat back, most of the time covered in cortex.

Quartering technique is known to produce cores of this variety. Semi conical too are end products of quartering technique, the difference between them and flat cores is that the former will have a conical shape.

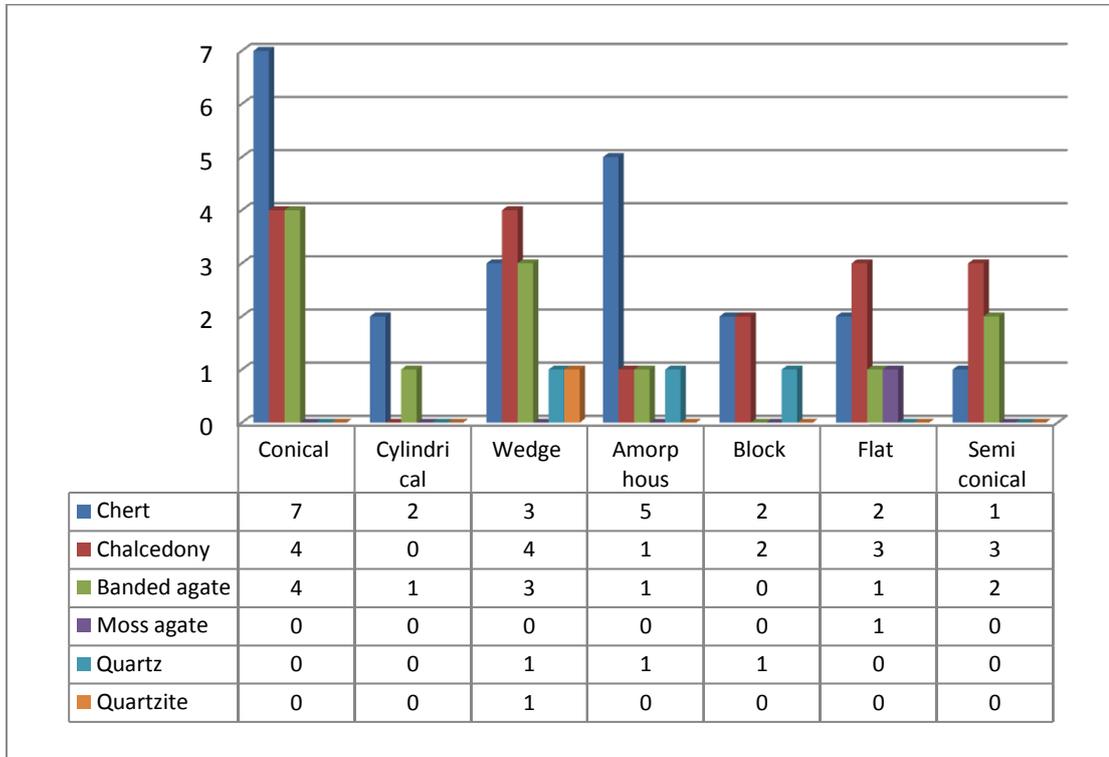


Figure 3.20: Core shapes according to raw materials during Mesolithic period at Loteshwar

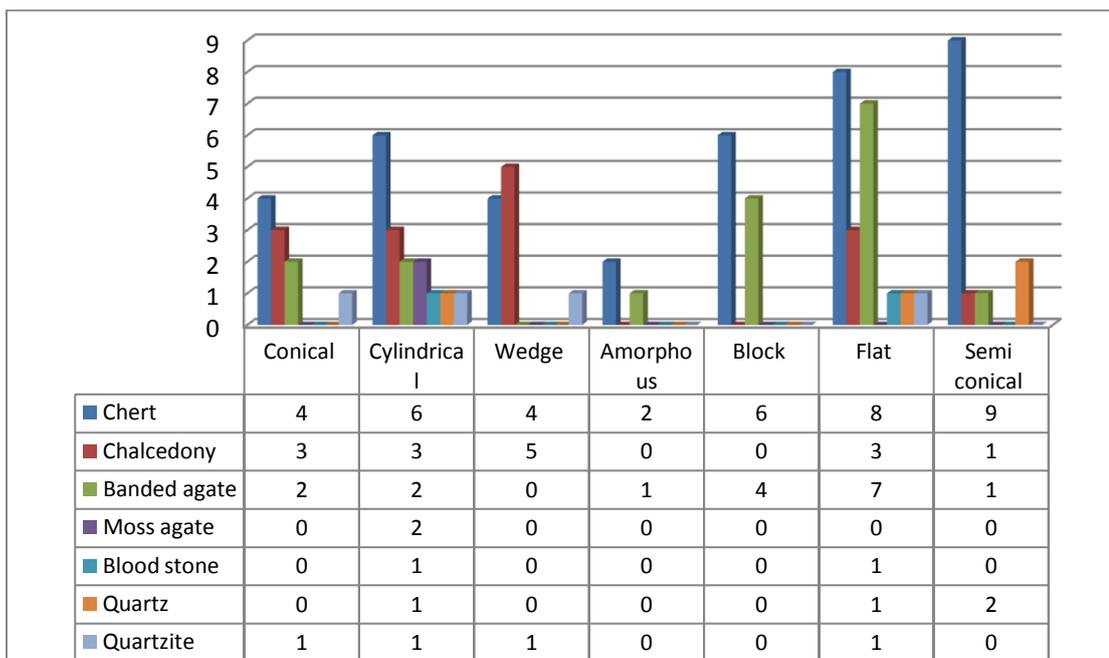


Figure 3.21: Core shapes according to raw materials during Chalcolithic period at Loteshwar

Blade removal pattern

Cores where blades were removed from only one side have been categorised as sliced, cores on which blades were removed by rotating come under rotated category while cores where flakes have been removed without a particular pattern have been called flexible [adapted from (Raczek 2007)]. Amongst the Mesolithic period blade cores, 31 or 67.4% cores show rotating blade removal, 9 or 19.6% show slicing blade removal while 6 or 13% show flexible removal of blades. This is in stark contrast to the flake cores where 87.5% show flexible removal of blades/flakes. For the Chalcolithic period blade cores it was seen that 21 or 28.38% cores were sliced, 52 or 70.27% were rotated and 1 or 1.35% showed flexible blade removal. All the flake cores showed flexible blade removal during this period.

Core platform preparation

5 different types of core platform preparation methods have been noted for the cores. Removal of multiple flakes to make the platform was the most common (16 cores or 34.78%) method for blade cores during Mesolithic period. However during Chalcolithic period, it was seen that single flake removal was more frequent (25 cores 33.78%). Could this be due to the removal of platform rejuvenation flake? Removal of a single flake to make the platform was the second preferred method (15 cores 32.61%) during Mesolithic period while removing multiple flakes was the second frequent method (17 cores 22.97%) during Chalcolithic period. A few platforms (7 cores or 15.2% during Mesolithic period, 9 cores or 11.7% during Chalcolithic period) were found to be in broken condition. 2 or 4.3% cores showed no platform preparation during Mesolithic period while 12 or 16.22% show no platform preparation during Chalcolithic period. 6 or 13% has shown chipping during Mesolithic period while 11 or 15.6% chipping was seen during Chalcolithic period. Amongst the flake cores, during Mesolithic period 87.5% show no type of platform preparation while 1 was found to be in broken condition. However during Chalcolithic period all flake cores are found to be without any platform preparation.

Core platform count

During Mesolithic period, amongst the blade cores, 35 or 81.4% had a single platform, 5 or 11.63% showed double platforms while only 3 or 6.98% showed the presence of three different platforms. And amongst the flake cores, 42.9% showed

more than 3 platforms, 28.6% showed double platforms and the rest 28.6% showed three platforms for flake removal. During Chalcolithic period 56 or 81.16% blade cores had a single platform, 11 or 15.94% showed double platform while remaining 2 or 2.9% showed the presence of more than 3 platforms. Amongst the flake cores from this period it was seen that 50% had double platform while the other 50% had 3 or more platforms.

Core butt condition

During Mesolithic period, amongst the blade cores, 19 44.19% showed some amount of cortex on their butts. Only 1 core was found to have been utilized as an end scraper and thus showed regular retouches on its butt end. 62.5% of flake cores showed presence of some amount of cortex on their butt ends. During Chalcolithic period, 13 or 17.57% showed presence of cortex and 20 or 27.03% showed some amount of retouching from the blade cores, amongst the flake cores 75% had cortex at their butt ends.

Cortex

Both the category of cores during both the periods have shown presence of cortex (35 cores 76.09% during Mesolithic period and 52 70.27% during Chalcolithic period) more than the absence of cortex (figure 3.22). This presence of cortex supports local blade removal. Most probably nodules were brought from the raw material sources and the blades were being taken out at the site itself.

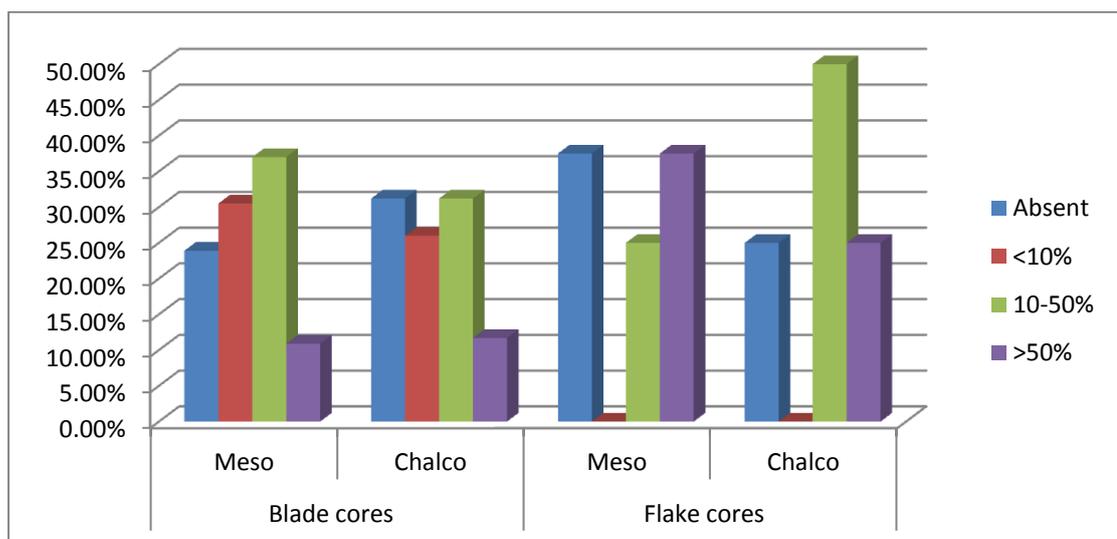


Figure 3.22: Presence of cortex on cores of Mesolithic and Chalcolithic periods at Loteshwar

Metric analysis of cores

Cylindrical cores are the shortest, narrowest and thinnest amongst all cores. They were also flaked bifacially and most probably that is the reason they are the smallest cores present.

Blade cores

Length

All the cores, during both periods, have a high standard deviation value which clearly suggests variation in their lengths. Conical and semi-conical cores of Mesolithic period however have comparative low standard deviation values, while block and amorphous cores during Chalcolithic period show low standard deviation values. Conical cores appear to be the longest cores while cylindrical cores are the shortest during Mesolithic period (table 3.28 & table 3.29). During Chalcolithic period flat cores appear to be the longest while amorphous cores are found to be the shortest (table 3.29).

Breadth

Here again we see very high standard deviation values though values for semi-conical cores during Mesolithic period and amorphous cores during Chalcolithic period are comparatively low. During Mesolithic period semi-conical cores are the broadest of cores while cylindrical cores are the narrowest cores (table 3.30). While during Chalcolithic period, wedge cores are the broadest while amorphous cores are the narrowest of cores (table 3.31).

Table 3.28: Lengths in mm of blade cores from Mesolithic period at Loteshwar

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	15	15.19	15.61	10.44	2.25	5.08
Cylindrical	3	11.64	14.22	3.62	7.09	50.28
Wedge	10	13.73	13.29	10.23	3.1	9.64
Block	4	14.71	12.54	12.31	4.49	20.23
Flat	7	14.8	14.33	11.33	3.69	13.65
Semi conical	6	13.28	13.56	9.87	2.76	7.59
Amorphous	1	12.38	12.38	12.38	0.00	0.00

Table 3.29: Lengths in mm of blade cores from Chalcolithic period at Loteshwar

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	10	14.79	14.65	9.37	4.4	19.37
Cylindrical	15	14.22	13.61	12.02	3.35	11.24
Wedge	10	15.1	15.35	10.67	2.87	8.24
Block	6	12.01	12.41	8.34	2.13	4.53
Flat	21	15.83	14.86	10.91	3.73	13.90
Semi conical	13	15.34	15.09	9.19	4.67	21.84
Amorphous	2	9.09	9.09	7.27	2.57	6.62

Table 3.30: Breadth in mm of blade cores from Mesolithic period at Loteshwar

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	15	11.34	10.06	12.28	4.06	16.53
Cylindrical	3	9.29	9.96	2.65	6.33	40.14
Wedge	10	12.12	11.17	7.98	3.45	11.94
Block	4	11.65	9.73	9.24	4.18	17.46
Flat	7	13.5	12.3	7.01	4.10	16.88
Semi conical	6	12.77	12.71	10.87	1.46	2.13
Amorphous	1	13.44	13.44	13.44	0.00	0.00

Table 3.31: Breaths in mm of blade cores from Chalcolithic period at Loteshwar

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	10	11.93	12.15	7.66	2.73	7.49
Cylindrical	15	11.1	10.92	6.76	2.95	8.69
Wedge	10	13.68	13.75	10.81	2.06	4.26
Block	6	11.84	12.05	4.95	4.45	19.85
Flat	21	12.65	12.67	7.44	2.91	8.47
Semi conical	13	11.15	11.45	6.5	2.14	4.58
Amorphous	2	10.49	10.49	9.94	0.78	0.62

Thickness

During Mesolithic period block cores appear to be the thickest cores while cylindrical cores appear to be the thinnest. While during Chalcolithic period amorphous core are the thickest while conical cores are the thinnest of cores. There is a big difference in

their standard deviation values during Mesolithic period (table 3.32) which changes during Chalcolithic period (table 3.33) where we do not see very high standard deviation values (except for cylindrical and wedge cores).

Table 3.32: Thickness in mm of blade cores from Mesolithic period at Loteshwar

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	15	9.65	8.87	5.69	3.34	11.13
Cylindrical	3	8.03	7.01	3.12	5.5	30.21
Wedge	10	8.37	8.25	2.74	2.99	8.94
Block	4	10.24	8.45	7.5	4.23	17.91
Flat	7	8.3	8.2	3.94	3.2	10.18
Semi conical	6	8.97	7.74	6.90	2.57	6.61
Amorphous	1	8.15	8.15	8.15	0.00	0.00

Table 3.33: Thickness in mm of blade cores during Chalcolithic period at Loteshwar

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	10	8.4	8.38	8.64	1.74	3.04
Cylindrical	15	9.6	8.8	5.26	3.09	9.56
Wedge	10	7.7	8.11	1.00	3.35	11.23
Block	6	10.16	9.45	8.05	2.17	4.7
Flat	21	8.59	9.38	4.67	1.95	3.83
Semi conical	13	7.66	7.71	4.33	2.42	5.8564
Amorphous	2	10.51	10.51	9.27	1.76	3.1

Flake cores or multidirectional cores

8 flake cores belonging to Mesolithic period were found. Since 7 of them belong to amorphous category, analyses of their measurements are taken together. Though they have high standard deviation values, it can be seen from the table that these were much larger, broader and thicker cores than blade cores. Only 4 flake cores were found from Chalcolithic period levels, 3 of which are block shaped while 1 was found to have amorphous shape. Measurements of all are taken together (table 3.34 & table 3.35). Looking at the measurements it appears that the cores of Mesolithic period were longer, broader and thicker than the cores of Chalcolithic period.

Table 3.34: Metrics in mm of flake cores of Mesolithic period at Loteshwar

	Mean	Median	Mode	Std dev	Variance
Length	23.60	21.60	16.53	6.35	40.39
Breadth	18.50	16.51	11.95	7.15	51.07
Thickness	15.86	13.62	11.55	4.76	22.71

Table 3.35: Metrics in mm of flake cores during Chalcolithic period at Loteshwar

	Mean	Median	Mode	Std dev	Variance
Length	21.59	21.12	16.5	4.89	23.96
Breadth	19.66	20.18	13.32	4.91	24.1
Thickness	14.82	14.01	12.4	3.01	9.08



Figure 3.23: Blade cores from the Mesolithic and Chalcolithic periods at Loteshwar (courtesy: NoGAP)



Figure 3.24: Blade cores from Mesolithic and Chalcolithic periods at Loteshwar (courtesy: NoGAP)

Summary

The lithic assemblages of Mesolithic period and Chalcolithic period recovered from the site of Loteshwar are mostly similar to each other. Contrary to popular belief we find that the Mesolithic period lithic assemblage is dominated by blades. It is also seen clearly that Chalcolithic period assemblage numerically dominates over the Mesolithic period assemblage. The most common type of blades found amongst the Mesolithic period are the blade flakes while simple blades are most common during Chalcolithic period. Retouched blades all together are 13.5% during Mesolithic period and 13.2% during Chalcolithic period. Chert, followed by chalcedony is the most favoured raw material exploited during both the cultural phases. Maximum numbers of blades are seen to be of either intact or proximal condition during both the periods. Blade flakes are mostly found in intact condition. Maximum proximal portions were seen of simple blades. Mesial or middle portion of blades are maximum in the simple blade category. Looking at the proximal end forms we can see that a combined percentage of 'retouched', 'difficult to see' and 'not prepared' is similar during the periods, 41.8% during Mesolithic period and 40.3% during Chalcolithic period. 'Irregularly lenticular' of proximal end form is the most frequent form during both the periods. The form 'gull winged' becomes less than half during Chalcolithic period. In the category of proximal end types, type 'single' dominates both the assemblages at 84.8% and 82.2%. Amongst the proximal end shapes, 'bulb scar' is represented almost equally in both the periods. 'Lipped' shape increased during Chalcolithic period while 'pointed' shape increased during Mesolithic period. Proximal width varies a lot between blades while the thickness was more or less of standardized size. We can also see that both the width and thickness are slightly bigger and thicker during Chalcolithic period. More than half of intact blades during Mesolithic period seem to have 'feathered' distal end termination. The most common type of distal end termination during Chalcolithic period was 'feathered', followed by 'plunging'. Majority of the flakes which are converted into tools or selected as tools are found to be devoid of cortex during both the periods. 73.9% blades show light to heavy edge damage leading to the conclusion that they have been used for some or the other purpose during Mesolithic period while it can be seen very clearly that a high proportion of blades (86.1%) show slight to heavy damage during Chalcolithic period. 186 (46.26%) out of 403 blades show edge damage on their right edges while 176

(43.78%) show edge damage on their left edges during Mesolithic period. During Chalcolithic period dorsal utilization of blades was very common. It can also be seen that during Chalcolithic period bifacial utilization is more than Mesolithic period. Retouches are mostly seen on the dorsal side of a blade. Notching is a common form of retouching. Dorsal backing is the most common type of retouching from Mesolithic period. Alternate retouches are not seen during Chalcolithic period but dorsal retouches of both the edges increase during this period. Notching of blades was also increased during Chalcolithic period. Retouched blades and backed blades are the longest blades while obliquely blunted blades appear to be the shortest during Mesolithic period. Amongst the Chalcolithic period blades, backed blades are the longest while simple blades are the shortest. No significant difference is observed of breadths in different types of blades, except amongst blade flakes of both the periods. Thicknesses of different blades seem not to differ too much. Blade flakes are the thickest while simple blades are found to be the thinnest blades amongst both the periods.

Lunates are the most common tools in the geometric and non-geometric tool category during both the periods. One lunate during Mesolithic period is formed out of a primary blade, thus challenging the theory that only secondary blades were made into different variety of tools. Their lengths vary quite a lot during both the periods. Chert, followed by Chalcedony was the favoured raw material to make different tools during both the periods. Banded agate and moss agate show their presence but are rare. Both were exploited to make geometric tools. Quartz is very rare too and is utilized exclusively for the manufacturing of geometric tools of both the periods. Isosceles triangles or the triangles with equal sides are found to be shorter, thinner and narrower than scalene triangles during both the periods. Half of the triangles are intact while the other half are found to be in broken condition during Mesolithic period and a little less than half (42.9%) are found to be in broken condition during Chalcolithic period. All have slight to heavy edge damages. Points and various types of scrapers are also recovered from both the periods.

The percentages of raw materials observed between Mesolithic period and Chalcolithic periods do not vary much and almost the similar kind of ratio is seen between flakes of different raw materials. 42.3% primary while 57.7% secondary

flakes are present in Mesolithic period assemblage. This changes during Chalcolithic period where 36.9% primary while 63.1% secondary flakes are observed from the assemblage. Around 1.2% flakes from both the periods seem to have some indication of their having edge damage. Most of the nodules are found to be broken in half. Others are found to have been flaked randomly. A total of 10 core rejuvenation flakes are found from the excavations. Most of the shatter has some amount of cortex present. 84% cores are blade cores during Mesolithic period, which changes during Chalcolithic period where we have 93% blade cores. Majority of cores belong to the raw material chert, followed by chalcedony and banded agate. Majority of the cores were of conical shape. Amongst the Mesolithic period blade cores, 67.4% cores show rotating blade removal, 19.6% show 'slicing' blade removal while 13% show flexible removal of blades. This is in stark contrast to the flake cores where 87.5% show flexible removal of blades/flakes. For the Chalcolithic period blade cores it was seen that 28.6% cores are 'sliced', 70.1% are 'rotated' and 1.3% are 'flexible'. All the flake cores show flexible blade removal during this period. Removal of multiple flakes to make the platform was the most common method for blade cores during Mesolithic period. However during Chalcolithic period, it was seen that single flake removal was more frequent. Majority of blade cores during both the periods had a single platform. Both the category of cores during both the periods have shown presence of cortex. Conical cores appear to be the longest cores while cylindrical cores are the shortest during Mesolithic period. During Chalcolithic period, flat cores appear to be the longest while amorphous cores are found to be the shortest. During Mesolithic period semi-conical cores are the broadest of cores while cylindrical cores are the narrowest cores. While during Chalcolithic period, wedge cores are the broadest while amorphous cores are the narrowest of cores. During Mesolithic period block cores appear to be the thickest cores while cylindrical cores appear to be the thinnest. While during Chalcolithic period amorphous cores were the thickest while conical cores were the thinnest of cores. Looking at the measurements it appears that the cores of Mesolithic period are longer, broader and thicker than the cores of Chalcolithic period.

Chapter 3 - Section II

Lithic Assemblages from Early Harappan and Urban Harappan Contexts

As mentioned in the beginning of this chapter this section deals with the lithic assemblages associated with Early Harappan and Urban Harappan sites. Lithic assemblages recovered from the site of Datrana represent the lithic assemblage belonging to Early Harappan period while the lithic assemblage recovered from the site of Shikarpur represents the lithic assemblage belonging to Urban Harappan period.

DATRANA (Early Harappan)

The lithic assemblage at Datrana comprises of 10,325 blades, 243 geometric and non-geometric tools and 77,235 fragments of lithic debitage including exhausted cores. As discussed earlier, the site comprises of 4 layers, all belonging to Chalcolithic period. A layer wise distribution of the lithic assemblage is presented here first (table 3.36).

Table 3.36: Layer wise distribution of lithic assemblage at Datrana

TOOLS	Layers				
	1	2	3	4	Total
Blades (various types)	870	8993	320	15	10325
Geometric and non-geometric tools	39	199	3	1	243
Lithic debitage	7867	67692	1481	102	77142
TOTAL	8776	76884	1804	118	87710
	10.01%	87.66%	2.06%	0.13%	100.00%

The highest quantity of lithic assemblage was recovered from Layer 2 which represents a relatively undisturbed habitational deposit of Chalcolithic period. 10.02% assemblage belongs to Layer 1. Layers 3 and 4 together represent less than 3% of the lithic assemblage recovered from the site.

Overview of Tool types

Blades

Simple used blades, backed blades, crested ridge blades, blade flakes, obliquely blunted blades and retouched blades (figure 3.25 and figure 3.26) are the main variety

of blades found from Datrana. Simple blades are the most common type of blades to be found (8528 blades or 82.60%), which is expected from a factory site. Retouched blades all together make up 4.33% (447 blades) of blade assemblage. Crested ridge blades (figure 3.27) are found in good numbers (915 blade 8.86%) and give concrete proof regarding the blade technology followed by the people of Datrana.



Figure 3.25: Various blades from Datrana (courtesy: NoGAP)



Figure 3.26: Various blades from Datrana (courtesy: NoGAP)



Figure 3.27: Crested Blades from Datrana (courtesy: NoGAP)

Raw materials

Chalcedony was clearly the most exploited raw material at the site. 85.03% (8783) blades are made out of chalcedony. Banded agate (598 blades or 5.79%), chert (444 blades or 4.3%), carnelian (294 blades or 2.85%) and moss agate (120 blades or 1.16%) are the other raw materials which show some significant representation. Raw materials such as quartz, Rohri chert and blood stone put together represent less than 1% (86 blades) of the assemblage (figure 3.28).

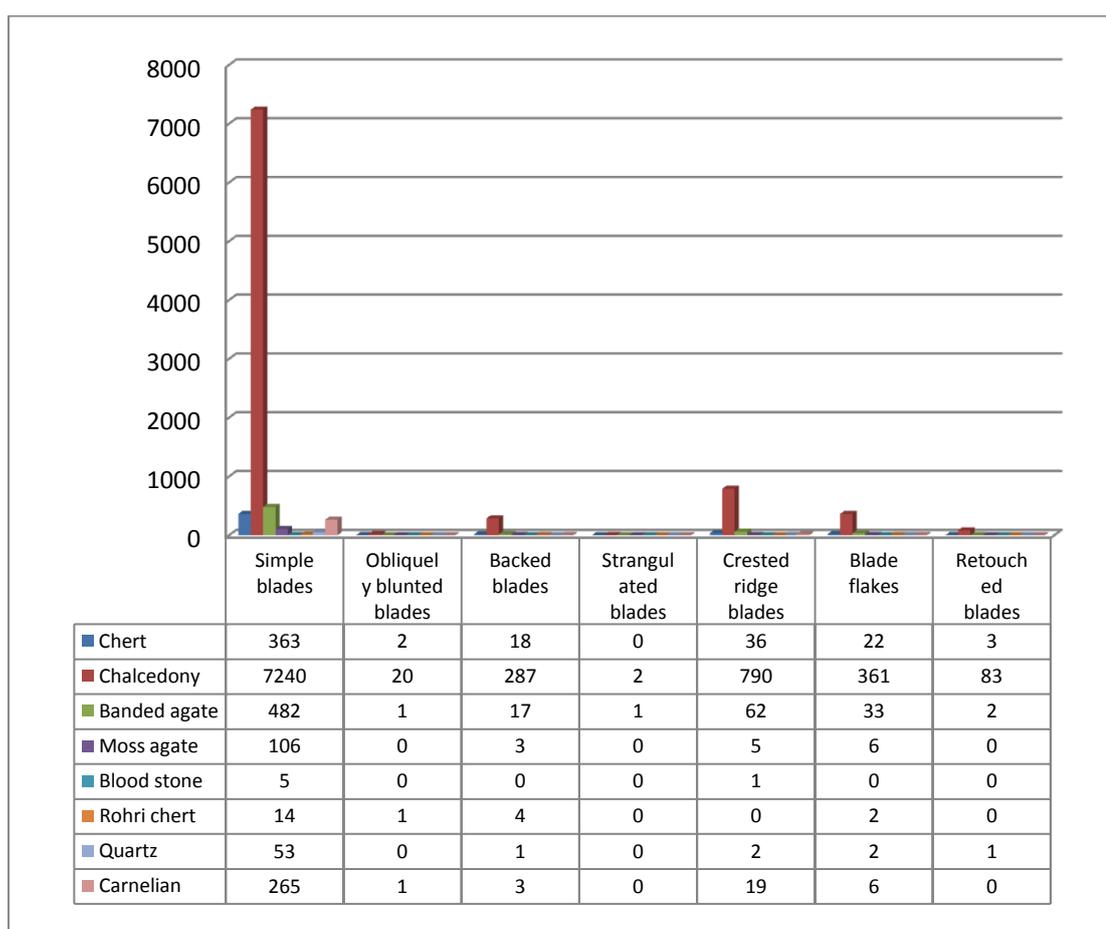


Table 3.28: Layer wise representation of lithic assemblage at Datrana

Condition of the blades

8694 or 84.20% blades are found in broken condition while 1631 or 15.80% are intact blades. Amongst the broken blades majority (4110 blades or 39.81%) were found to be proximally broken blade fragments, 2923 blades (28.31%) of mesial fragments and 1661 (16.09%) distally broken fragments (figure 3.29). It is not uncommon to find detached pieces, such as blades, that have been snapped into several fragments for insertion into a composite tool (Andrefsky 2005: 171). Can we assign this reason for

the large number of broken blades found at the site? Or was it just that they broke while in use and were discarded? Low percentage of intact blades most probably suggests their removal from the site due to trade or barter.

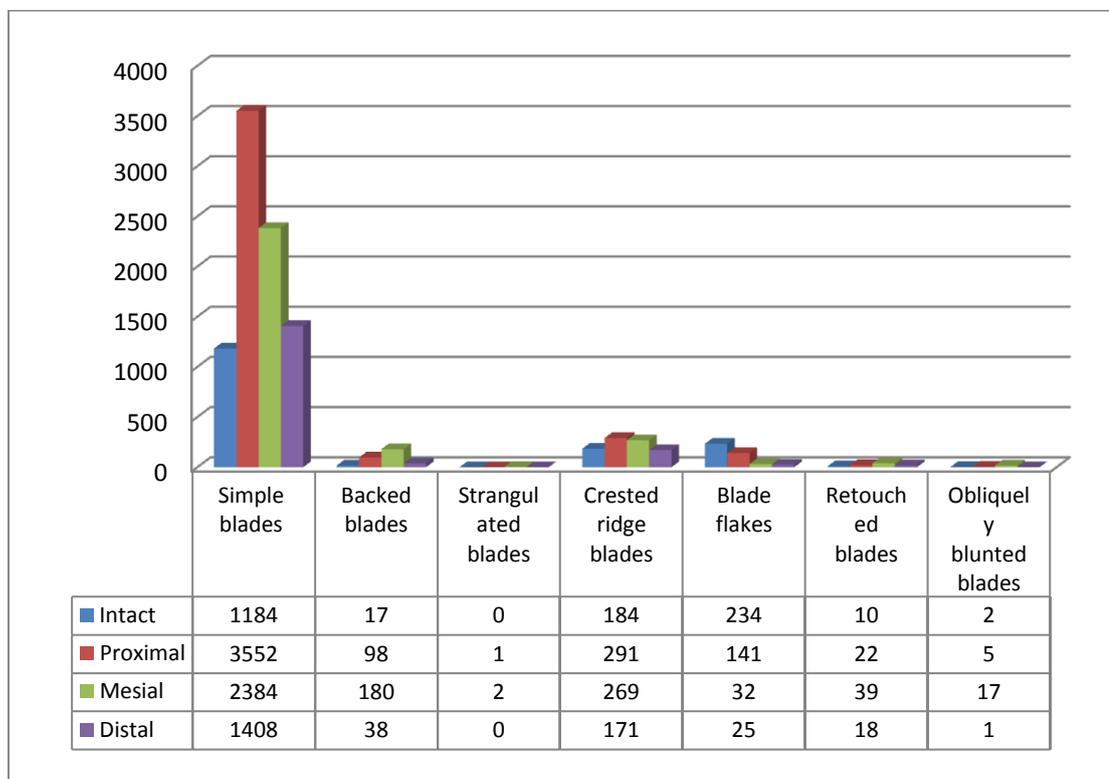


Figure 3.29: Condition of different blades at Datrana

Proximal conditions

Proximal end form

Ten proximal end form categories were noted for all intact as well as proximally broken blades (table 3.37).

Proximal end types

It was found that 49.89% blades showed a ‘multiple’ category for their proximal end type. 37.71% were ‘single’ category which clearly points towards their removal from unidirectional cores (Andrefsky 2005: 164). Very few (0.55%) showed cortex on their proximal ends (table 3.37).

Proximal end shape

Blades/flakes with a diffuse bulb of force and a pronounced lip have been called soft hammer percussion flakes (Crabtree 1972: 74). However not all researchers agree on this. Hard hammer percussion is believed to produce flakes with pronounced bulbs of

force, no lipping, and slightly crushed striking platform areas (Crabtree 1972: 44). Even though soft-hammer and hard hammer flaking techniques produce detached pieces that over-lap in their range of bulb morphology and amount of lipping, these characteristics may be effective discriminators in most cases (Andrefsky 2005: 119). The proximal end attributes seen at Datrana are given in table 3.37.

Table 3.37: Various proximal end categories at Datrana

P E FORM	No	%	P E TYPE	No	%	P E SHAPE	No	%
Rectangular	785	13.78	Single	1836	37.71	Lipped	1595	32.53
Lenticular	1329	23.32	Dihedral	576	11.83	Pointed	2197	44.81
Irregularly lenticular	391	6.86	Multiple	2429	49.89	Bulb-scar	1111	22.66
Triangular	1333	23.39	Cortex/ patina	26	0.53	Total	4903	100.00
Irregularly triangular	866	15.20	Part cortex	1	0.02			
Gull winged	80	1.40	Crushed/snapped	1	0.02			
Semi-circular	78	1.37	Total	4869	100.00			
Irregularly shaped wide platform	8	0.14						
Retouched	77	1.35						
Difficult to see	751	13.18						
Total	5698	100.00						

Platform width and thickness

Only intact platforms were measured for width and thickness values. Looking at the table 3.38 we can say that the proximal width and thickness values do not vary much between different types of blades made out of different raw materials.

Table 3.38: Metrics in mm of platform end width and thicknesses at Datrana

	Mean	Median	Mode	Std dev	Variance
Width	3.75	3.53	3.17	1.3	1.7
Thickness	1.74	1.65	1.8	0.55	0.3

Distal end terminations

Intact blades and distal fragments

Retouched (1522 blades or 46.23%) distal ends were the most common from Datrana. Plunging type of distal end termination was also found in good quantity (1019 blades or 30.95%). Plunging termination has been associated with tool making, especially with blade flaking (Cotteral & Kamminga 1987). The other common distal end termination was ‘feathered’ (553 blades 16.80%). Hinged termination were found to comprise (187 blades or 5.68%) and the rest (11 blades or 0.33%) of the blades showed damage on their distal ends leading to the conclusion that they might have been used from their distal ends (figure 3.30).

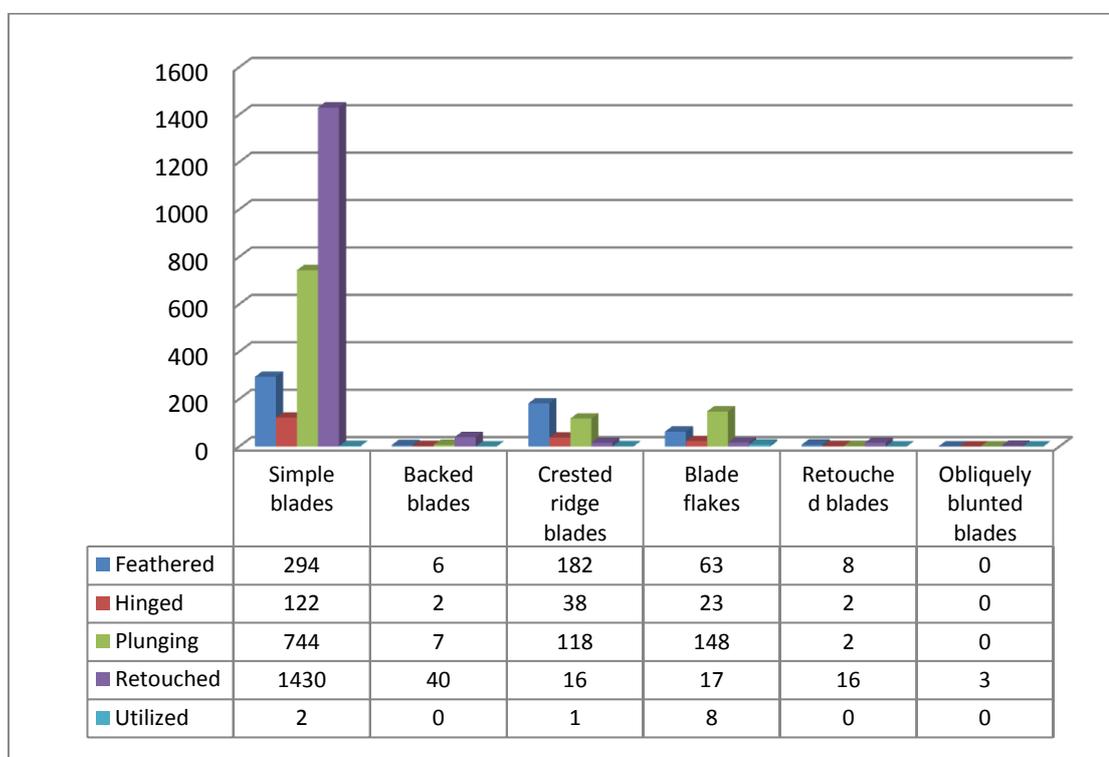


Figure 3.30: Distal end terminations for intact and distal fragments of blades at Datrana

For proximal fragments and mesially broken blade fragments

Amongst blades of these types, 5712 or 81.22% blades were found to have been snapped (figure 3.31). Though whether this was done intentionally is difficult to say. Stepped termination is found in good number (1215 or 17.28%) too. Other type of distal end features such as hinged termination (64 blades), crushed distal end (12), retouched distal end (28), utilized distal end (2) are represented by small percentage of 1.51%.

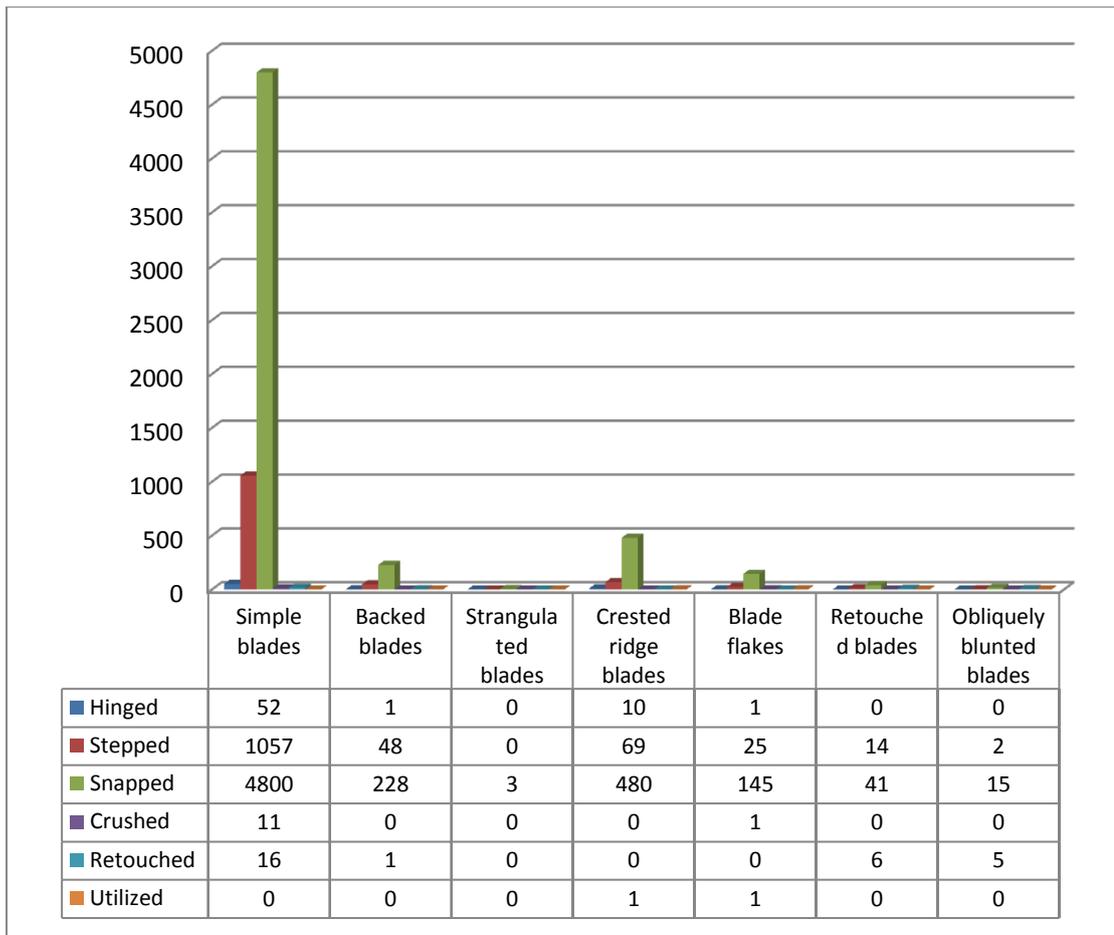


Figure 3.31: Distal end terminations for proximal and mesial blade fragments

Presence of cortex on blades

Amongst all the blades, 9811 or 95.02% blades were found to be devoid of cortex, 380 or 3.68% blades showed less than 10% cortex present on their dorsal side, 82 or 0.79% blades had between 10-50% cortex on their body and only 52 or 0.50% showed more than 50% cortex on their dorsal surface (figure 3.32). Retouching was almost exclusively done on secondary blades.

Edge condition and retouches

It was observed that 6687 or 64.76% blades showed light to heavy edge damage leading to the conclusion that most probably they were utilized at the site (figure 3.33). 752 or 7.28% blades showed evidence of secondary retouches. 2211 or 21.41% blades were found to have been blanks. It was difficult to determine the edge conditions of remaining 1298 or 12.57% blades. Relatively less percentage of blade blanks at the site is not surprising since they would have been traded or bartered. The relative high percentage of utilized blades however is puzzling. 54.51% blades

showed edge damages on their right edges while 48.22% showed edge damages on their left edges. 4.9% blades showed retouches on their right edges while 5.1% showed retouches on their left edges.

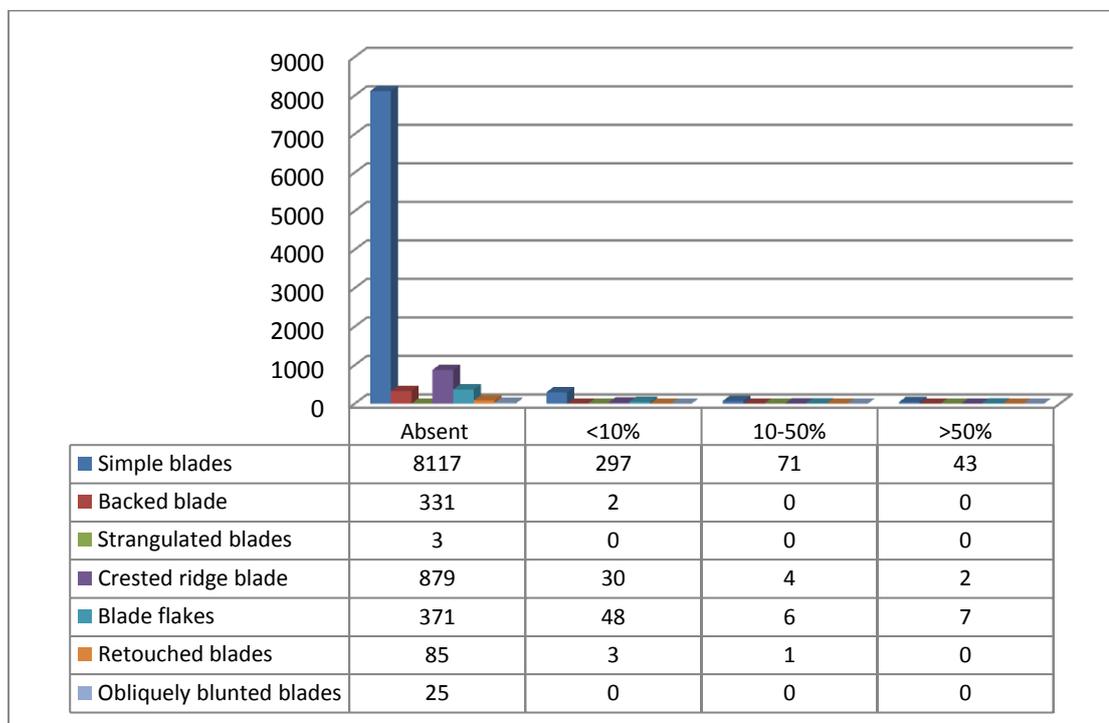


Figure 3.32: Representation of cortex on different blade types at Datrana

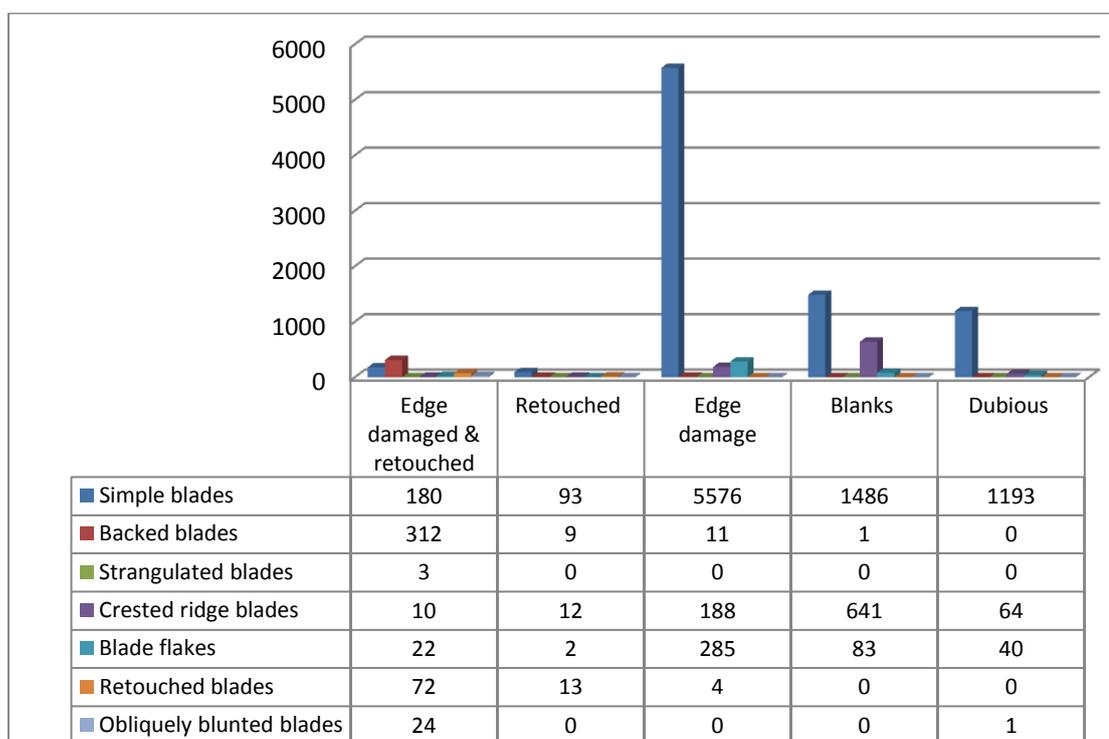


Figure 3.33: Representation of edge condition and retouches of various blades at Datrana

Metric comparison

Different types of intact blades

A separate metric analysis was carried out for blades made of chalcedony since they dominate the assemblage. But it was observed that there was no significant difference between blades made of chalcedony and other raw materials thus finally blades of all the raw materials were taken together for their metric analysis. This metric similarity between raw materials most probably is due to the similar technology of blade removal followed at the site.

Length

High standard deviation values give evidence of the fact that all the blades have a lot of variation in their lengths (table 3.39). The biggest variation was observed in obliquely blunted blades which could be due to the small sample size of this blade type. Blade flakes appear to be the shortest of blades and obliquely blunted blades seem to be the longest blades found from the assemblage.

Table 3.39: Metrics in mm of lengths of various intact blades at Datrana

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	1183	16.44	15.07	12.77	5.58	31.21
Backed blades	17	20.53	20.43	10.19	7.98	63.78
Blade flakes	234	13.71	13.24	10.17	4.81	23.13
Retouched blades	10	15.75	14.67	7.18	6.8	46.38
Obliquely blunted blades	2	22.99	22.99	13.49	13.43	18
Crested ridge blades	184	15.04	14.02	8.38	5.8	33.64

Breadth

Most of the blades do not show a high standard deviation value for their breadths leading to the conclusion that there was standardization in breadths of various types of blades (table 3.40). Backed blades appear to be the narrowest of blades which could be due to their backing. Obliquely blunted blades are the widest blades found.

Thickness

Thickness values of blades also appear to be of standardized size (table 3.41). Simple blades are the thinnest blades amongst all the blades while obliquely blunted blades are the thickest blades to be found.

Table 3.40: Metrics in mm of breadth values of intact blades at Datrana

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	1183	5.53	5.34	4.87	1.36	1.86
Backed blades	17	5.45	5.04	3.04	1.43	2.05
Blade flakes	234	8.03	7.53	6.62	2.64	6.96
Retouched blades	10	7.68	6.62	5.55	2.48	6.16
Obliquely blunted blades	2	8.11	8.11	7.5	0.87	0.75
Crested ridge blades	184	6.46	5.9	5.21	2.43	5.91

Table 3.41: Metrics in mm of thickness values of intact blades at Datrana

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	1183	1.6	1.5	1.08	0.56	0.32
Backed blades	17	1.96	1.68	1.68	0.72	0.53
Blade flakes	234	2.3	2.2	1.39	1.04	1.07
Retouched blades	10	2.58	2.32	1.27	1.35	1.83
Obliquely blunted blades	2	3.1	3.1	1.94	1.65	2.71
Crested ridge blades	184	2.67	2.58	1.84	0.82	0.68

Different types of broken blades

Metric analysis of broken blades was done according to their breakage category. It can be observed from the table 3.42 that except the variation in lengths between categories, the breadths and thickness values are almost uniform.

Table 3.42: Metric analysis of different types of broken blades in mm at Datrana

	Condition of blade	No	Mean	Median	Mode	Std dev	Variance
Length	Proximal	4107	11.92	11.00	10.29	4.39	19.28
	Mesial	2923	9.55	8.82	6.19	3.84	14.76
	Distal	1661	10.88	10.08	9.71	3.86	14.93
Breadth	Proximal	4107	5.99	5.73	5.31	1.66	2.78
	Mesial	2923	5.97	5.77	5.13	1.65	2.73
	Distal	1661	5.52	5.29	4.83	1.51	2.29
Thickness	Proximal	4107	1.83	1.74	1.6	0.65	0.43
	Mesial	2923	1.71	1.58	1.35	0.66	0.44
	Distal	1661	1.61	1.49	1.32	0.62	0.38

Geometric and non-geometric tools

The geometric tools (figure 3.35) found from Datrana include triangles 28 (11.52%), lunates 22 (9.05%) and trapeziums 13 (5.35%) while the non-geometric tools include points 175 (72.02%) (figure 3.35 and figure 3.36) and various types of scrapers such as end scraper(1), side scraper (1), double sided scraper (2) and side and end scraper(1), all together representing 2.05% of this category.

Raw material exploitation

Majority, 201 or 82.72%, of the tools were made out of chalcedony, 17 or 7% out of banded agate, 16 or 6.58% out of chert, 5 or 2.06% out of carnelian, 3 or 1.23% out of moss agate and 1 or 0.41% out of quartz (figure 3.34).

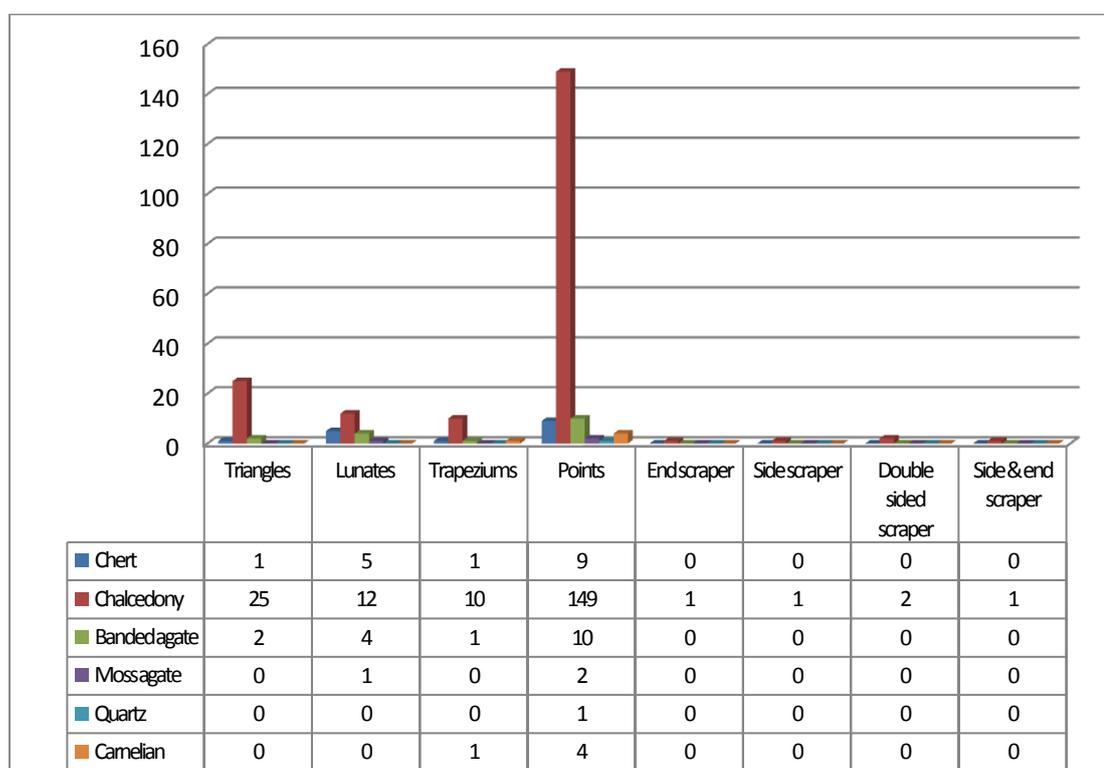


Figure 3.34: Distribution of geometric and non-geometric tools vs raw materials at Datrana

Analysis of geometric and non-geometric tools

Triangles

All the triangles recovered from datrana belong to the category of scalene triangles. 78.57% (22) of these tools were found in intact condition while the rest were found to be broken. All the triangles were made on secondary blades, no trace of cortex was

observed on any of them. 89.29% (25) showed traces of edge damage on their lateral edges, suggesting utilization. 10.71% (3) were found to be without any edge damages leading to the conclusion that they were not utilized and most probably were kept for future use. 53.57% showed edge damages on their right edges while 32.14% showed edge damages on their left edges. More than 60% were found to have been retouched on their left edges. Looking at the table 3.43 it can be said that there is variation in their lengths but they show standardization in their breadths and thickness.

Table 3.43: Metric analysis of triangles in mm at Datrana

	Mean	Median	Mode	Variance	Std dev
Length	15.1	14.78	9.47	13.07	3.62
Breadth	4.93	4.61	2.91	1.45	1.21
Thickness	1.78	1.69	1.99	0.42	0.64

Lunates

Majority (81.82%) of the lunates were found to be in intact condition. 90.91% (20) were made on secondary blades while 9.09% (2) were made on blades with minimal amount (<10%) of cortex present. 95.45% (21) showed presence of edge damages while one lunate was found to be without any edge damage. Here too it was seen that their lengths show variation but breadths and thickness values are standardized (table 3.44).

Table 3.44: Metric analysis of lunates in mm at Datrana

	Mean	Median	Mode	Variance	Std dev
Length	14.15	13.09	8.34	13.83	3.72
Breadth	5.53	5.46	3.37	1.5	1.22
Thickness	2.36	2.21	2.24	1.01	1.00

Trapeziums

69.23% (9) tools of this category were found in intact condition while the rest, 30.77% (4) were broken fragments. Majority (92.31%) were found to have been made on secondary blades while 1 specimen showed presence of cortex (>10%) on its surface. This shows, contrary to popular belief that formal tools were not exclusively being made out of secondary blades. However, this particular tool was found to be

devoid of any edge damages suggesting that it was not utilized. Maximum number of tools (12) showed edge damages, most probably they were utilized. Trapeziums show variation in their lengths as well as their breadths (table 3.45). The thickness appears to be uniform.

Table 3.45: Metric analysis of trapeziums in mm at Datrana

	Mean	Median	Mode	Variance	Std dev
Length	11.45	10.34	8.39	12.18	3.49
Breadth	6.15	5.7	3.68	5.22	2.29
Thickness	1.97	1.73	2.2	0.86	0.93



Figure 3.35: Geometric tools and points from Datrana (courtesy: NoGAP)

Points

Maximum (175) numbers of tools of non-geometric variety were found be points. Majority (74.29%) of these tools were found in broken condition. Most of the points were made out of secondary blades/flakes but a few (4%) were found to have minimal presence of cortex. 23.43% tools showed no signs of edge damage and were not

utilized, all the other points were heavily used. Since majority of the tools were found in broken condition, metric analysis has been divided into two categories comprising intact points and broken points. As can be seen from the table 3.72, intact as well as broken points show a lot of variation in their lengths (table 3.46). The breadth values on the other hand are also varied but follow a pattern in both the categories. Some amount of standardization, however, can be seen in thickness values, especially for broken points.

Table 3.46: Metric analysis of points in mm at Datrana

		Mean	Median	Mode	Variance	Std dev
Intact points	Length	16.99	15.68	5.94	35.48	5.95
	Breadth	6.02	5.64	5.16	6.51	2.55
	Thickness	2.46	2.14	1.53	1.6	1.27
Broken points	Length	12.28	11.06	9.94	30.68	5.53
	Breadth	5.01	4.44	2.83	4.89	2.21
	Thickness	1.86	1.72	1.09	0.68	0.83

End scraper

A single specimen belonging to this category was found amongst the tools. It was in intact condition and did not have any cortex. Looking at the edge damages, it has been assumed that it was most probably utilized. The measurements of this tool are as following: 15.02mm length, 12.42mm breadth and 2.55mm thickness.

Side scraper

A single example was found of a tool of this category. This is a broken piece, a mesial fragment devoid of any cortex. It was observed that it had retouches on the right edge while the left edge most probably was utilized. This scraper was found to be the longest, broadest and thickest amongst all the scrapers. The measurements of this tool are as following: 33.19mm length, 18.88mm breadth and 10.48mm thickness.

Double sided scrapers

Two examples were found of this category. One was found in intact condition while the other was broken. The intact scraper was made on a secondary flake while the broken scraper was made on a primary flake. After a close examination of the edges it

was seen that the intact scraper most probably was not utilized while the broken scraper showed evidence of utilization. The intact scraper was longer and broader than the broken one (19.03mm length, 14.00mm breadth, 3.68mm thickness), while the broken scraper was seen to be thicker than the intact scraper(14.43mm length, 10.16mm breadth and 4.34mm thickness).



Figure 3.36: Points from Datrana (courtesy: NoGAP)

Side and end scraper

A single tool of this category has been found. It was in intact condition and was made on a secondary flake. Edge examination showed that this scraper was most probably

utilized. It had retouches on the right edge and at distal end. Use marks were observed on the left edge of the tool. The measurements of this tool are as following: 24.21mm length, 13.75mm breadth and 3.73mm thickness

Lithic debitage

The lithic debitage (figure 3.37) recovered from the site includes primary and secondary flakes 45173 (78.30%), 631 nodules (6.21%), cores (0.87%), core rejuvenation flakes 27 (0.87%) and waste/shatter 30927 (13.76%).

Raw material exploitation

Raw materials are represented by chalcedony 62443 (41.80%), banded agate 4013 (19.74%), carnelian 7562 (18.42%), chert 2541 (15.79%), moss agate 125 (2.19%) and quartz 71 (1.19%). Other raw materials such as blood stone (2), Rohri chert (1), sandstone (10), amazonite (14), quartzite (2) and calcite (3) altogether were represented by 0.86%.

Flakes

45,319 flakes were recovered from the excavation. 19741 or 43.56% were found intact while 25578 or 56.44% were found in broken condition. Out of the total flakes found, 15873 or 35.03% were primary flakes (with different quantities of cortex) while the rest 29446 or 64.97% were secondary flakes (without cortex). Amongst the intact flakes 7631 or 38.65% were primary flakes while 12110 or 61.34% were secondary flakes. It was further observed that in the proximal fragments 8234 or 32.21% flakes showed varying amount of presence of cortex while 17328 or 67.79% flakes were devoid of cortex making them secondary flakes. Flakes of different raw materials such as chalcedony, chert, banded agate, moss agate, quartz and carnelian show presence of different amount of cortex, confirming that they were being worked at the site. None of the flakes in lithic debitage category show any sign of retouches or utilization marks. Flakes were categorized according to their size in cm while taking into account their condition. Most of the flakes were either found in intact condition or in proximal condition. It was observed that most of the flakes either intact or proximal fragments were very small (figure 3.38). Amongst the intact flakes 11186 or 56.65% of flakes belong to the size category of 0.5-1cm, 5965 or 30.22% to 1-1.5cm, 364 or 1.85% to 0-0.5cm and 1617 or 8.19% to 1.5-2cm. Very few flakes 212 or

(1.07%) of sizes 3cm or up were found from the assemblage. While amongst the proximal fragments it was observed that 16164 or 63.23% flakes belonged to the category of 0.5-1cm, 4449 or 17.40% flakes.

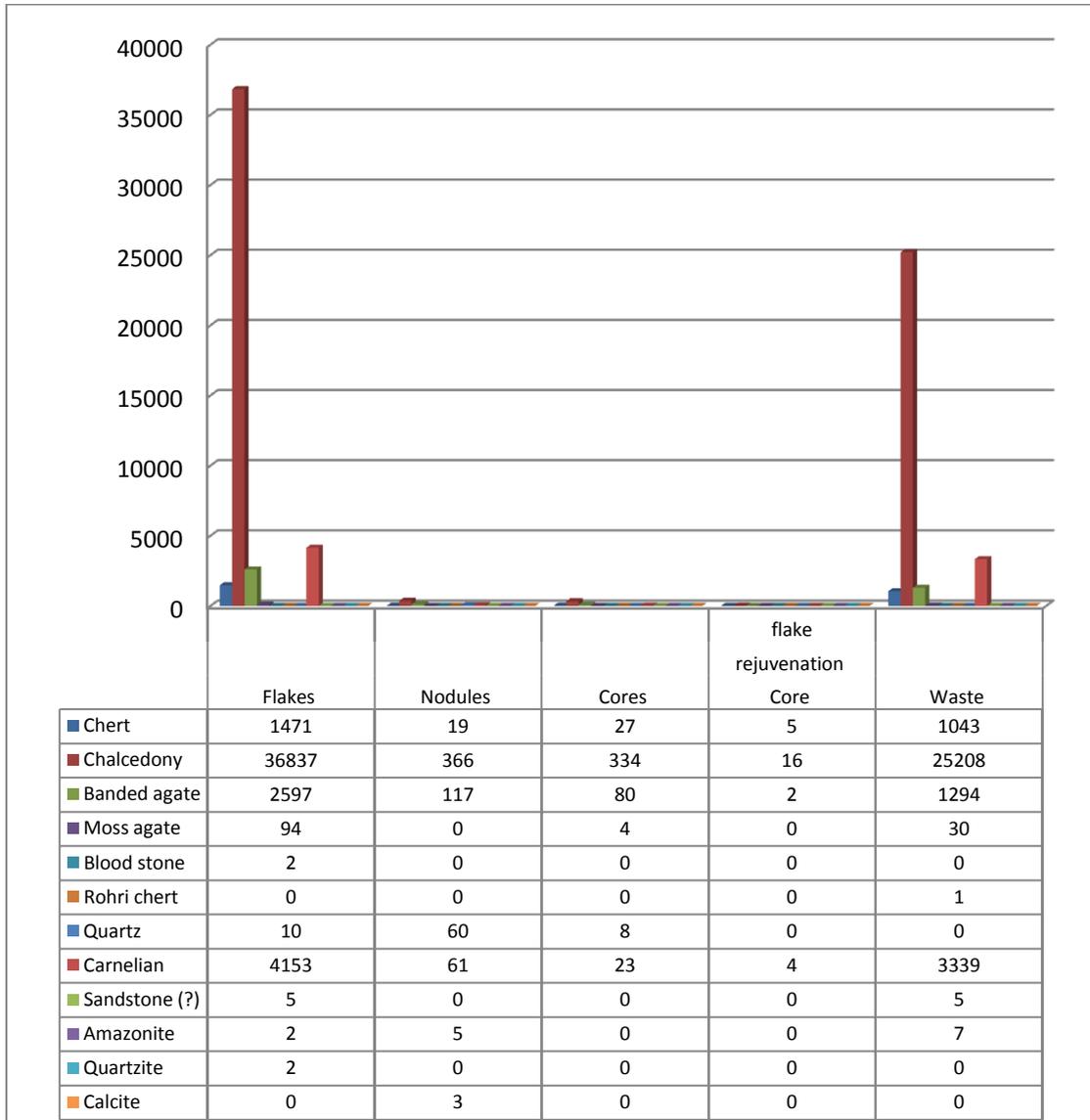


Figure 3.37: Distribution of lithic debitage according to raw materials at Datrana

to the category of 1-1.5cm, 4083 or 15.97% flakes to the category of 0-0.5cm and 690 or 2.7% flakes to the category of 1.5-2cm. Only 176 or 0.68% proximal fragments belonged to 2.5cm and above (figure 3.38).

Nodules

485 nodules belonging to various raw materials were found from the lithic assemblage. Majority of the nodules were found either in broken condition 332 or

(68.45%) or were randomly flaked 87 or (17.94%). Very few 66 or (13.61%) nodules were found intact. Raw materials (figure 3.39) include 220 nodules of chalcedony (45.36%), 117 nodules of banded agate (24.12%), 61 nodules of carnelian (12.58%), 60 nodules of quartz (12.37%), 19 nodules of chert (3.92%), 5 nodules of quartzite (1.03%) and 14 nodules of calcite (0.62%). Most of the nodules 470 or (96.9%) were found with good amount of cortex present on their surface. Nodules without any amount of cortex were very few 15 or (3.09%).

Here it should be mentioned that a small stock-pile of carnelian nodules from the southeast corner of the trench was revealed during excavations. 654 nodules were arranged in this pile, 130 were in intact condition while 524 were found either in broken condition or showed preliminary flaking. The nodules are irregular in shape and their size varies considerably. All of them, however, were heat treated and were found in different shades of reddish carnelian. This suggests that they were essentially meant for bead production (Ajithprasad et al 2010). These nodules have not been included in this study.

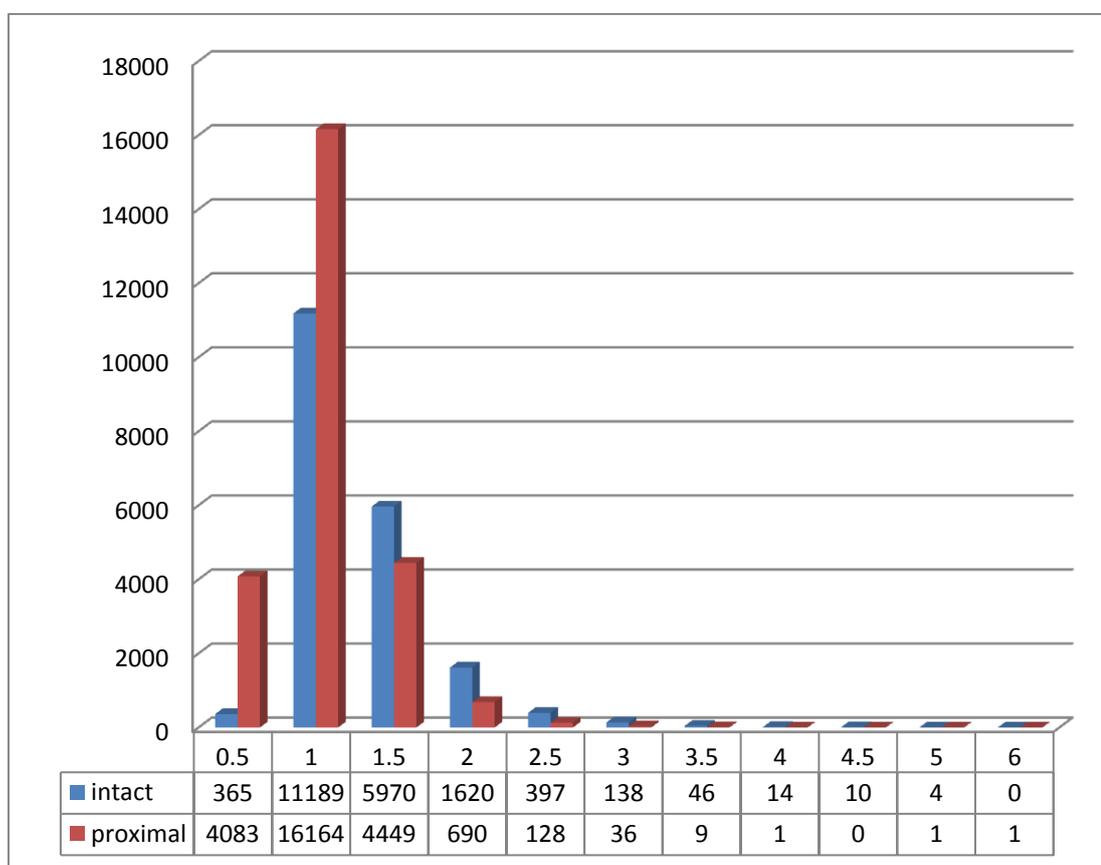


Figure 3.38: Size wise representation of intact and proximal fragments of flakes at Datrana

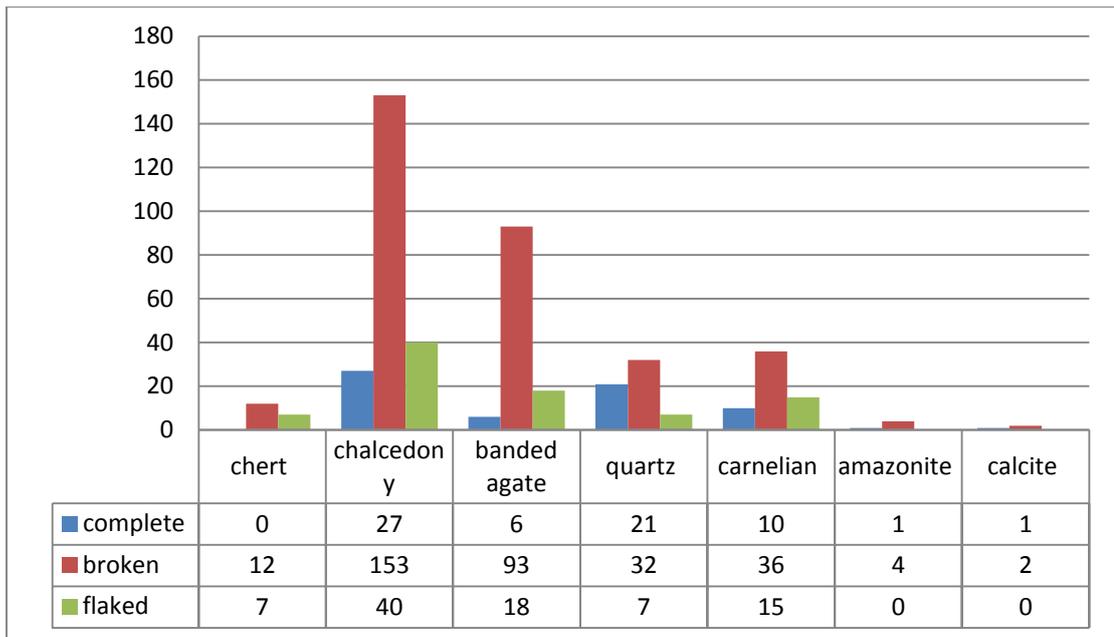


Figure 3.39: Representation of nodules vs raw materials at Datrana

Core rejuvenation flakes

27 core rejuvenation flakes were recovered from the assemblage. They belong to raw materials chalcedony (16 or 59.26%), carnelian (4 or 14.81%), chert (5 or 18.52%) and banded agate (2 or 7.41%). 22 or 81.84% were found in intact condition while 5 were found to be broken. Most (20 or 74.07%) were devoid of cortex while 7 showed the presence of cortex on their surface. Banded agate core rejuvenation flakes were found without any cortex while all the others showed some amount of cortex present. Only intact core rejuvenation flakes were further analyzed. Their metric analysis is as presented below. It can be seen from the table 3.47 that core rejuvenation flakes of chert are very broad and have a lot of variation in their breadths than their lengths and thicknesses which in turn are found to be of standard size. The core rejuvenation flakes of chalcedony do show variation in their lengths but are less varied in their breadths and thicknesses. The core rejuvenation flakes of banded agate follow the pattern of chalcedony. The core rejuvenation flakes of carnelian are found to be of very standardized size.

Waste/shatter

A considerable amount of lithic debitage comprises of this category. As expected the highest number of waste/shatter belongs to raw material chalcedony. 81.51% (25208 fragments) waste comprises of this raw material. Carnelian is represented by 10.80%

(3339 fragments), banded agate by 4.18% (1294 fragments), chert by 3.37% (1043 fragments) and the rest, moss agate, rohri chert, sandstone and amazonite, are represented by 0.14% (43 fragments). Figure 3.40 represents presence of cortex on different raw materials.

Table 3.47: Metric analysis of core rejuvenation flakes in mm at Datrana

Raw materials	No		Mean	Median	Mode	Std Dev	Variance
Chert	3	Length	7.8	7.92	6.4	1.13	1.27
		Breadth	11.99	13.36	12.49	6.75	45.64
		Thickness	3.25	3.06	2.16	1.15	1.33
Chalcedony	14	Length	12.73	15.37	10.3	4.61	21.29
		Breadth	9.32	6.88	10.98	2.86	8.22
		Thickness	4.93	5.62	2.06	2.1	4.41
Banded agate	1	Length	13.39				
		Breadth	7.17				
		Thickness	3.7				
Carnelian	4	Length	11.06	11.48	10.12	0.82	0.67
		Breadth	9.38	7.49	11.49	2.00	4.03
		Thickness	4.05	4.36	2.87	1.05	1.11

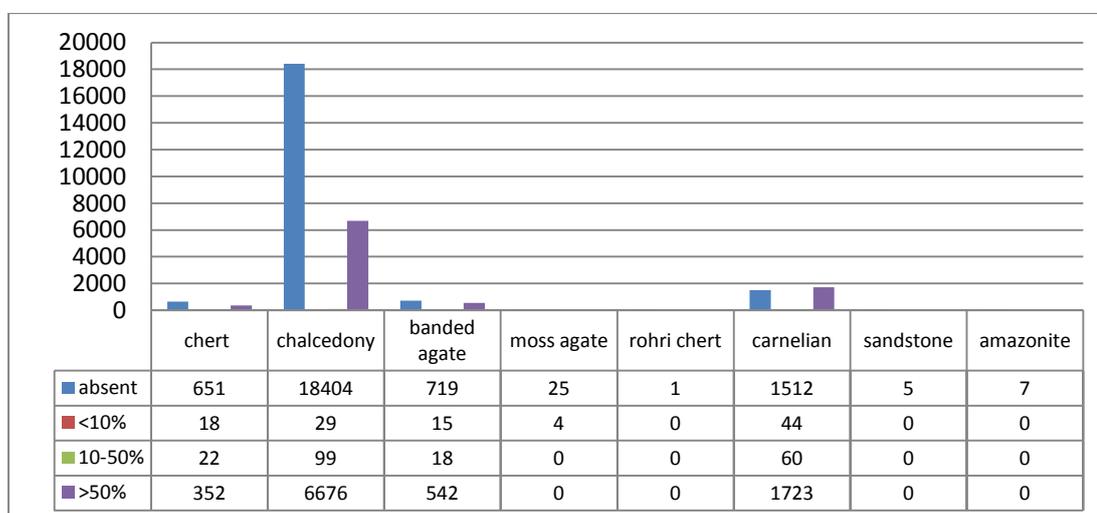


Figure 3.40: Cortex vs raw materials for waste/shatter at Datrana

Cores

A total 474 cores (figures 3.43, 3.45 and 3.46) were recovered from this solitary trench. 27 were found in broken condition and thus no in-depth analysis was done for them. 447, however, were found in intact condition and different features were recorded for them.

The broken cores

Almost half (14) of the fragments were found to be distal ends of cores. 3 fragments were of proximal ends and the rest were broken fragments of no particular distinction (figure 3.41).

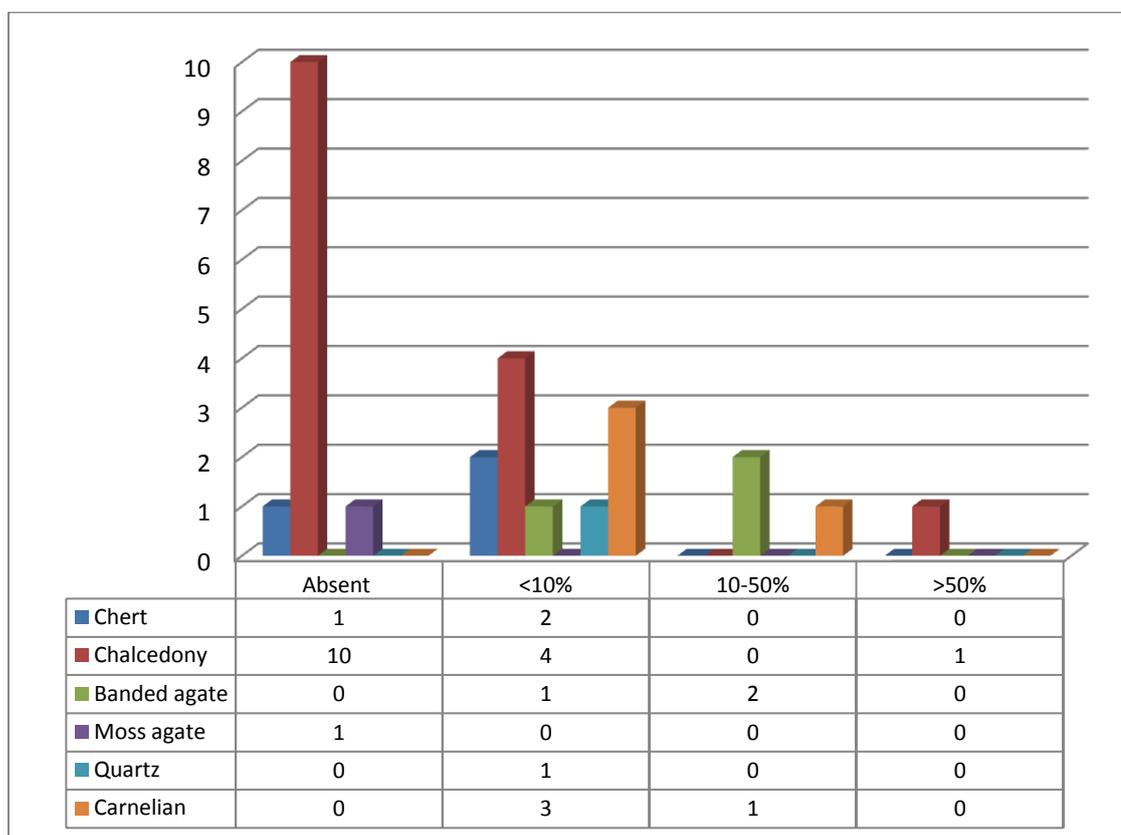


Figure 3.41: Representation of cortex on broken cores at Datrana

Intact cores

Intact cores were subdivided into 4 categories: blade cores, flake cores, core cum scrapers and proto blade cores. 433 (96.87%) cores fall into the first category of blade cores, 7 (1.57%) into the second category of flake cores, 3 (0.67%) into the third category of core cum scraper and 4 (0.89%) were found from the fourth category of proto blade cores from the site (figure 3.42).

Core shape

Amongst the blade cores, 203 (46.88%) were found to be of cylindrical shape, 133 (30.72%) of semiconical shape, 38 (8.78%) of wedge shape, 34 (7.85%) of conical shape, 9 (2.08%) of block shape, 8 (1.85%) of amorphous shape and 8 (1.85%) flat shaped.

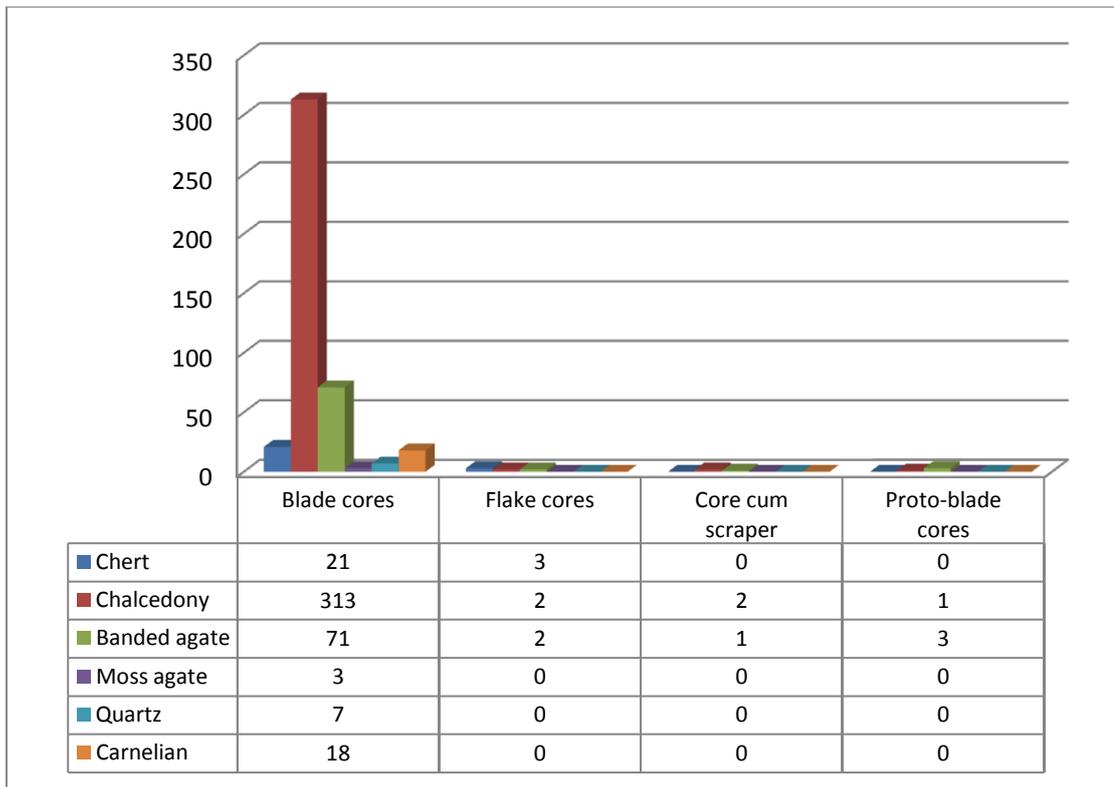


Figure 3.42: Representation of intact cores according to raw materials at Datrana

It was observed for the flake cores that majority (71.43%) of them were amorphous in shape. However, one was found to have a wedge shape and one had a semi-conical shape.

Blade removal pattern and blade removal direction

Amongst blade cores, 292 (67.59%) were found to have been ‘sliced’, 128 (29.63%) were ‘rotated’ and 11 (2.55%) were flaked randomly. 369 (85.42%) cores were flaked unidirectionally, 52 (12.04%) cores were flaked bidirectionally and 11 (2.55%) cores were flaked in multiple direction.

Flexible flake removal was observed for majority (85.71%) of the flake cores. One flake core however showed the sliced way of flake removal. As to the direction of flake removal it was observed that majority of the cores (85.71%) showed multipliedirection of flake removal while one core showed bidirectional flake removal.

Core platform preparation and platform count

Among the blade cores, 291 (67.21%) core platforms were found to have tiny multiple flakes removed to prepare the platform, 53 (12.24%) core platforms showed

the removal of a single flake to prepare the platform, 45 (10.39%) platforms were found in broken condition and 44 (10.16%) platforms do not show any preparation. 348 (86.57%) cores showed a single platform, 48 (11.94%) showed presence of two platforms while multiple platforms were seen on 6 (1.49%) cores.

Flake cores showed no preparation of platform most of the time. In one instance it was seen that the platform was prepared by removing a single flake. Majority of the cores (71.43%) showed presence of multiple platforms, most of the time, more than three. However, two cores differ in this aspect where in one only two platforms were observed while the other showed presence of three different platforms.

Presence of cortex

It was found that majority of the blade cores had some amount of cortex present on their surface. Maximum amount of cortex was found on semi-conical cores, most of the time back of this particular core type was covered fully with cortex. Majority (76) of the cylindrical cores were found to have been without any cortex (figure 3.46).

All the flake cores showed presence of cortex on their surface. Half of the cores (57.14%) showed less than 10% of cortex on their surface while the other half showed between 10-50% cortex on their surface.

Preparation of the back and potential cause of discard

It was found that amongst the blade cores of Datrana, a crest at the back of the core was the most common (20.55%) feature. By observing the proto-blade cores, we know that the cores were prepared by creating multiple crested ridges on them. 89 cores show presence of these ridges on their surface. The next most frequent (19.63%) feature is either the random removal of flakes from the back or presence of diagonal flakes which represent rotation of a core. 19.40% cores showed back which were totally unprepared and showed presence of cortex. 11.55% cores showed presence of regular negative blade removal scars from their backs, this was seen specially in rotated cores such as conical and cylindrical.

Flake cores either showed cortex at the back or showed negative flake scars on the back side of the core. It was observed the flake cores were discarded either because they had become exhausted or were discarded due to raw material faults.



Figure 3.43: Blade cores from Datrana I (courtesy: NoGAP)



Figure 3.44: Blade cores from Datrana II (courtesy: NoGAP)



Figure 3.45: Cores showing remaining crests (courtesy: NoGAP)

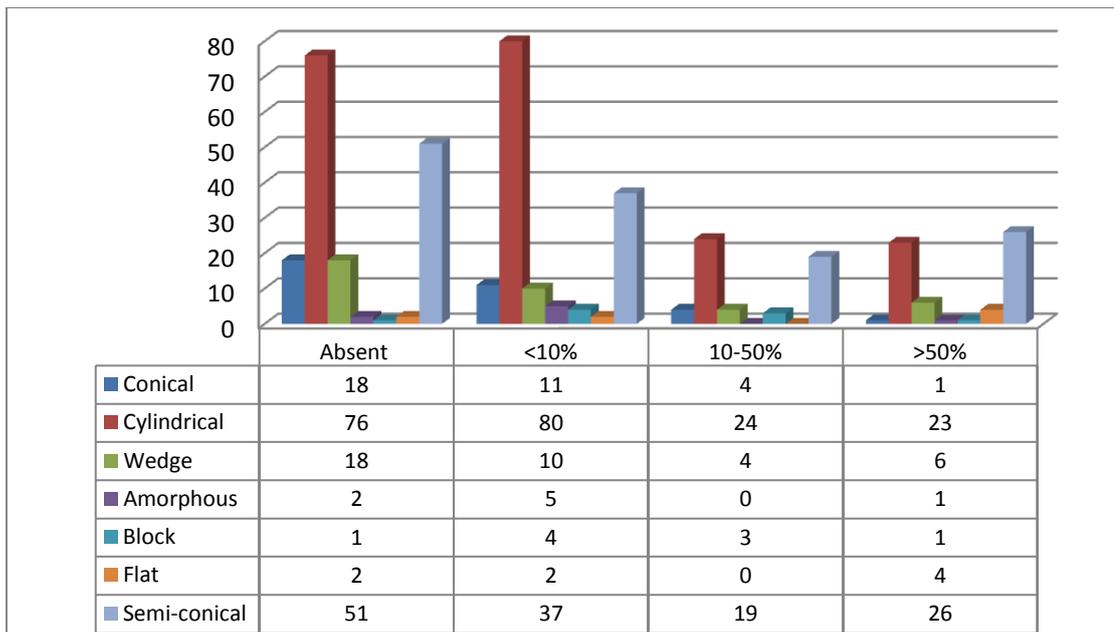


Figure 3.46: Representation of cortex on blade cores at Datrana

Metric analysis

Blade cores

The table 3.48 represents the metric analysis of blade cores according to their shape. Lengths of all the category of cores show a lot of variation while thickness values seem to be the least varied, except in the category of block cores.

Table 3.48: Metric analysis of blade cores in mm at Datrana

Core shape		Mean	Median	Mode	Std dev	Variance
Conical	Length	19.67	17.29	15.71	7.06	49.85
	Breadth	14.24	13.41	9.27	3.47	12.04
	Thickness	9.51	9.17	11.00	2.57	6.61
Cylindrical	Length	21.67	19.93	19.93	7.21	52.02
	Breadth	14.84	14.9	14.9	3.39	11.49
	Thickness	9.65	8.95	5.30	3.52	12.40
Wedge	Length	18.29	18.51	19.1	4.03	16.31
	Breadth	15.18	15.45	15.19	3.09	9.58
	Thickness	10.88	9.81	7.74	3.69	13.63
Amorphous	Length	17.44	17.08	10.14	5.18	26.8
	Breadth	16.69	16.94	12.68	2.45	5.98
	Thickness	11.49	11.72	8.16	2.72	7.42
Block	Length	20.25	19.64	7.49	11.89	141.52
	Breadth	16.41	14.69	11.93	5.01	25.11
	Thickness	11.65	10.78	4.83	6.12	37.44
Flat	Length	14.55	14.86	9.69	4.61	21.24
	Breadth	13.53	13.52	8.09	3.29	10.82
	Thickness	8.11	7.06	5.64	2.66	7.09
Semi-conical	Length	23.29	21.24	13.34	7.87	62.06
	Breadth	14.74	14.79	13.53	2.99	8.98
	Thickness	9.47	9.17	8.63	2.54	6.46

Flake cores

As can be seen from the table 3.49, flake cores vary significantly in their sizes.

Core cum scrapers

Three cores, after blade removal, were further utilized as scrapers. Retouches and edge damages on their sides and in one instance on its distal end classifies them in this category. Two were classified as side scrapers while one was an end scraper. Two were made out of chalcedony while one was made out of banded agate. All three were semi-conical in shape. It was observed that blades were removed in rotation style

from two of the cores while one showed sliced blade removal pattern. All three showed unidirectional blade removal. All three showed single platforms. Two platforms were found to have been in broken condition while one was prepared by removal of multiple flakes. Two cores were found to have been without any cortex while one showed significant (10-50%) presence of cortex. One core showed a crested ridge at the back while the other two showed the presence of negative blade scars. It was observed that these core cum scrapers do not vary much in their sizes (table 3.50).

Table 3.49: Metric analysis of flake cores in mm at Datrana

	Mean	Median	Mode	Std dev	Variance
Length	23.65	24.48	14.82	6.59	43.46
Breadth	22.02	16.11	14.54	10.26	105.4
Thickness	13.75	11.78	6.9	6.05	36.59

Table 3.50: Metric analysis of core cum scrapers in mm at Datrana

	No	Mean	Median	Mode	Std dev	Variance
Length	3	15.64	15.6	15.47	0.2	0.04
Breadth		15.34	16.05	13.12	1.96	3.87
Thickness		5.98	6.69	4.21	1.55	2.39

Proto blade cores

One of the most significant discoveries was finding these blade cores (figure 3.47). These were found during the surface explorations but since they provide very important information they have been included here. A total four of these cores were found. Three belong to the raw material banded agate while one is made out of chalcedony. Shapes include two cores in the category of a 'block', one core of 'wedge' and one core of 'semi-conical' shape. High presence of cortex (>50%) was seen on all the cores. The platforms were prepared by removing multiple tiny flakes. Three crested ridges were prepared on three cores while the fourth core showed presence of four crested ridges. Other than preparing the crested ridges, no further flake/blade removal was undertaken on these cores. A closer examination revealed raw material flows, such as the presence of quartz crystals at the centre of the nodule,

most probably due to which the cores were not utilized further for blade removal. Separate metric analysis was conducted for both the raw materials (table 3.51).

Table 3.51: Metric analysis of proto blade cores in mm at Datrana

Raw materials	No		Mean	Median	Mode	Std dev	Variance
Banded agate	3	Length	44.94	43.99	40.5	4.99	24.95
		Breadth	25.33	26.03	21.29	3.74	13.98
		Thickness	23.22	22.8	17.8	5.64	31.83
Chalcedony	1	Length	25.92				
		Breadth	19.17				
		Thickness	14.28				

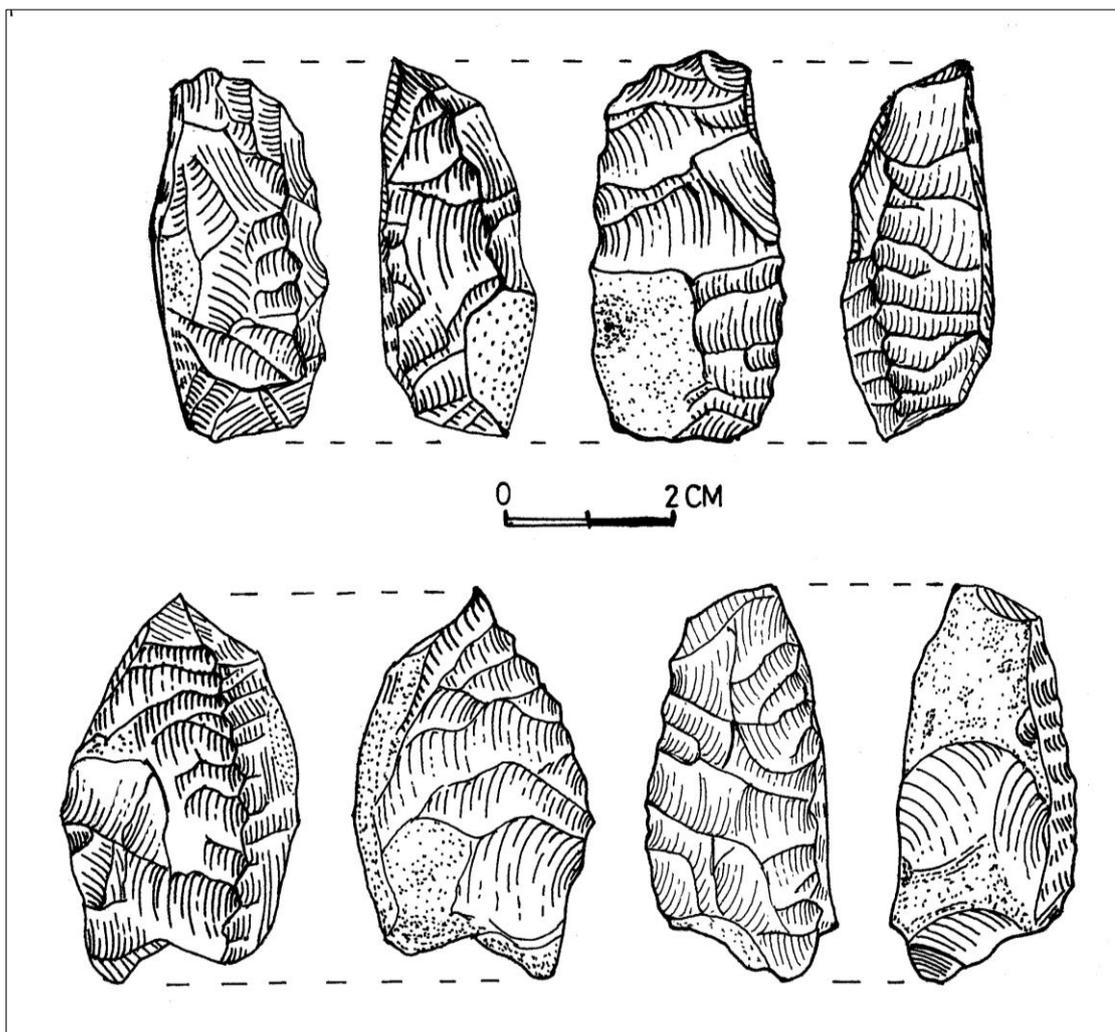


Figure 3.47: Proto blade cores from Datrana (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda, Vadodara)

Summary

The Chalcolithic period lithic assemblage recovered during the field season of 2009-10 from Datrana is represented by blades (10,325), geometric and non-geometric tools (243) and lithic debitage (77,235). Simple blades, utilized as well as unutilized, are the main category of blades found amongst the blade assemblage. Retouched blade types are very few in number. Crested ridge blades represent 8.86% of blade assemblage. Blade raw materials are dominated by Chalcedony, and it was exploited most to make different types of blades. Banded agate, chert, carnelian and moss agate are the other raw materials which show significant representation. Blades made out of Quartz, Rohri chert and blood stone together represent less than 1% of the blade assemblage. The maximum numbers of blades were represented by their proximal ends, closely followed by mesial fragments. The proximal end forms were mostly found to be 'triangular', 'lenticular', 'rectangular' and 'difficult to see or identify'. Proximal end types were mostly found to be 'multiple', closely followed by 'single'. Proximal shape was dominated by 'pointed' category but 'lipped' and 'bulb-scar' were well represented too. It was observed that proximal width and thickness values were more or less standardized. It was observed for intact and distal fragments of blades that their distal end terminations showed characteristics of 'retouching', closely followed by 'plunging' type of termination. It was seen amongst broken blades that they broke in a clean way while stepped termination was also evidenced. Majority of the blades (95.02%) showed no evidence of cortex. 64.76% blades showed evidence of edge damage and thus these blades appear to have been utilized. 21.41% blade blanks were found. 7.28% blades were retouched as well as utilized and it was further observed that the retouching was most of the time carried out on the right edges of the blades. Length values of intact as well as broken blades show a lot of variation while the breadth and thickness was found to have been comparatively standardized.

Points dominate the non-geometric tool category at Datrana. They represent 72.02% of this category. The geometric tools (triangles, lunates and trapeziums) made up 25.92%. Very few (2.05%) scrapers were found from the site. The tools of this category were made out of chalcedony (82.72%), followed by banded agate (7%), chert (6.58%), carnelian (2.06%), moss agate (1.23%) and quartz (0.41%).

All the triangles belong to the category of scalene triangles. Majority (78.57%) were found intact. All were made on secondary blades and most probably were utilized. Their lengths vary but breadth and thickness show similar values. Majorities (81.82%) of the lunates were found in intact condition and were made on secondary blades. Their measurements follow the pattern of triangles. Trapeziums follow the same pattern for condition as that of triangles and lunates. They showed variation in their lengths and breaths, thickness was standardized. Majority (72.29%) of the points were found in broken condition. Lengths and breadth values vary a lot while some amount of standardization was observed in their thickness values. All afore mentioned tools, though in a very minor percentage, showed being made out of primary blades. This is something generally not observed in geometric tools. Could this be due to the nature of this site?

An intact end scraper, a broken side scraper, double sided scrapers belonging to both the conditions, and an intact side and end scraper make up the scrapers found from the site. All of these were made out of chalcedony. The side scraper was the longest, broadest and thickest amongst all the scrapers which were found. Most of the scrapers seem to have been utilized.

Lithic debitage at the site was divided into categories of flakes (primary, secondary, core rejuvenation), nodules, cores and waste/shatter. Flakes comprise main bulk of the lithic debitage assemblage at almost 60%. Amongst the flakes 34.82% flakes were found to be primary flakes with varying amount of cortex on their dorsal side. 43.38% flakes were found intact while 56.63% flakes were found in broken condition. All the flakes were found without any utilization marks or retouching. Size frequency of flakes (primary and secondary flakes) showed that maximum number of flakes belonged to the size category of 0.5-1cm (60.56%) followed by 1-1.5cm (23.06%). Very few flakes (0.58%) of sizes 3cm or up were found from the assemblage.

Complete nodules were very few in number; mostly they were found either broken or randomly flaked. Core rejuvenation flakes belonged to raw materials chalcedony, carnelian, chert and banded agate. Banded agate core rejuvenation flakes were found without any cortex while all the others showed some amount of cortex present. Waste/shatter comprised almost 40% of the lithic debitage recovered from the site.

Majority of cores found from the assemblage belong to the category of blade cores. Cylindrical followed by conical shape was the most common shape amongst blade cores. Blades were removed out of these cores by 'slicing' them unidirectionally. Most of the blade cores had showed removal of tiny multiple flakes to prepare the platform. Cortex was found to be present on almost all the cores. Amongst the blade cores of Datrana, a crest at the back of the core was the most common (20.55%) feature. Lengths of all the different blade cores showed variation while the thickness values were found to be standardized. Flake cores on the other hand showed variation in their measurements. Three cores were found to have been further utilized as scrapers. One of the most significant discoveries from the site was of four proto blade cores. These type of cores are generally not found from a site. The only other recorded proto-type core is from Mohenjo-daro (Cleland 1977). The discovery of these cores indicates that such cores made use of multiple initiation ridges. It can also indicate that cores dressed in this way might have been easier to transport.

SHIKARPUR (Urban Harappan)

The lithic assemblage at Shikarpur comprises of 736 blades, 33 geometric and non-geometric tools and 4,460 fragments of lithic debitage including exhausted cores. As discussed earlier, Shikarpur has been excavated for seven field seasons. More than 80 trenches have been excavated during this time. A trench-wise distribution of lithic assemblage is presented here first in table 3.52 to show the distribution of lithics across site.

We can see from the table 3.52 that 46.2% of lithic assemblage belongs to trenches (Er10, Er13, Er14, Er2, Er5, Er6, Er9, Ew2, El16, Em11, Em12, Em13, Em15, Em16) which are situated almost at the center of the fortification (figure 3.48).

A lot of trenches had been opened to see the extent of the fortification wall. It was observed that trenches which fall exactly on the fortification wall have produced, as expected, very little artefacts. Altogether they have about 3% lithic assemblage. About 9.2% of lithic assemblage was recovered from trenches which form partial part of the fortification. Trenches which are situated outside the fortification have about 12.3% lithic assemblage. It should also be kept in mind that not all trenches were excavated till natural soil. Thus the volume of earth removed varies from trench to trench.

Table 3.52: Trench wise distribution of lithic assemblage at Shikarpur

Trench	No.	Percent	Trench	No.	Percent	Trench	No.	Percent
Dj11	46	0.90%	Er2	68	1.30%	Hc10	24	0.50%
Dj12-Ef9	2	0.00%	Er5	183	3.50%	Hc10/11	18	0.30%
Dj15	22	0.40%	Er6	123	2.40%	Hc11	21	0.40%
Do14	30	0.60%	Er9	142	2.70%	Hc14	4	0.10%
Do15	4	0.10%	Es2	3	0.10%	Hc15	7	0.10%
Do16	15	0.30%	Es3	76	1.40%	Hc2	168	3.20%
Do3	10	0.20%	Es4	173	3.30%	Hc3	12	0.20%
Do7	28	0.50%	Et1	90	1.70%	Hc6	88	1.70%
Eb10	1	0.00%	Et2	89	1.70%	Hc6/7	84	1.60%
Eb2	2	0.00%	Et3	41	0.80%	Hc7	43	0.80%
Eb6	2	0.00%	Et4	49	0.90%	Hh2	1	0.00%
Eg4	36	0.70%	Ew10	137	2.60%	Ib1	4	0.10%
Eh1	45	0.90%	Ew2	303	5.80%	Ic2	72	1.40%
Eh2	124	2.40%	Fk13	65	1.20%	Ic3	43	0.80%
Ek13	53	1.00%	Fp1	67	1.30%	Ic4	62	1.20%
Ek14	99	1.90%	Fp1-Fk13 Baulk	24	0.50%	Id1	138	2.60%
El16	186	3.60%	Fp2	5	0.10%	Id2	150	2.90%
Em11	70	1.30%	Fp3	63	1.20%	Ik11	14	0.30%
Em12	122	2.40%	Ge4	1	0.00%	Ik12	14	0.30%
Em13	193	3.70%	Ge6	11	0.20%	Ik7	24	0.50%
Em15	42	0.80%	Ge7	5	0.10%	Ik8	47	0.90%
Em16	84	1.60%	Ge8	4	0.10%	Ik8/Ik12	8	0.20%
En15	60	1.10%	Ha1	7	0.10%	Iv3	60	1.10%
Eo4	25	0.50%	Ha11	2	0.00%	Surface	114	2.20%
Er10	332	6.30%	Ha15	13	0.20%	Total	5229	100.00%
Er13	430	8.20%	Ha4	46	0.90%			
Er14	133	2.50%	Ha7	22	0.40%			

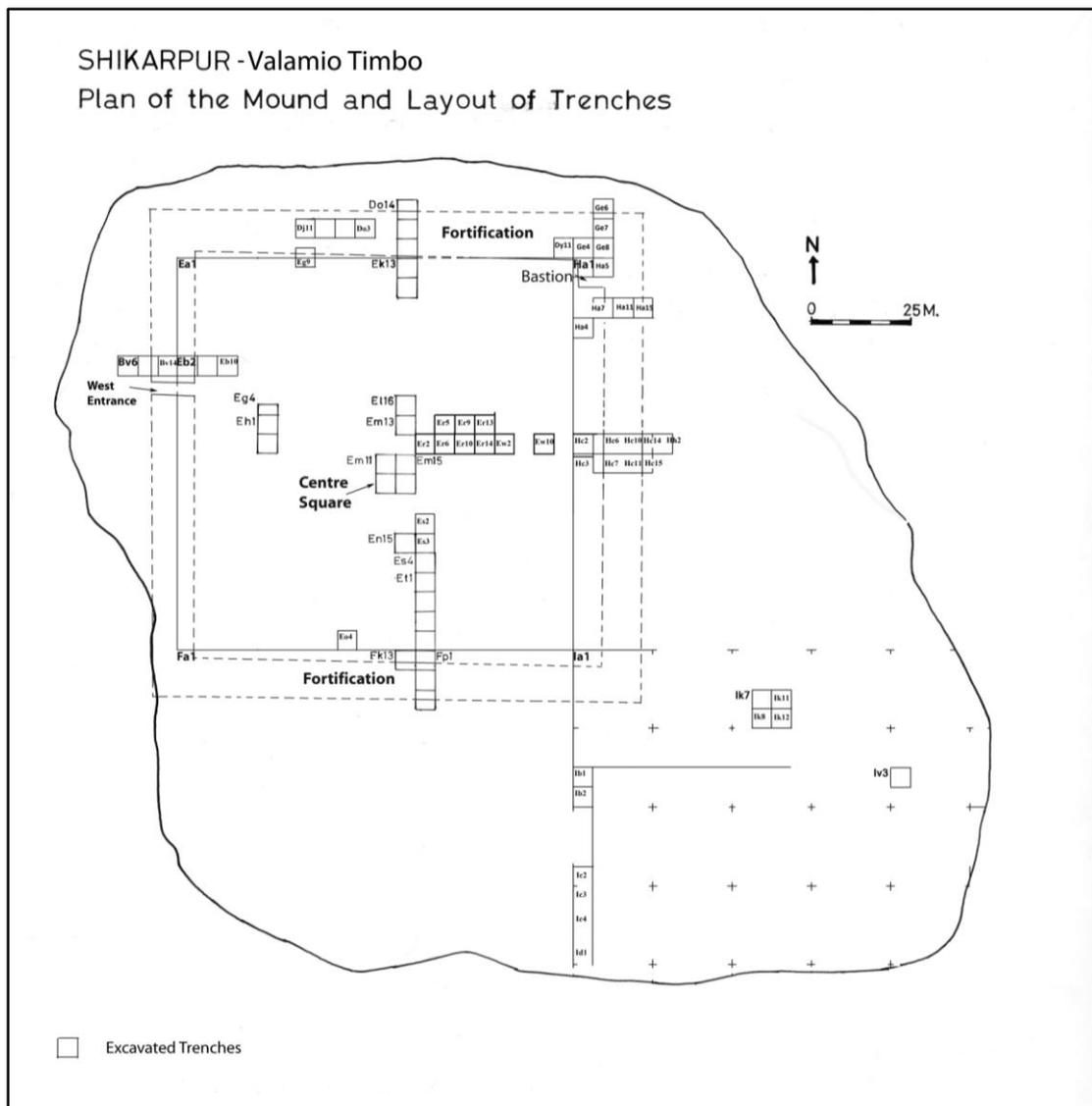


Figure 3.48: Layout of trenches at Shikarpur (Courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

Overview of tool types

Blades

Simple utilized blades are the most frequent blades found from Shikarpur. Backed blades, blade flakes, retouched blades, crested ridge blades, strangulated blades and obliquely blunted blades are the other blade categories present at the site. As can be seen clearly from the figure 3.49, Rohri chert blades dominate the blade assemblage at 89.13% (655 blades). Chert found at the Rohri Hills near Sukkur in Sind region of Pakistan is distinctive and easily identifiable amongst different raw materials. The fine, homogeneous texture, mineralogical composition, high degree of crystallization of the quartz and the absence of cracks or micro-fractures in the nodules make this

flint ideal for knapping (Biagi and Starnini 2012). After analyzing Rohri chert blades of major Harappan sites scholars have firmly established that long distance trade and standardized products characterize lithics of the Harappan civilization (Inizan and Lechevallier 1997). Shikarpur is a unique site of Gujarat from where such a large collection of Rohri chert blades has been discovered. In comparison, blades made out of local raw materials (chert, chalcedony, moss agate, banded agate, carnelian and blood stone) are found in few numbers 80 or (10.87%).

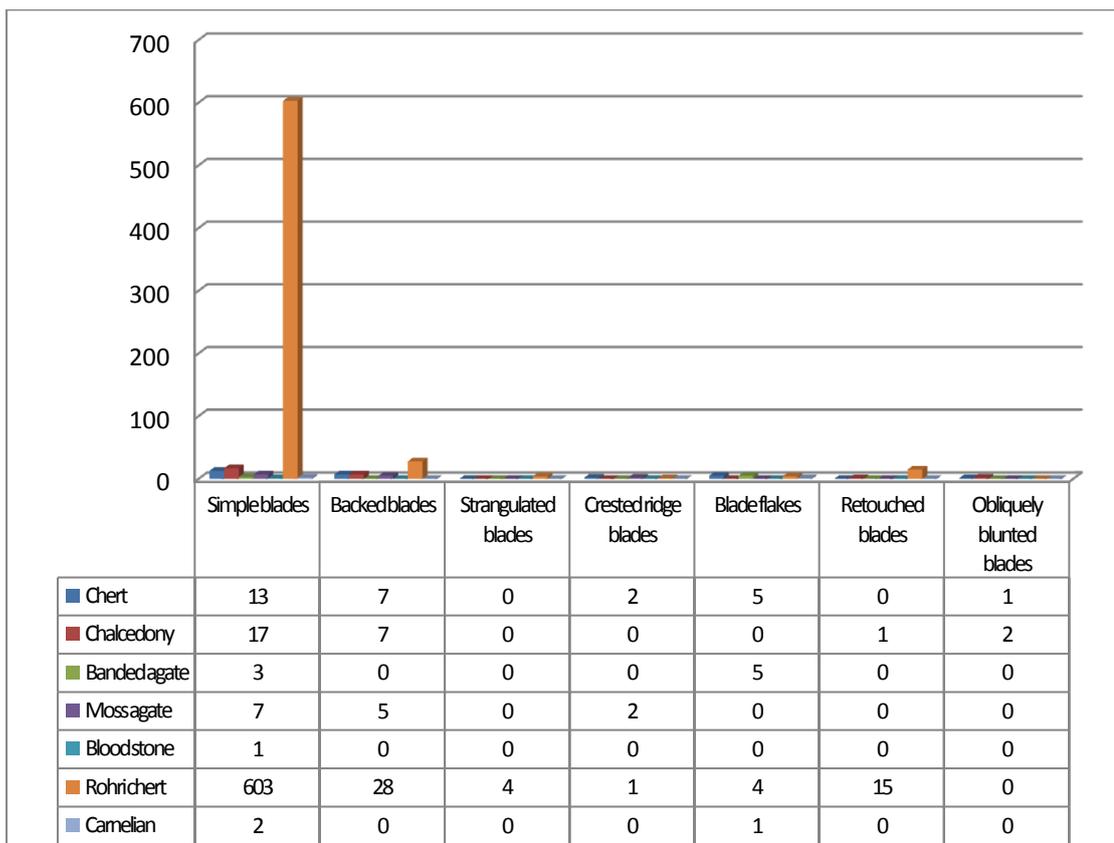


Figure 3.49: Various blades vs raw materials at Shikarpur

Rohri chert blades

Since Rohri chert blades (figures 3.51, 3.52 and 3.53) were clearly imported from Rohri hills and follow a standardized pattern of measurement, their analysis will be done separately from the blades made out of local materials.

Condition of blades

It was observed that majority of Rohri chert blade fragments (382 or 58.23%) are of mesial fragments. Very few (21 or 3.2%) were found to be intact, 182 or 27.74% were proximal fragments and 71 or 10.7% were distal fragments of blades.

Proximal conditions

Proximal end forms

It was observed that ‘triangular’, ‘rectangular’, ‘gull-winged’, ‘irregularly triangular’ and ‘lenticular’ were the most common forms of proximal end forms (table 3.53).

Proximal end type

It has been observed by scholars that flat or single striking platform is formed when flakes are removed from unidirectional cores (Andrefsky 2005: 16). Most probably that is true for Shikarpur as the highest percentage of proximal end types are found to be of the category single.

Proximal end shape

‘Pointed’ appears to be the most common proximal end shape amongst Rohri chert blades. Blades/flakes with a diffuse bulb of force and a pronounced lip have been called soft hammer percussion flakes (Crabtree 1972: 74). However not all researchers agree on this. Hard hammer percussion is believed to produce flakes with pronounced bulbs of force, no lipping, and slightly crushed striking platform areas (Crabtree 1972: 44). Even though soft-hammer and hard hammer flaking techniques produce detached pieces that over-lap in their range of bulb morphology and amount of lipping, these characteristics may be effective discriminators in most cases (Andrefsky 2005: 119).

Table 3.53: Proximal end features of Rohri chert blades at Shikarpur

PE form	No	Percent	PE type	No.	Percent	PE shape	No.	Percent
Rectangular	37	18.4%	Single	134	68.7%	Lipped	20	10.3%
Lenticular	27	13.2%	Dihedral	37	19.0%	Pointed	128	65.6%
Irregularly lenticular	17	8.3%	Multiple	24	12.3%	Bulb scar	47	24.1%
Triangular	42	20.6%	Total	195	100.0%	Total	195	100.0%
Irregularly triangular	30	14.7%						
Gull winged	36	17.6%						
Semi-circular	6	2.9%						
Retouched	3	1.5%						
Difficult to see	6	2.9%						
Total	204	100.0%						

Proximal end width and thickness

From the measurements of intact proximal ends, it was seen that proximal end width varied between blades while the thickness is found to be more or less of a standardized size (table 3.54).

Table 3.54: Proximal end width and thickness in mm of Rohri chert blades at Shikarpur

	Mean	Median	Mode	Std dev	Variance
Width	6.63	6.3	4.33	2.97	8.86
Thickness	2.79	2.65	3.63	1.03	1.07

Distal ends

Intact and distal blade fragments

Plunging (62 or 67.39%) and feathered (22 or 23.91%) types of distal end terminations were found to be most common amongst Rohri chert blades. Very few blades (3 or 3.26%) were found to be either retouched or having use marks on their distal ends. Hinged type of distal end termination was present only in five blades (5.46%).

Proximal blade fragments and mesial blade fragments

Clean snapping of distal end was the most common (517 blades 91.73%) amongst broken blades. As mentioned earlier, blades made out of Rohri chert are most frequent from this site. Rohri chert blades are known to be broken into two or more fragments to maximize their utility (Inizan & Lechevallier 1997). Thus these results are not out of line. Very few blades (10 or 1.77%) were found to be retouched at their distal ends, 1 (0.18%) showed crushed distal end.

Presence of cortex on blades

644 or 98.17% blades were found to be devoid of any amount of cortex (figure 3.50). It was also seen that most of the time retouched blades were found to be without any cortex. Can we presume here that secondary blades were selected to manufacture specialized tools? Simple blades and blade flakes do show presence of different categories of cortex, though in very few blades. Since the main bulk of blades came from Rohri hill quarries, this discrepancy in the presence of cortex is to be expected.

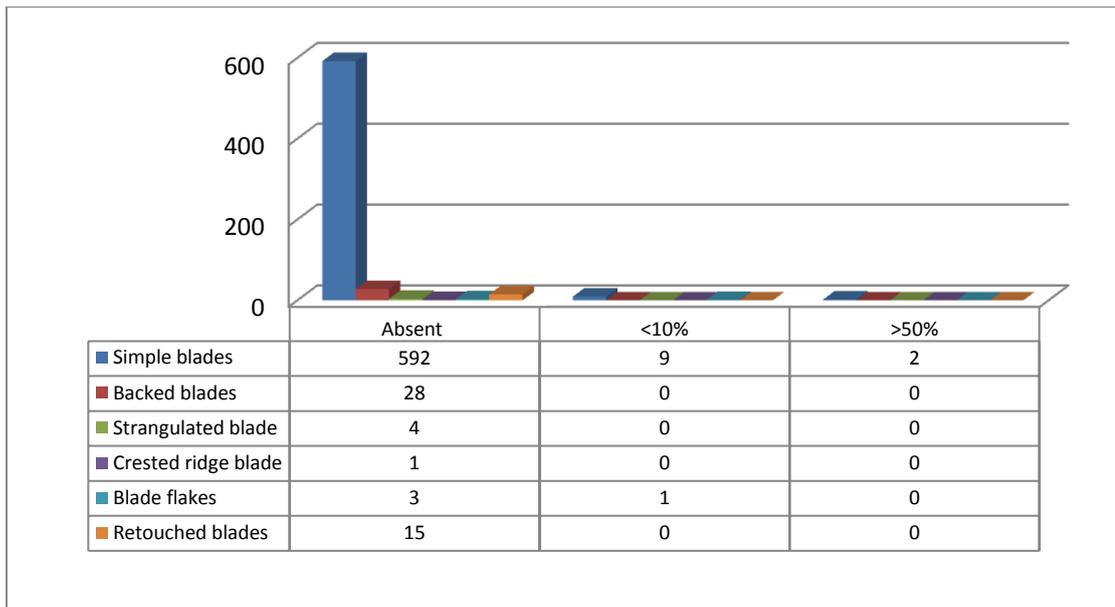


Figure 3.50: Presence of cortex on Rohri chert blades at Shikarpur

Edge damage and retouche

More than 57% (376) blades were found to have edge damages, leading to the conclusion that they had been used for some purpose. More than 14% (91) blades were retouched in one or the other form. Since a majority of blades were found to be without any retouches it can be said that people preferred to utilize blades without first making them into specialized tools. Rohri chert blades are much broader and thicker than blades of other raw materials and thus it could be possible that no secondary retouches were required on them. It was also noticed that very few blades were left totally blank (28 or 4.27%). Most of the blades were utilized from their dorsal sides. It appears that right edge was more preferred than the left edge. Though for bifacial utilization it was seen that left edge of the blade showed more edge damage. No retouches were found on the left edge of the blades. Retouches were most common on the dorsal side too.

Metric comparison

It was observed that lengths of intact as well as broken blades show large variation in their standard deviation values (table 3.55). Breadth and thickness on the other hand show low values of standard deviation confirming their uniformity. The only exception here is the breadth value of intact blades, which are very varied. This inconsistency is most probably due to the inclusion of two blade flakes with very wide breadths.

Table 3.55: Metrics of Rohri chert blades in mm at Shikarpur

	No		Mean	Median	Mode	Std dev	Variance
Intact blades	20	Length	47.62	42.25	24.79	21.48	461.62
		Breadth	12.84	9.91	6.07	12.2	148.77
		Thickness	3.03	2.34	1.28	2.12	4.5
Proximal fragments	183	Length	33.49	31.36	34.61	15.18	230.48
		Breadth	10.96	11.4	13.17	3.64	13.25
		Thickness	2.98	2.96	2.92	1.79	3.2
Mesial blades	382	Length	25.59	22.53	8.66	11.92	142.27
		Breadth	11.52	11.63	7.53	3.13	9.82
		Thickness	3.03	2.93	2.76	1.25	1.55
Distal fragments	70	Length	31.18	29.45	19.82	13.72	188.16
		Breadth	10.63	11.37	10.67	2.82	7.94
		Thickness	2.86	2.77	3.16	1.46	2.12

Metric comparison of different types of intact blades of Rohri chert to see if there is any variation amongst different types of blades is presented here (table 3.56). Lengths of simple blades show a high value of standard deviation and thus vast variation. While the breadth and thickness values seem to be clustered close to each other. Blade flakes on the other hand show variation in their breadths and have lengths and thicknesses close to each other. The single retouched specimen was found to be smaller in length but was broad and thick.

Table 3.56: Metrics of different intact blades in mm of Rohri chert at Shikarpur

	No		Mean	Median	Mode	Std dev	Variance
Simple blades	17	Length	47.59	38.43	24.79	23.3	543.311
		Breadth	8.89	8.56	6.07	1.92	3.69
		Thickness	2.28	2.13	1.28	0.74	0.55
Blade flakes	2	Length	51.02	51.02	49.18	2.61	6.8
		Breadth	45.67	45.67	32.55	18.55	344.27
		Thickness	8.61	8.61	7.42	1.68	2.83
Retouched blade	1	Length	41.26				
		Breadth	14.4				
		Thickness	4.47				



Figure 3.51: Rohri chert blades from Shikarpur (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)



Figure 3.52: Rohri chert blades from Shikarpur (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)



Figure 3.53: Rohri chert blades from Shikarpur (Courtesy: Department of Archaeology and Ancient History, The M.S. University of Baroda, Vadodara)

Blades made out of chert, chalcedony, banded agate, moss agate, blood stone and carnelian

Majority of the blades in this category were found to be mesial 35 (43.75%) fragments. Intact blades comprised 15 (18.75%); proximal blade fragments were 24 (18.75%) and distal blade fragments were found to consist of 4 (7.5%) of the assemblage. A raw material wise distribution of condition of these blades is given in table 3.57.

Table 3.57: Representation of blades according of raw materials at Shikarpur

	Chert	%	Chalcedony	%	Banded agate	%	Moss agate	%	Blood stone	%	Carnelian	%
Intact	8	29.63	2	7.41	3	37.5	1	7.14	0	0	1	33.3
Proximal	7	25.93	8	29.63	3	37.5	6	42.86	0	0	0	0
Mesial	10	37.04	17	62.96	1	12.5	4	28.57	1	100	2	66.67
Distal	2	7.41	0	0	1	12.5	3	21.43	0	0	0	0
Total	27	100	27	100	8	100	14	100	1	100	3	100

Proximal conditions

‘Triangular’ proximal end form followed by ‘lenticular’, ‘rectangular’, ‘irregularly triangular’ and ‘difficult to see/identify’ were the most common amongst intact and proximally broken blades (figure 3.54).

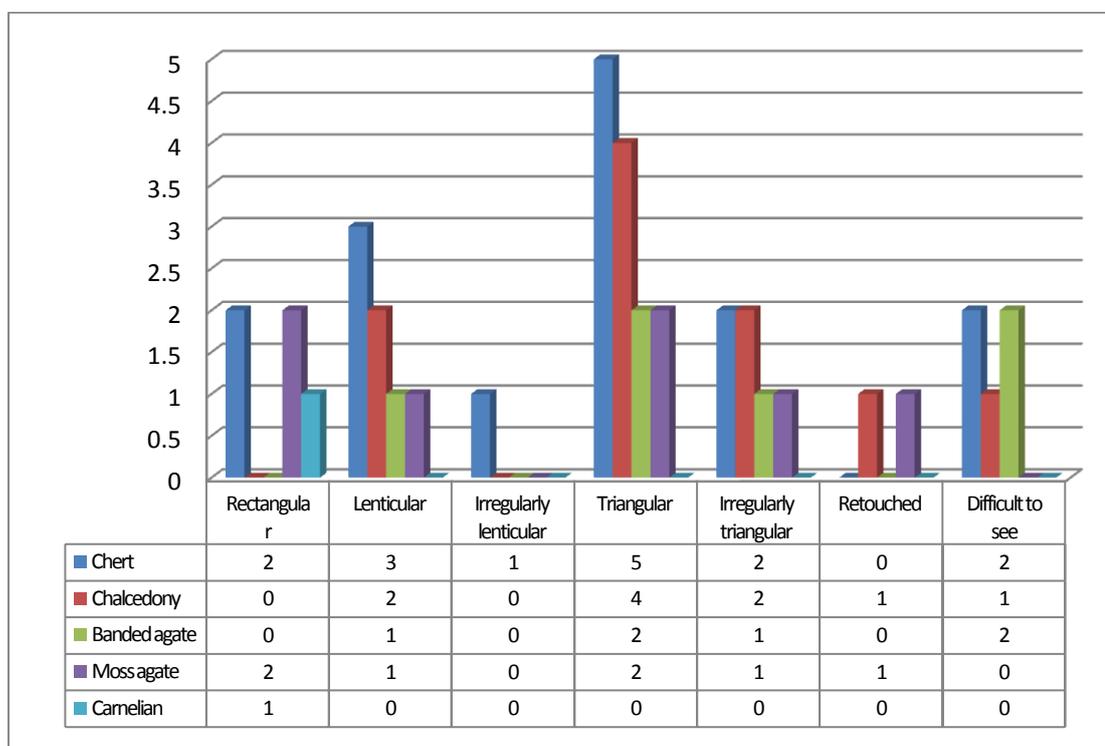


Figure 3.54: Proximal end forms of different blades at Shikarpur

Proximal end type

Single proximal end type was the most common amongst these blades (figure 3.55).

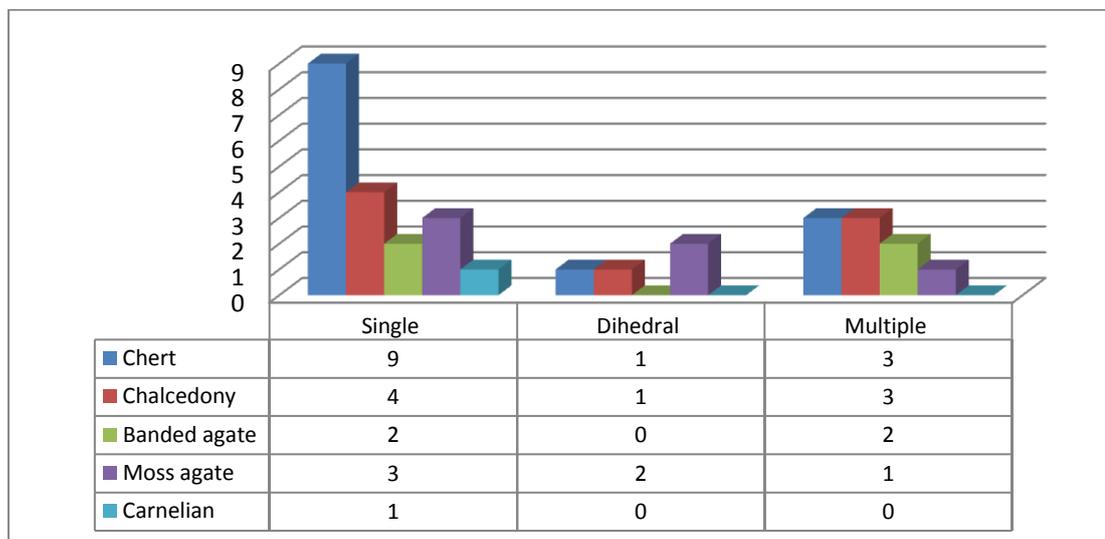


Figure 3.55: Proximal end types of different blades at Shikarpur

Proximal end shape

‘Pointed’ proximal end followed by ‘lipped’ were the most common proximal end shapes amongst the blades (figure 3.56).

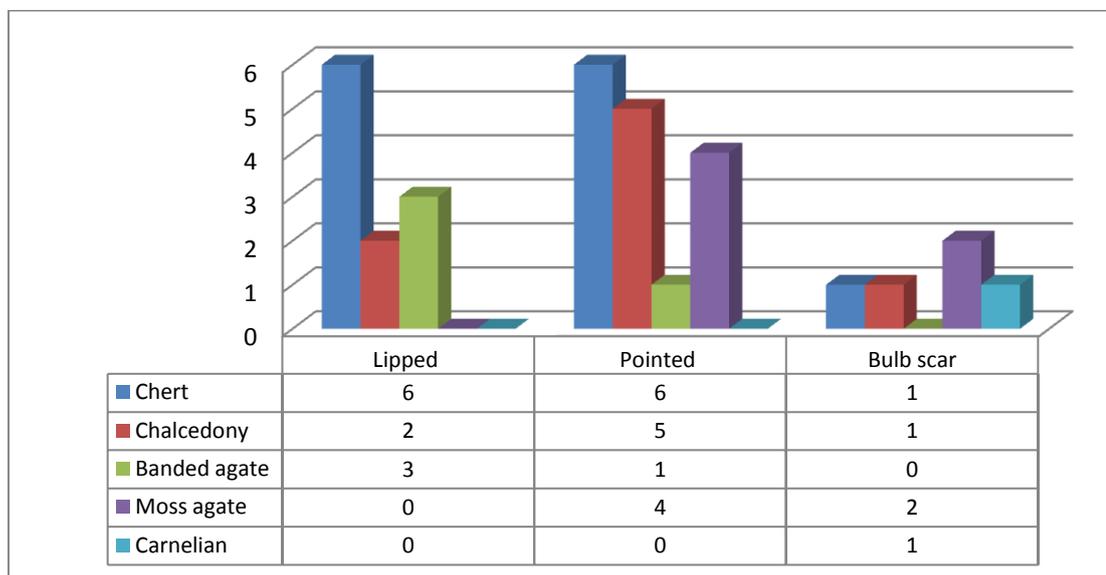


Figure 3.56: Proximal end shape of different blades at Shikarpur

Platform width and thickness

Measurements of platform end do not seem to vary much between blades of various raw materials which can be seen in the low value of standard deviation (table 3.58).

Table 3.58: Proximal end width and thickness in mm at Shikarpur

	Mean	Median	Mode	Std dev	Variance
Width	5.49	5.04	3.79	2.84	8.08
Thickness	2.66	2.28	2.36	1.57	2.47

Types of distal end terminations

Out of the 15 intact blades, it was found that 6 (40%) showed plunging type, 6 (40%) showed feathered type, 2 (13.33%) showed hinged and 1 (6.67%) showed retouching on their distal ends. 24 proximally broken blades were found and majority 22 (91.67%) were snapped at their distal ends while 2 (8.33%) showed stepped fracture of distal end termination. Mesial fragments of blades showed 28 (77.78%) snapping, 4 (11.11%) of stepped fracture, 2 (5.56%) of hinged fracture and 2 (5.56%) of retouching on their distal ends. Distal blade fragments showed equal distribution (33.33%) amongst hinged fracture, plunging type of termination and retouching on

their distal ends. First we will have a look at the intact and distally broken blades (figure 3.57). We can see that plunging type of termination was the most common, followed by feathered, hinged and retouched.

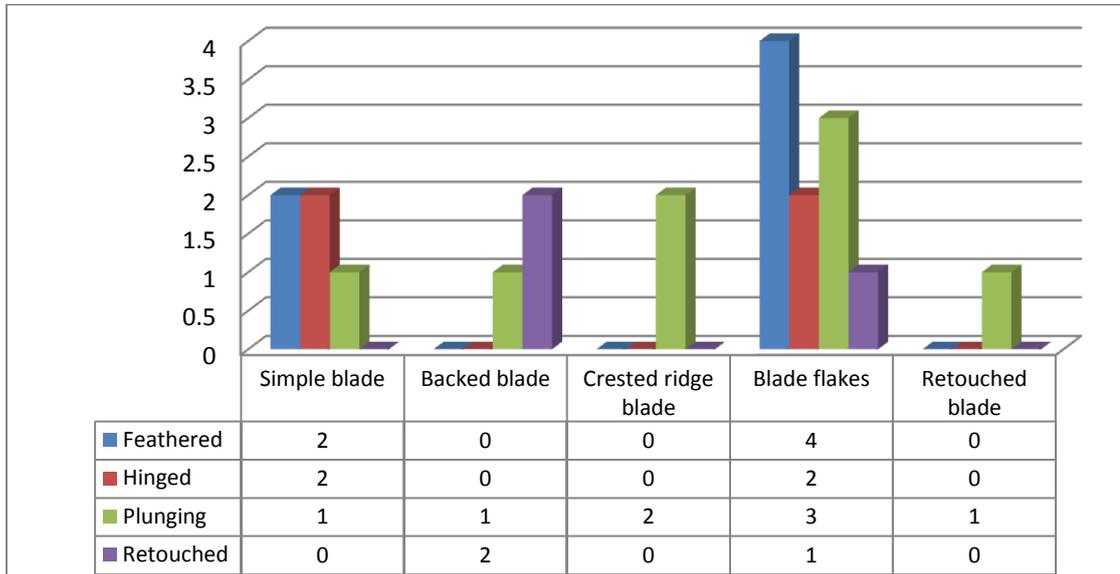


Figure 3.57: Distal end terminations of intact blades at Shikarpur

The distal end terminations of proximally broken blades and mesial blade fragments are described in Figure 3.58. More than 83.33% (50) blades were ‘snapped’. 6 or 10% showed stepped type of termination and the rest were either hinged or retouched.

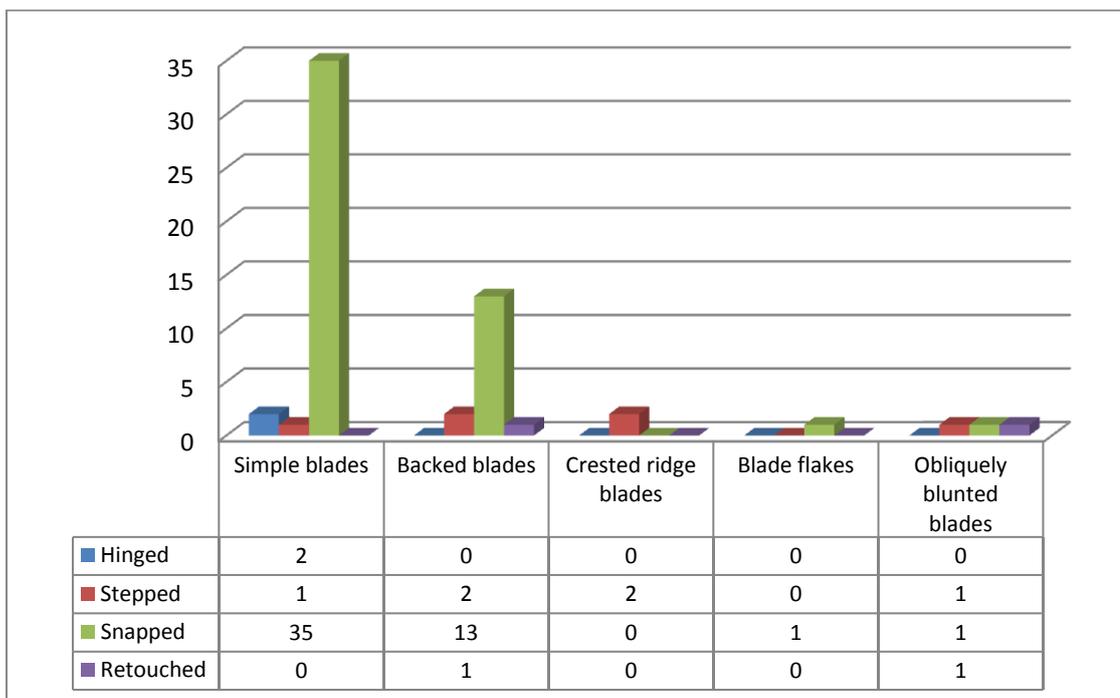


Figure 3.58: Distal end terminations of broken blades at Shikarpur

Presence of cortex on blades

As expected, it was found that most of the specialized tools (22 retouched tools) were made on secondary blades (figure 3.59).

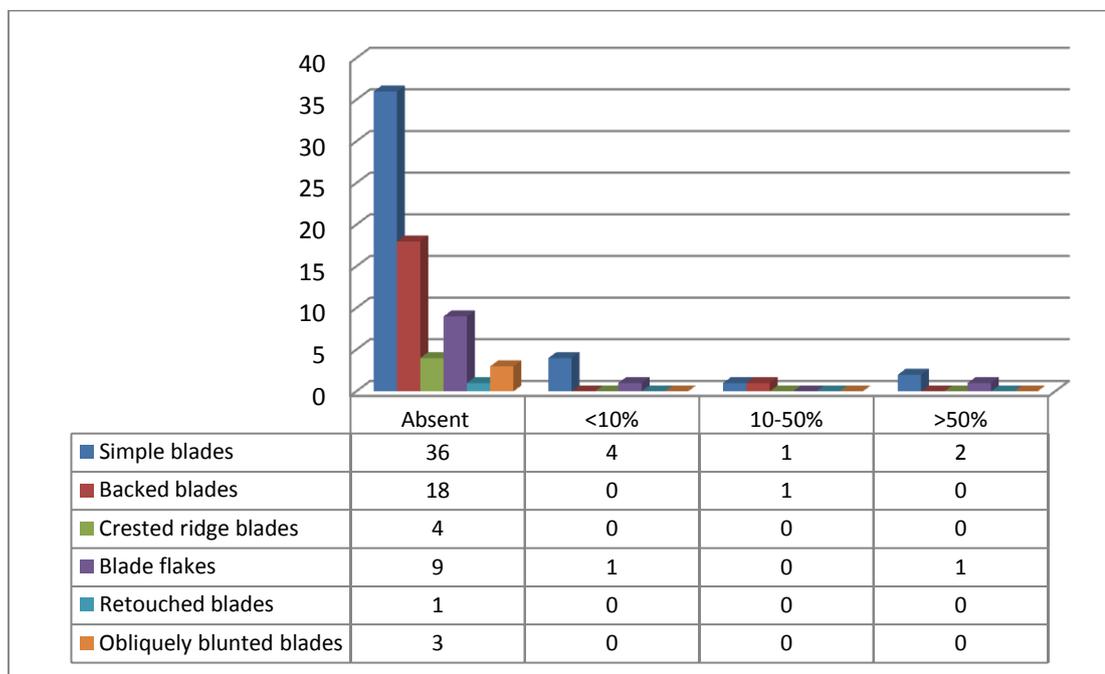


Figure 3.59: Presence of cortex on blades at Shikarpur

Edge damage and retouches

It was found that majority of the blades 51 (64.2%) showed slight to heavy edge damage leading to the conclusion that most probably they were utilized for some purpose (figure 3.60). 45.6% blades had edge damages on their right edges. These were found mostly (72.97%) on the dorsal side of the blade though bifacial edge damages (16.22%) were not uncommon too. 34.56% blades showed edge damages on their left edges. Amongst these, again, dorsal edge damage (78.57%) were the most common while bifacial edge damages (21.43%) were observed as well. Retouches were done exclusively on right edges of these blades and consisted of dorsal retouches and notches.

Metric comparison

Different types of intact blades

Since single examples of intact crested ridge blade and retouched blade have been found it is not possible to do any statistical analysis for them (table 3.59). Even the numbers for simple blades are very small. It is possible that the high standard

deviation values for lengths of these blades are due to small sample. Breaths and thicknesses of simple blades, comparatively, are standard. Blade flakes, on the other hand, show a very high variation in their measurements.

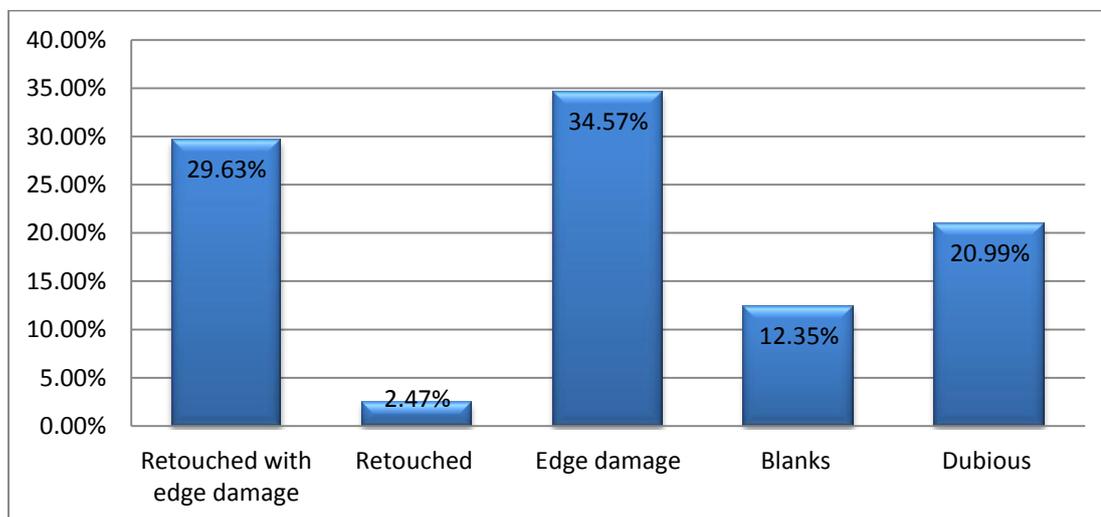


Figure 3.60: Edge condition of blades at Shikarpur

Table 3.59: Metrics of intact blades in mm at Shikarpur

	Numbers		Mean	Median	Mode	Std dev	Variance
Length	4	Simple blades	21.86	24.53		6.39	30.59
	1	Crested ridge	22.12				
	9	Blade flake	14.68	20.64		12.35	135.78
	1	Retouched blade	14.59				
Breadth	4	Simple blades	5.52	7.33		2.79	5.75
	1	Crested ridge	5.95				
	9	Blade flake	5.94	12.72		6.39	36.39
	1	Retouched blade	9.45				
Thickness	4	Simple blades	1.7	2.02		1.03	0.80
	1	Crested ridge	4.76				
	9	Blade flake	2.12	3.88		3.29	9.50
	1	Retouched blade	4.12				

Different types of broken blades

Lengths of all the blades show very varied values. This is to be expected in broken blades. The exception is seen in the lengths of crested ridge blades which show very less difference in their lengths. Crested ridge blades are also longer, broader and thicker than other types of blades found in this particular assemblage. Breadths and thickness values appear more or less of standard size for all the different type of blades. The only exception is seen in the breadth values of blade flakes, which are very different (table 3.60).

Table 3.60: Metrics of broken blades in mm at Shikarpur

Blade type	No		Mean	Median	Mode	Std Dev	Variation
Simple blades	39	Length	16.4	14.45	5.35	6.84	46.86
		Breadth	7.39	7.27	6.46	2.11	4.43
		Thickness	2.21	2.16	2.02	1.01	1.02
Backed blades	19	Length	18.7	17.7	10.49	5.36	28.74
		Breadth	5.61	5.18	3.15	1.96	3.85
		Thickness	2.11	1.81	1.01	1.12	1.25
Crested ridge blades	3	Length	18.66	18.53	17.93	0.81	0.65
		Breadth	9.34	8.81	7.94	1.72	2.96
		Thickness	4.32	3.55	3.23	1.61	2.58
Blade flakes	2	Length	10.3	10.3	7.61	3.80	14.47
		Breadth	19.29	19.29	15.42	5.47	29.95
		Thickness	1.93	1.93	0.83	1.55	2.42
Obliquely blunted blades	3	Length	17.06	16.32	13.07	4.39	19.35
		Breadth	6.7	7.1	4.66	1.87	3.52
		Thickness	2.18	2.05	1.87	0.4	0.16

Geometric and non-geometric tools

Compared to the other type sites selected for the study, very few (33) geometric and non-geometric tools have been found from Shikarpur. Geometric tools discovered from the site include lunates (2) and trapeziums (1) while non-geometric tools comprise of points (20), burin (7) and end scrapers (3). A lot of times scholars consider geometric tools to belong to Mesolithic period lithic assemblage and any

geometric tools found from Chalcolithic period levels are considered survivals of earlier tool types beyond their specific original use (Sankalia 1967).

A trench wise distribution is presented first in figure 3.62. It was found, once again, that the central trenches contained more than 40% of these tools.



Figure 3.61: Blades from Shikarpur (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

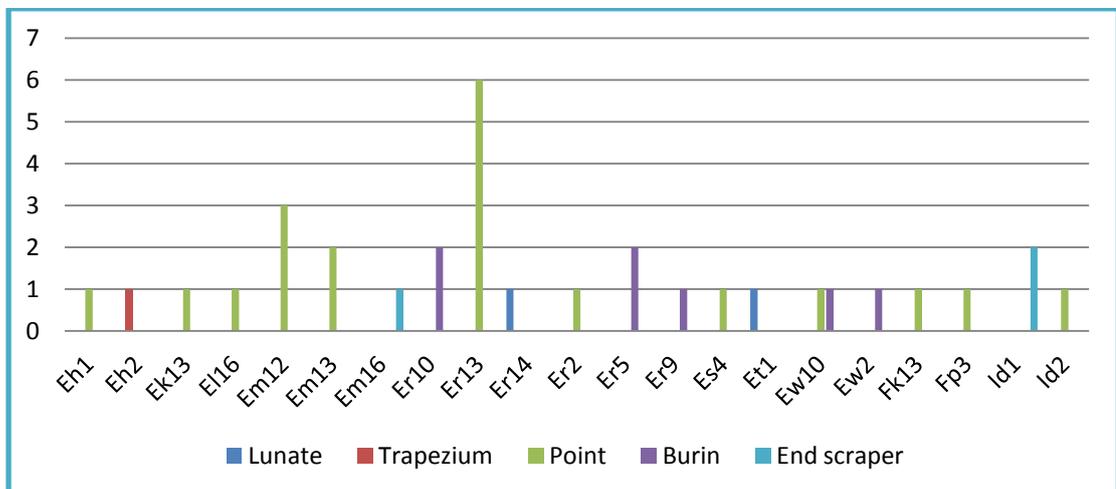


Figure 3.62: Representation of trenches for geometric and non-geometric tools at Shikarpur

Raw material exploitation

Geometric tools were found to be made exclusively out of chalcedony while the non-geometric tools were made out of, apart from chalcedony, chert, banded agate, blood stone and Rohri chert (figure 3.63). Rohri chert blades were also used extensively to manufacture different variety of tools.

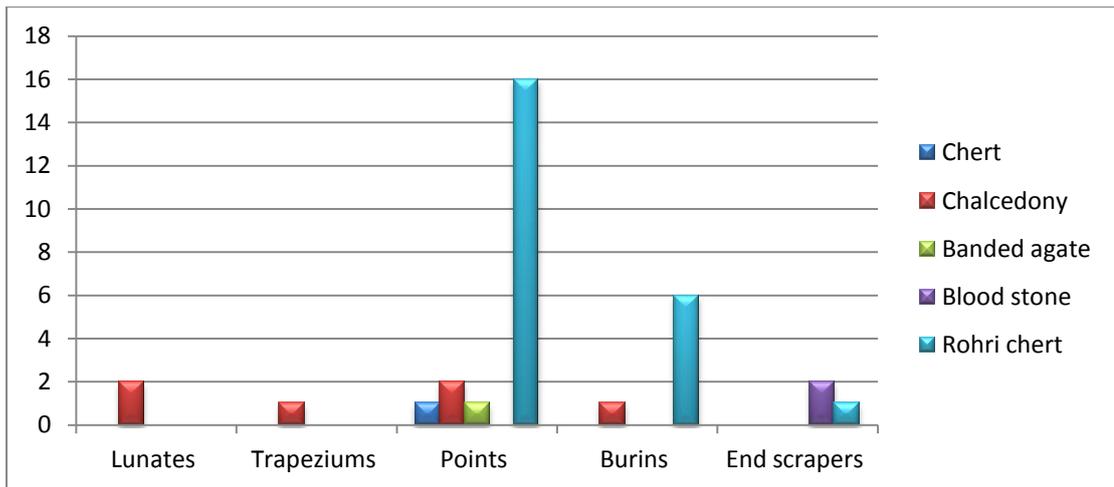


Figure 3.63: Representation of raw materials for geometric and non-geometric tools at Shikarpur

Analysis of geometric and non-geometric tools

Lunates

The lunates, two in number, were made of chalcedony and were found in intact condition. Both of them were made on secondary blades. Both lunates showed edge damages so most probably were utilized. There is a big difference in their sizes which can be seen from the high values of standard deviation for length and breadths (table 3.61).

Table 3.61: Metrics of lunates in mm at Shikarpur

	Mean	Median	Mode	Variance	Std dev
Length	14.21	13.21	9.45	28.27	5.31
Breadth	6.22	6.22	3.97	10.12	3.18
Thickness	2.08	2.08	1.64	0.38	0.62

Trapeziums

The one and only trapeziums was found to be made out of chalcedony and was in intact condition. It was made on a secondary blade and showed signs of utilization. Its measurements were found to be as following; 17.64mm length, 6.32mm breadth and 4.01mm thickness.

Points

These were made out of Rohri chert (16), chalcedony (2), chert (1) and banded agate (1). 9 points were found to be intact while 11 were found in broken condition. 18 were

found to be without cortex while 2 showed some amount of cortex present on their dorsal side. Most probably all of them were utilised for some or the other purpose. High standard deviation values for their lengths and breadths shows variation in their sizes (table 3.62).

Table 3.62: Metrics of points in mm at Shikarpur

	Mean	Median	Mode	Variance	Std dev
Length	18.5	16.11	11.92	39.18	6.25
Breadth	9.27	9.49	0.43	13.81	3.71
Thickness	3.56	3.18	2.38	2.35	1.53

Burins

All seven burins were found to be in intact condition. 6 of these were made out of Rohri chert while 1 was made of chalcedony. All of them were made on secondary flakes. Their lengths are very diverse but breadth and thickness appear to be somewhat of a standardised size (table 3.63).

Table 3.63: Metrics of burins in mm at Shikarpur

	Mean	Median	Mode	Variance	Std dev
Length	21.78	19	12.45	159.32	12.62
Breadth	9.45	9.53	4.62	6.24	2.49
Thickness	3.00	3.06	1.27	1.07	1.04

End scrapers

All three were found to be intact and were made on secondary flakes. 2 were made out of blood stone while 1 was made on Rohri chert flake. Most probably all of them were utilized. Their sizes appear to be very different, specially the values of breadth (table 3.64).

Table 3.64: Metrics of end scrapers in mm at Shikarpur

	Mean	Median	Mode	Variance	Std dev
Length	27.82	26.85	24.3	16.79	4.1
Breadth	23.1	20.55	9.62	222.75	14.92
Thickness	5.89	5.39	3.14	9.22	3.04

Lithic debitage

Lithic debitage includes all the waste produced during tool making. Since cores are end products of blades and most of the time not re-used, they have been included in this category.

Lithic debitage recovered from the site was classified into flakes (primary, secondary and core rejuvenation flakes), nodules, cores, chunks (bead rough-outs?) and waste/shatter. Flakes dominate the assemblage at 70% (3120). Chert (46.04%), banded agate (24.15%) and chalcedony (17.76%) together make up more than 88% of the raw material exploited at the site (figure 3.64).

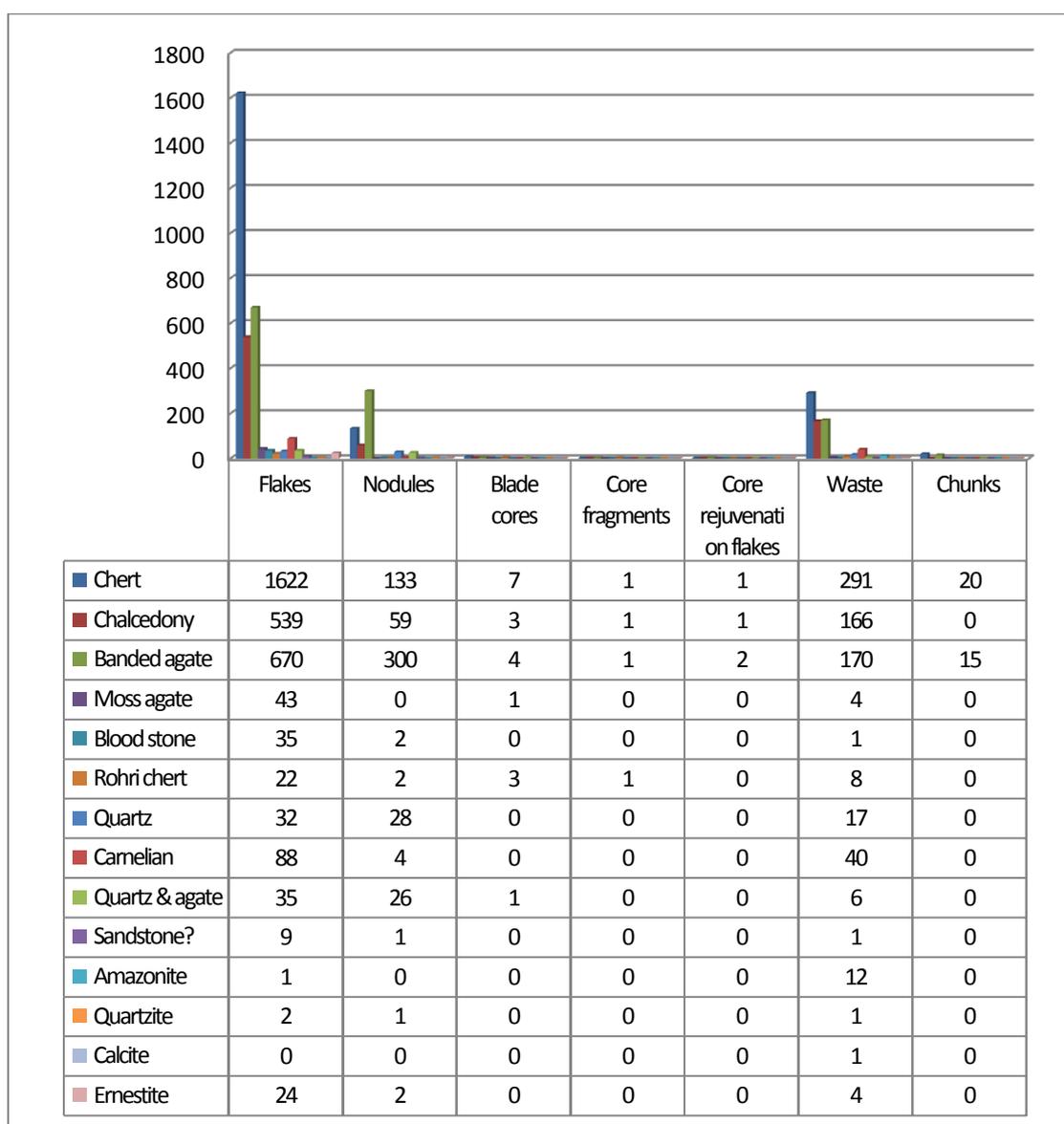


Figure 3.64: Representation of lithic debitage according to raw materials at Shikarpur

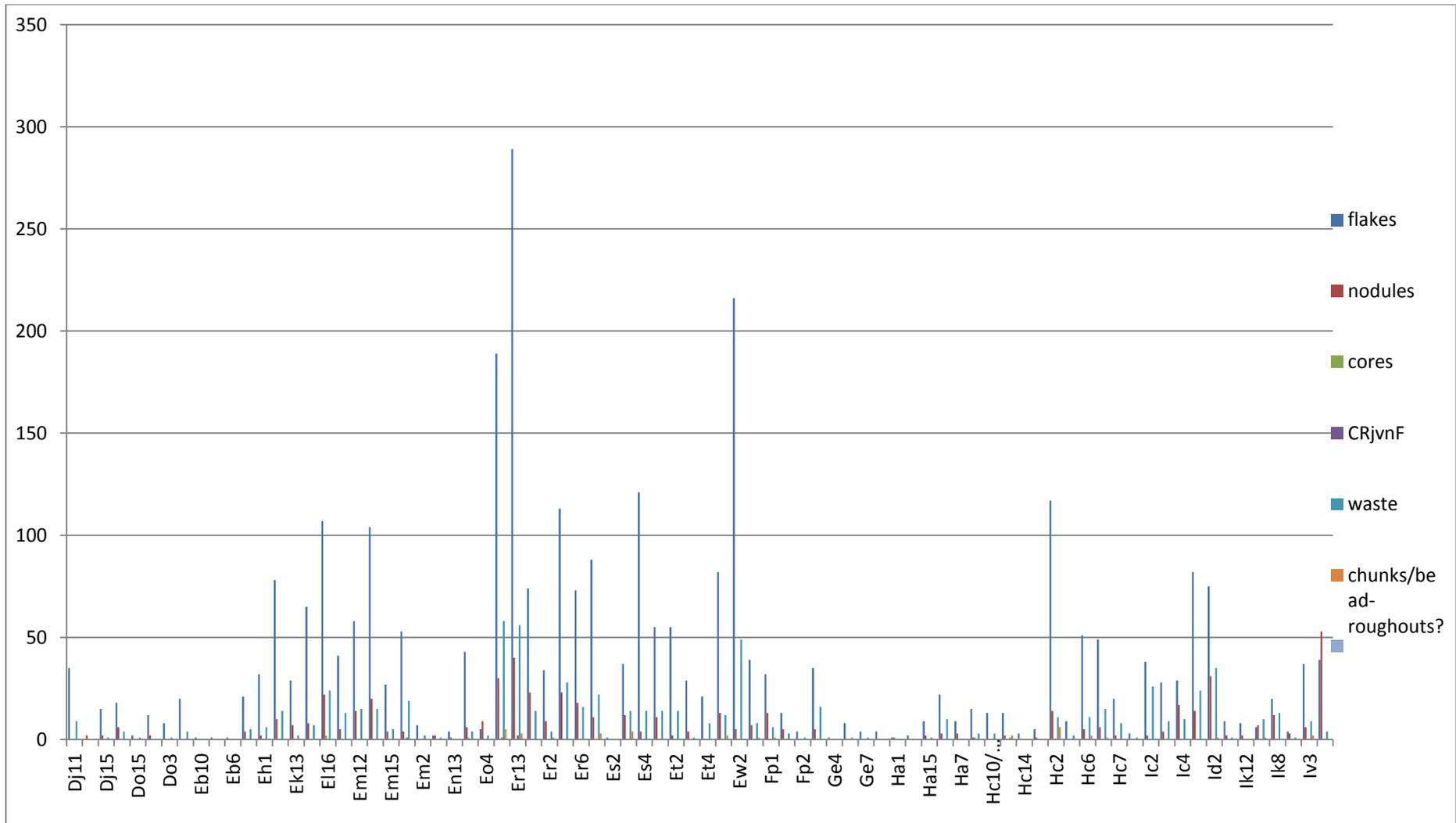


Figure 3.65: Trenchwise representation of lithic debitage at Shikarpur

Flakes

A total of 3120 flakes of different raw materials have been recovered from excavations. More than 86% (2685) flakes were found to be in intact condition while the remaining 14% (435) were found to be broken (figure 3.66). Flakes made out of chert, chalcedony, banded agate, moss agate, blood stone, Rohri chert, quartz, carnelian and ernestite were found to be either intact or broken while flakes of sandstone, amazonite and quartzite were found only in intact condition. More than 52% (1660) flakes showed signs of presence of cortex on their surface (figure 3.67). About 47% (1460) were found to be without cortex, thus falling into the category of secondary blades. Flakes made of chert, chalcedony, banded agate, moss agate, blood stone and carnelian show various percentages of cortex on them, confirming that they were worked at the site. Rohri chert, quartz and sandstone show either less than 10% or more than 50% cortex on their body. While flakes made of amazonite, quartzite and ernestite were found to be either without cortex or with less than 10% cortex present. About 98% (3068) flakes were not utilized for any purpose and thus belong to the category of debitage. 0.5% (15) flakes showed signs of secondary retouching while 1.2% (36) flakes appeared to have been utilized for some purpose. Flakes made out of chalcedony and banded agate were found to have some nominal retouches on them. Flakes made out of chert, chalcedony, banded agate, moss agate, blood stone, rohri chert and carnelian were found to have some edge damages. In the size category it was observed that there were a few differences amongst intact flakes with cortex and intact flakes without cortex as well as broken flakes with cortex and broken flakes without cortex. Intact secondary flakes showed that maximum flakes (1041) were found between sizes 1-2.5cm (86.5%) while intact primary flakes showed the maximum representation (1320) between 1-3cm (85.64%). It was further observed that secondary intact flakes showed maximum size going upto 12.5cm. No flake bigger than 5.5cm was found amongst primary intact flakes. Amongst the broken secondary flakes it was found that maximum (201 or 85.44%) representation of flakes was between the sizes 1-2cm and maximum size was found to be 3.5cm. while in the broken primary flake category maximum (165 or 85.87%) representation was between sizes 1-2.5cm and here the maximum size was observed to be of 6cm (figure 3.68).

Nodules

562 nodules were recovered from excavations. Almost half of them were found to be

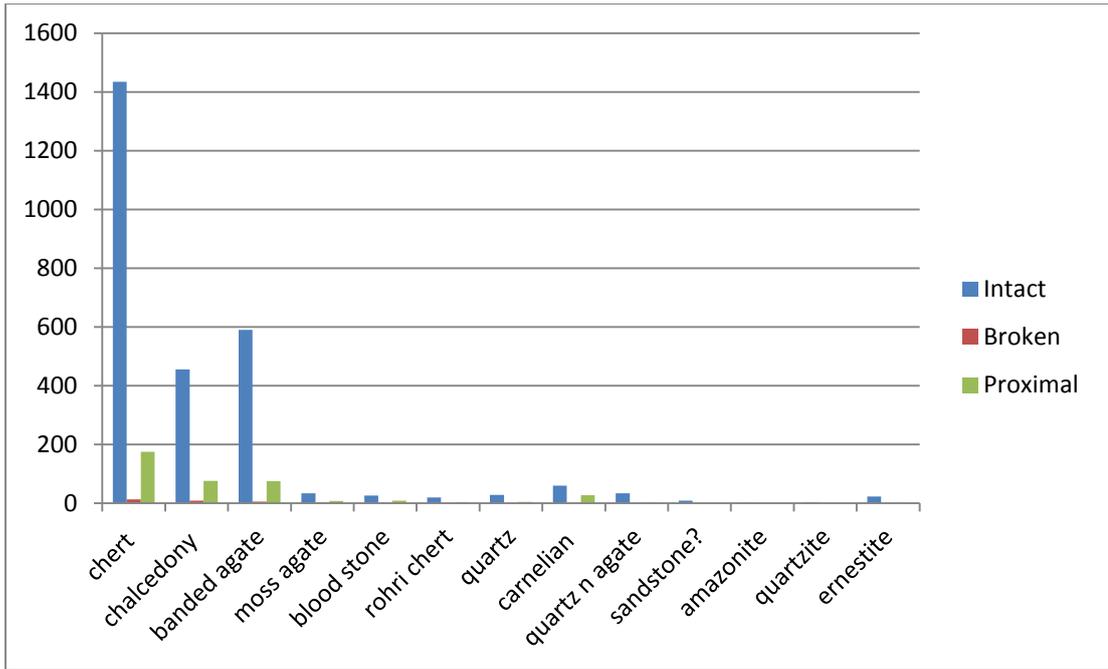


Figure 3.66: Condition of flakes according to raw materials at Shikarpur

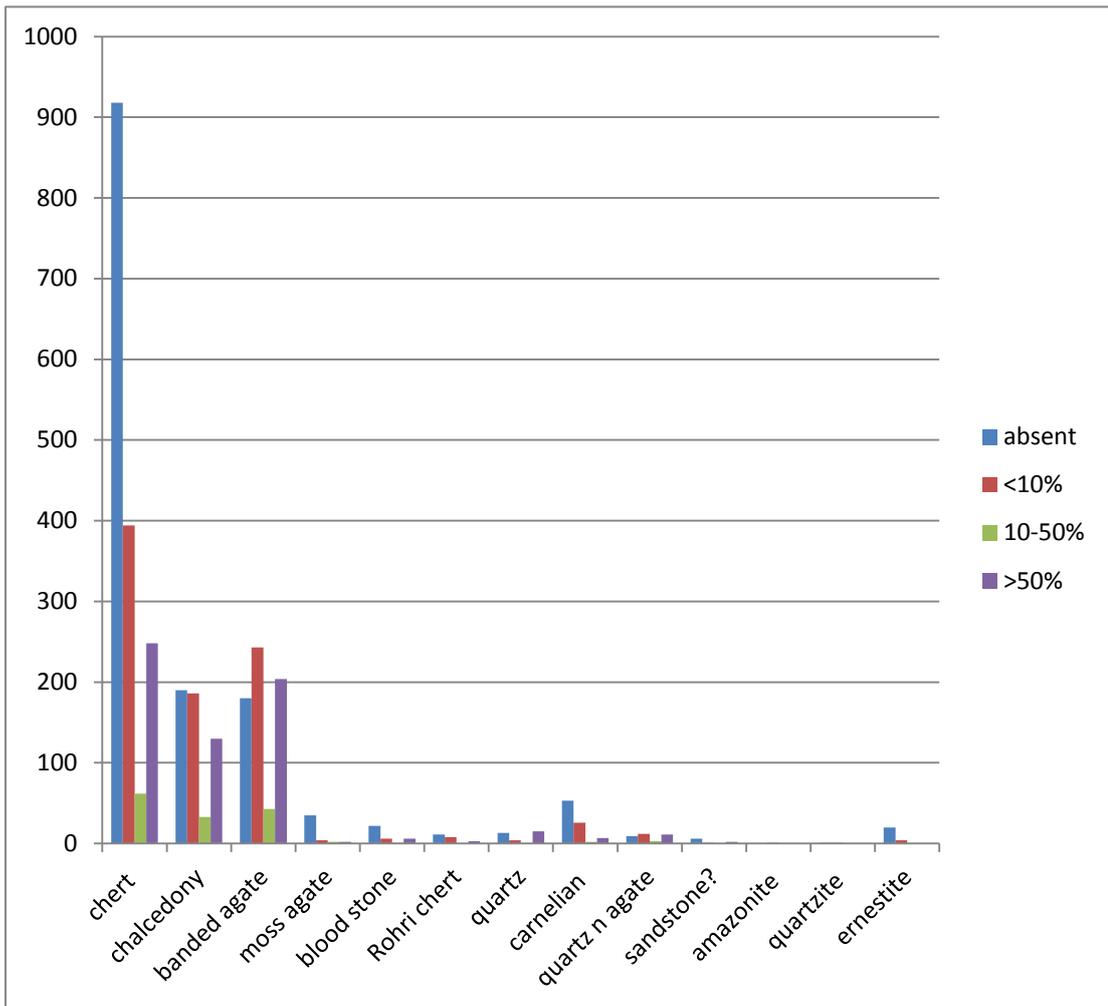


Figure 3.67: Representation of cortex on flakes at Shikarpur

broken (306 or 54.45%). 10.14% (57) were found intact and more than 34% (192) showed some amount of random flaking done on their surface (figure 3.69). 53.56.4% (301) nodules were of banded agate, 23.84% (134) of chert, 10.68% (60) of chalcedony, 6.7% (28) of quartz, 0.71% (4) of carnelian, 2.89% (7) of blood stone, Rohri chert and Ernestite, 0.36% (2) of sandstone and quartzite. 77.4% (435) nodules showed heavy and 14.77% (83) showed slight to medium presence of cortex on their surface. 7.83% (44) nodules were found to be without any cortex.

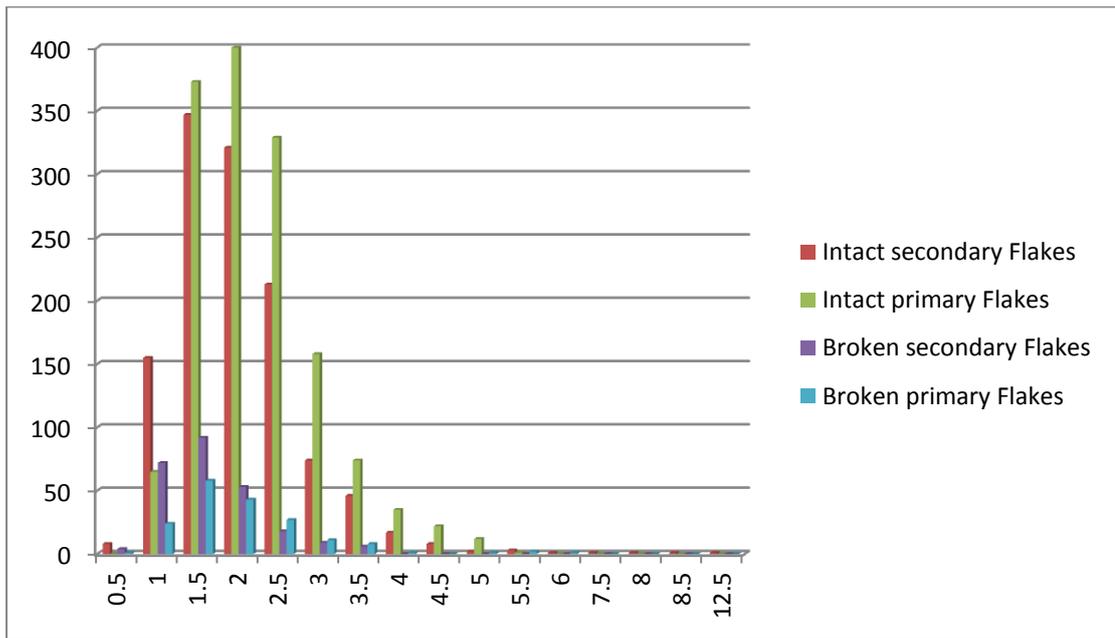


Figure 3.68: Representation of size (cm) of intact as well as broken flakes according to presence and absence of cortex at Shikarpur

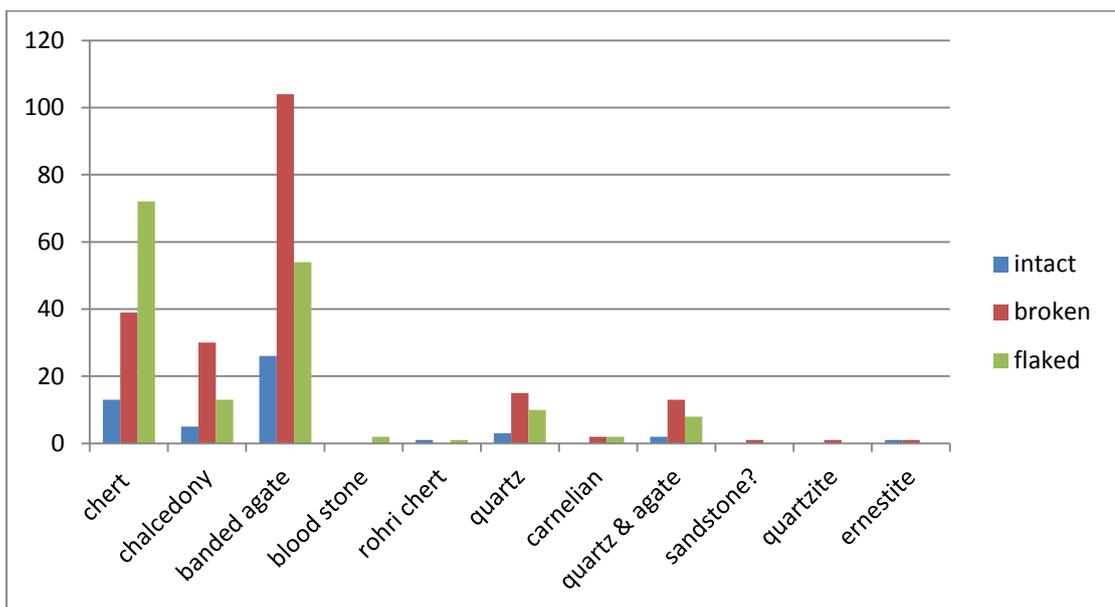


Figure 3.69: Condition of nodules at Shikarpur

Core rejuvenation flakes

A total of two core rejuvenation flakes were found from the lithic assemblage. One each belonging to the raw materials chert and chalcedony. Low presence of core rejuvenation flakes might suggest that cores were made out of small nodules and thus most probably it was not necessary or practical to rejuvenate an exhausted core (table 3.65).

Table 3.65: Measurements of core rejuvenation flakes in mm at Shikarpur

	Length	Breadth	Thickness
Chert	26.37	18.96	7.13
Chalcedony	15.45	12.37	6.17

Waste/shatter

Undiagnostic broken fragments or tiny debitage pieces without any specific shape or form have been classified in this category. 87.09% (627) waste belongs to the raw materials chert, chalcedony and banded agate. 5.42% (39) waste/shatter belonged to the carnelian and 2.36% (17) to quartz. Rest of the raw materials (moss agate, blood stone, Rohri chert, sandstone, amazonite, quartzite, calcite, ernestite) are represented between 0.1% and 1.7% (37 fragments) (figure 3.70).

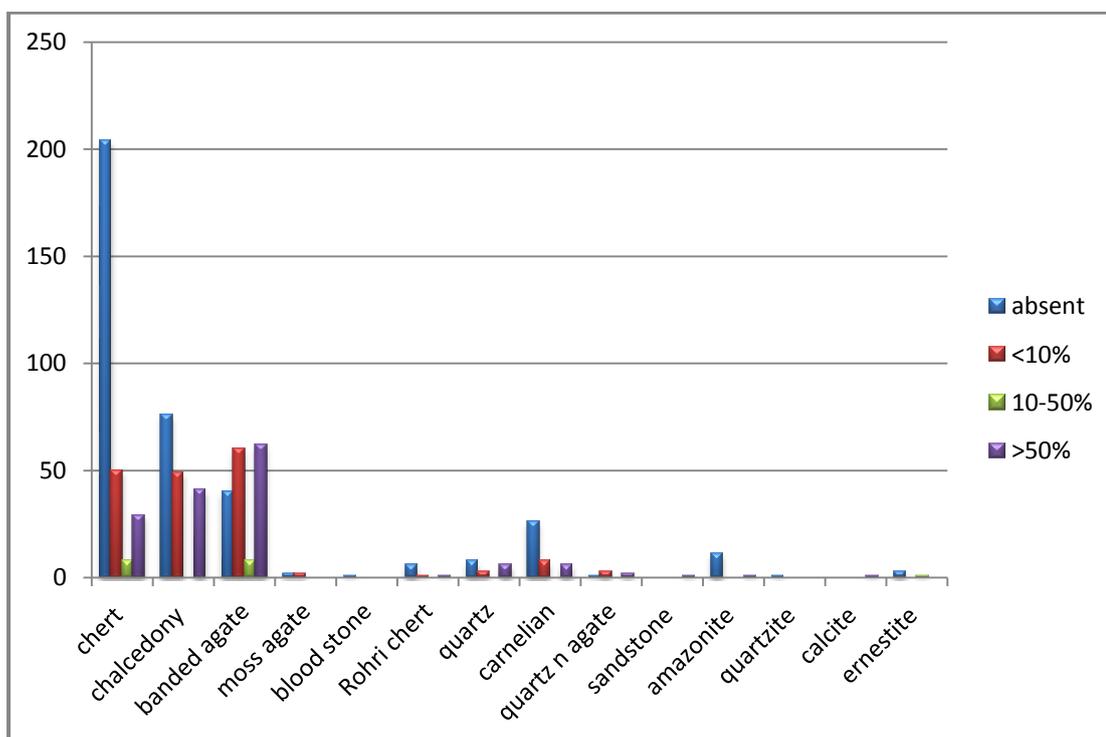


Figure 3.70: Cortex on waste/shatter vs raw material at Shikarpur

Cores

A total of 19 cores were found amongst the lithic assemblage. Out of these 4 were core fragments and thus were not selected for any detail analysis. 15 cores were properly analyzed and all were found to belong to one category; blade cores (figure 3.73a and figure 3.73b).

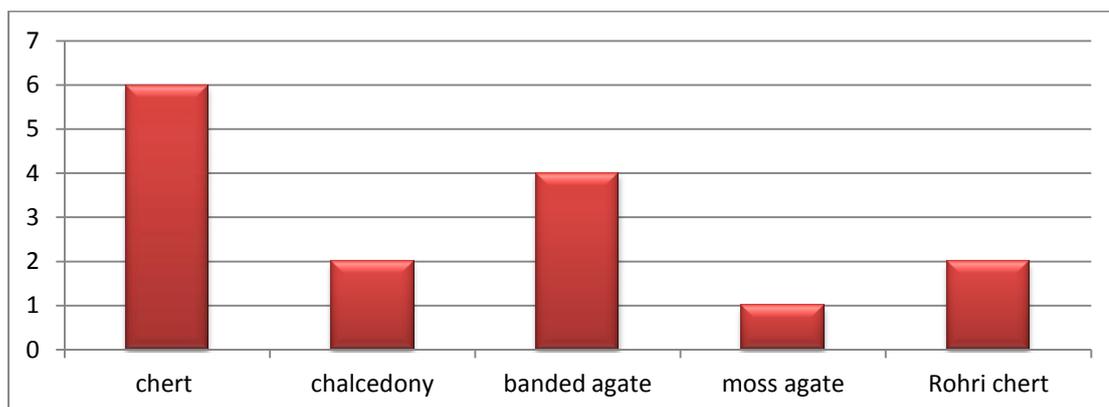


Figure 3.71: Blade cores vs raw materials at Shikarpur

Core shape

Cores were found to belong to conical, cylindrical and semi-conical shapes. Cylindrical shape is represented at 9 or 60% (chert, chalcedony, banded agate, Rohri chert), conical at 5 or 33.3% (chert, chalcedony, moss agate and Rohri chert) and semi-conical (banded agate) at 1 or 6.7% (figure 3.72).

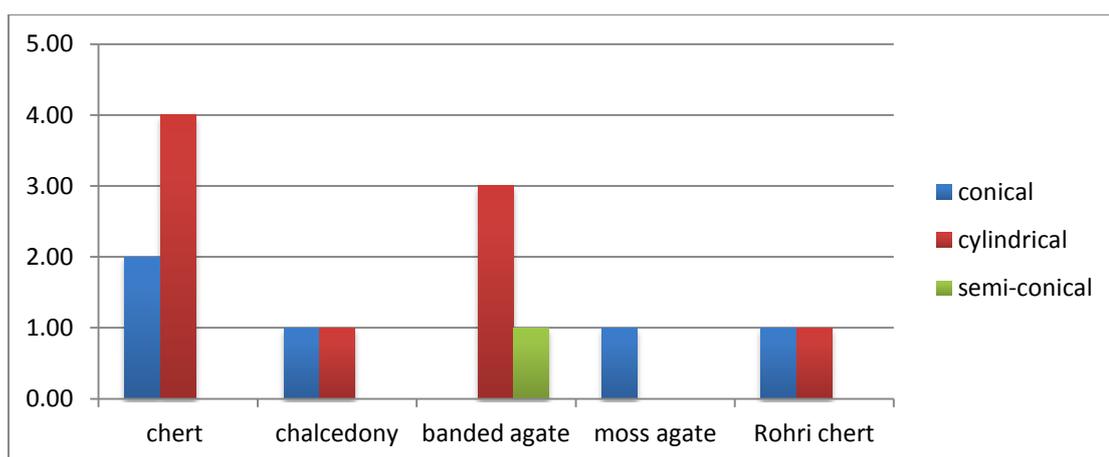


Figure 3.72: Blade core shapes vs raw materials at Shikarpur

Blade removal pattern

Majority (60%) of the blades (9) were removed by rotating the core while 40% (4) showed evidence of slicing the core. Blades were removed from blade cores

belonging to chert, chalcedony, banded agate and moss agate by either rotating the core or slicing the core whereas blades were removed out of moss agate cores only through rotating the core.

Core platform preparation

A single flake was removed for 7 or 46.7% of the cores. This was done on core shaped such as conical, cylindrical and semi-conical. Multiple flakes (33.33% or 5 cores) were removed for platform preparation for conical and cylindrical cores. No platform preparation (13.3% or 2 cores) was seen on afore mentioned core categories. All the cores had a single platform.

Condition of core butt

33.3% (5) core butts showed removal of a single flake on their butt ends. 20% (3) showed breakage at the butt end. 13.3% (2) showed presence of some amount of cortex on their butt ends. And the remaining 33.3% (5) were found to be without any specific attribute.

Cortex

Conical cores were found to be either without any cortex (1) or with less than 10% cortex on their surface (4). Cylindrical cores, however, showed presence of cortex (6 or 66.6%) more than the absence of cortex (3 or 33.3%). Semi-conical core (1) was covered with cortex on the surface opposite the flaked surface.

Metric analysis of cores

Rohri chert cores

Two cores of rohri chert were found during the excavations. One is a huge conical core (figure 3.73a) and the other a cylindrical core (table 3.66). The conical core corresponds with the descriptions given by Biagi of big cores found from Rohri hill quarries. (Biagi and Starnini 2012). Discovery of this core proves that a very limited amount of blade production was most probably carried on at the site.

Table 3.66: Metrics in mm of Rohri chert cores at Shikarpur

	Length	Breadth	Thickness	Weight (g)
Conical	116.61	37.22	26.45	171.6
Cylindrical	50.57	24.74	17.56	28.47

Cores made of other raw materials

Conical cores were found to be the longest, broadest and thickest of cores amongst all the core categories (table 3.67).



Figure 3.73a: Rohri chert blade core from Shikarpur (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara, Abhayam G.S.)



Figure 3.73b: Blade cores from Shikarpur (courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda)

Length

All the cores have a high standard deviation value which clearly suggests variation in their lengths (table 3.67). Conical cores appear to be the longest while the semi-conical core was found to be the shortest core.

Table 3.67: Metrics in mm of lengths of different types of cores at Shikarpur

	No	Mean	Median	Mode	Std dev	Variance
Conical	4	38.86	20.84	16.77	43.53	1895.45
Cylindrical	8	26.73	25.56	12.02	11.18	125.06
Semi-conical	1	17.73				

Breadth

Standard deviation values for conical core breadths are high which clearly suggests variation (table 3.68). Comparatively the standard deviation values for cylindrical

cores are low and suggest a certain level of uniformity. Conical cores were found to be the broadest of cores while semi-conical core was the narrowest.

Table 3.68: Metrics in mm of breadths of different types of cores at Shikarpur

	No	Mean	Median	Mode	Std dev	Variance
Conical	4	22.93	21.26	15.24	8.62	74.3
Cylindrical	8	18.95	17.6	13.27	3.55	12.59
Semi-conical	1	15.93				

Thickness

Here again it can be seen that the thickness values for conical cores are very varied while the thickness values for cylindrical cores are comparatively standard (table 3.69).

Table 3.69: Metrics in mm of thickness of different types of cores at Shikarpur

	No	Mean	Median	Mode	Std dev	Variance
Conical	4	16.23	15.15	10.86	6.36	40.5
Cylindrical	8	15.89	14.66	11.91	3.01	9.02
Semi-conical	1	8.33				

Summary

The lithic assemblage recovered from the field seasons 2007-08 till 2012-2013 from Shikarpur is represented by blades (736), geometric and non-geometric tools (33) and lithic debitage (4460). This fortified site has been excavated for six field seasons. More than 80 trenches have been excavated during this time. It was found that 46.2% of lithic assemblage belongs to trenches (Er10, Er13, Er14, Er2, Er5, Er6, Er9, Ew2, El16, Em11, Em12, Em13, Em15, Em16) which are situated almost at the center of the fortification. Trenches which are situated outside the fortification have about 12.3% lithic assemblage.

Rohri chert blades dominate the blade assemblage at 89%. Majority (58.3%) of Rohri chert blade fragments are of mesial condition. Amongst the intact blades and proximal blade fragments the highest percentage of proximal end forms are 'triangular'

followed by 'rectangular', 'gull winged', 'irregularly rectangular' and 'lenticular'. Proximal end types are found to be of the category 'single' and proximal end shape as 'pointed'. Proximal end width varied between blades while the thickness is found to be more or less of a standardized size. Plunging and feathered types of distal end terminations were found to be most common amongst intact and distal blade fragments. Clean snapping was the most common amongst broken blades. 98.2% blades were found to be devoid of any amount of cortex. It was also seen that most of the time retouched blades were found to be without any cortex. More than 70% blades were found to have edge damages, leading to the conclusion that they had been used for some purpose. More than 12% blades were retouched in one or the other form. Most of the blades were utilized from their dorsal sides. It appears that right edge was preferred more than the left edge. Though for bifacial utilization it was seen that left edge of the blade showed more edge damage. No retouches were found on the left edge of the blades. Lengths of intact as well as broken blades show large variation in their standard deviation values. Breadth and thickness on the other hand show low values of standard deviation confirming their uniformity. The only exception here is the breadth value of intact blades, which are very varied.

Blades made out of chert, chalcedony, banded agate, moss agate, blood stone and carnelian: Majority of the blades in this category were found to be mesial (44.4%) fragments. Intact blades comprised 18.5%; proximal blade fragments were 29.6% and distal blade fragments were found to consist of 7.4% of the assemblage. 'Triangular' proximal end form was found to be the most common amongst intact and proximally broken blades. 'Single' proximal end type and 'pointed' proximal end was the most common proximal features amongst the blades. Measurements of platform ends do not seem to vary much between blades of various raw materials. 'Plunging' followed by 'feathered' was the most common type of distal end termination for intact blades. 'Snapping' was the most common for broken blades. Most of the specialized tools (retouched tools) were made on secondary blades. Majority of the blades (64.2%) showed slight to heavy edge damage, mostly on their left edges. Retouches were done exclusively on right edges of these blades and consisted of dorsal retouches and notches. Breadths and thicknesses of simple intact blades are standard. Intact blade flakes, on the other hand, show a very high variation in their measurements. Lengths of all the broken blades show very varied values. The exception is seen in the lengths

of crested ridge blades which show less difference in their lengths. Breadths and thickness values appear more or less of standard size for all the different type of blades.

Very few geometric and non-geometric tools have been found from Shikarpur. Geometric tools discovered from the site include lunates and trapeziums while non-geometric tools comprise of points, burin and end scrapers. The central trenches contained more than 40% of these tools. Geometric tools were found to be made exclusively out of chalcedony while the non-geometric tools were made out of, apart from chalcedony, chert, banded agate, blood stone and Rohri chert. The lunates were made out of secondary blades of chalcedony and were found in intact condition. Both of them showed edge damages and a big difference was observed in their sizes. The one and only trapeziums was found to be made out of secondary blade of chalcedony, was in intact condition and showed signs of utilization. Points were made out of Rohri chert, chalcedony, chert and banded agate. 9 points were found to be intact while 11 were found in broken condition. 18 were found to be without cortex while 2 showed some amount of cortex present on their dorsal side. They show a lot of variation in their sizes. All the seven burins were found in intact condition and were made out of secondary flakes. 6 of these were made out of Rohri chert while 1 was made of chalcedony. Their lengths are very diverse but breadth and thickness appear to be somewhat of a standardised size. All three end scrapers were found to be intact and were made on secondary flakes. 2 were made out of blood stone while 1 was made on Rohri chert flake. All of them appear to be utilized. Their sizes were very different.

Lithic debitage recovered from the site was classified into flakes (primary, secondary and core rejuvenation flakes), nodules, cores, chunks (bead rough-outs?) and waste/shatter. 52% flakes were primary flakes with varying amount of cortex on their dorsal side. 86% flakes were found intact while 14% flakes were found in broken condition. About 98% flakes were not utilized for any purpose and thus belong to the category of debitage. 0.5% flakes showed signs of secondary retouching while 1.2% flakes appeared to have been utilized for some purpose. Size frequency of flakes (primary and secondary flakes) showed that maximum number of flakes belonged to the size category of 0.5-1cm (60.56%) followed by 1-1.5cm (23.06%). Very few flakes (0.58%) of sizes 3cm or up were found from the assemblage.

Complete nodules were very few in number; mostly they were found either broken or randomly flaked. Core rejuvenation flakes belonged to raw materials chalcedony, chert and banded agate. Waste/shatter comprised almost 16% of the lithic debitage recovered from the site.

All the cores found from the assemblage belong to the category of blade cores. A total of 19 cores were found out of which 4 were core fragments. Cylindrical followed by conical shape were the most common shapes amongst blade cores. Blades were removed out of these cores by either 'rotating the core' or 'slicing' them unidirectionally. Most of the blade cores had showed a 'single flake' removal to prepare the platform. Cortex was present on almost all the cores. Two cores of Rohri chert were found during the excavations. One is a huge conical core and the other a cylindrical core. Measurements of all the different blade cores showed a lot of variation. Conical cores were found to be the longest, broadest and thickest of cores amongst all the core categories.

Chapter 3 - Section III

Lithic assemblages from Mesolithic and Sorath Harappan Contexts

This section deals with the lithic assemblages associated with the Mesolithic and Sorath Harappan Chalcolithic periods recovered from the site of Pithad. The lithic assemblage belonging to Mesolithic period is discussed first followed by the lithic assemblage belonging to the Sorath Harappan period.

PITHAD/JAIDAK NO TIMBO (Mesolithic Period)

The Mesolithic period lithic assemblage at Pithad comprises of 380 blades, 172 geometric and non-geometric tools and 3,723 fragments of lithic debitage including 130 exhausted cores. Three trenches were excavated at the site and they comprise of six layers belonging to two distinct periods. Period I, represented by layers 3, 4, 5 and 6, belong to the Mesolithic period culture while layers 1 and 2 belong to Period II, Sorath Harappan (IAR 1991-92, Ajithprasad 2008). Since three trenches were excavated during 1992 field season a trench wise representation followed by a layer wise distribution of the lithic assemblage is presented below (table 3.70 & 3.71).

Here we will be dealing with the lithic assemblage excavated during 1991-92 field

season, majority of which, as noted earlier in chapter 2, comprises of material belonging to the Mesolithic period. The few fragments belonging to the Chalcolithic period excavated during this field season will be discussed later in this section.

Table: 3.70: Trenchwise representation of the lithic debitage at Pithad (1992)

TRENCH	Blades	Geometric & non-geometric tools	Percentage	Lithic debitage	Percentage
I	189	97	56.73%	1826	50.82%
II	133	63	36.84%	1389	38.66%
III	58	11	6.43%	378	10.52%
Total	380	171	100.00%	3593	100.00%

Table 3.71: Representation of layers at Pithad (1992)

Layer	Blades	Geometric & non-geometric tools	Cores	Lithic debitage	Total	Percentage
1	4	7	1	11	23	0.54
2	15	4	11	164	194	4.54
3	50	21	49	706	826	19.33
4	210	59	57	1562	1888	44.18
5	88	53	10	984	1135	26.56
6	13	27	1	166	207	4.84
Total	380	171	129	3593	4273	100.00

Overview of tool types

Blades

The blades in the assemblage are dominated by simple blades (248 or 68.7%) and blade flakes (65 or 18%) types (figure 3.74). Retouched blade types such as backed blades, retouched blades and obliquely blunted blades are represented by small numbers (46 or 12.8%). The majority of simple blades are in contrast with Mesolithic period at Loteshwar where blade assemblage is dominated by blade flakes. The crested guiding ridge blade found from here has a half crest on its dorsal surface and thus is not a true crested ridge blade (figure 3.75).

Raw materials

Chert was the raw material utilized most (195 or 54% blades are made out of this raw

material) to make different variety of blades. Moss agate (86 blades 23.8%), chalcedony (50 blades 13.9%), banded agate (15 blades 4.2%), carnelian (9 blades 2.5%) and blood stone (6 blades 1.7%) are some of the other raw materials which were utilized for blade manufacturing activity. It appears that blood stone and carnelian were exclusively used for simple blades and blade flakes (figure 3.76).



Figure 3.74: Blades from the Mesolithic period at Pithad (courtesy: Department of Archaeology, The M.S.University of Baroda, Vadodara)

Condition of blades

The maximum numbers (118 or 32.7%) of blades were represented by their proximal ends, closely followed by intact blades (112 or 31%). The numbers representing mesial (69 fragments 19.1%) and distal fragments (62 or 17.2%) are almost the same. Simple blades (54) as well as blade flakes (42) were mostly found in intact condition (figure 3.77).

Proximal end conditions

Intact blades as well as proximally broken blades have been included in this analysis.



Figure 3.75: Crested blade from Chalcolithic period and half crested blade from the Mesolithic period of Pithad (courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

Proximal end form, type and shape

11 different types of proximal end forms were noted (table 3.72). Five different varieties of proximal end types and three different varieties of proximal end shapes were noted for all proximal end forms numbered from 1 till 8. As noted earlier too, scholars believe that flat or single striking platform is formed when flakes are removed from unidirectional cores (Andrefsky 2005: 164). Mesolithic period blades of Pithad were manufactured using a unique technique, ‘slashed flake’ where large flakes were converted into blade-cores with remarkable efficiency (Ajithprasad 1992). Blades/flakes with a diffuse bulb of force and a pronounced lip have been called soft hammer percussion flakes (Crabtree 1972: 74).

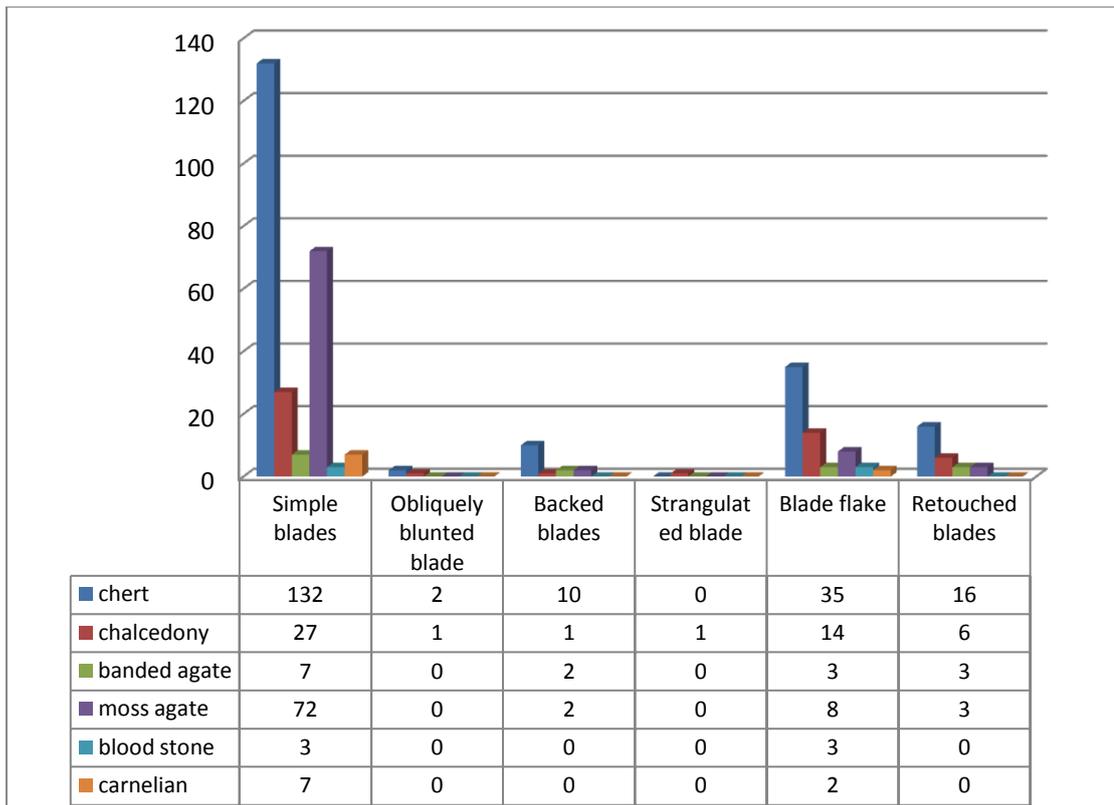


Figure 3.76: Various types of blades according to raw materials during Mesolithic period at Pithad

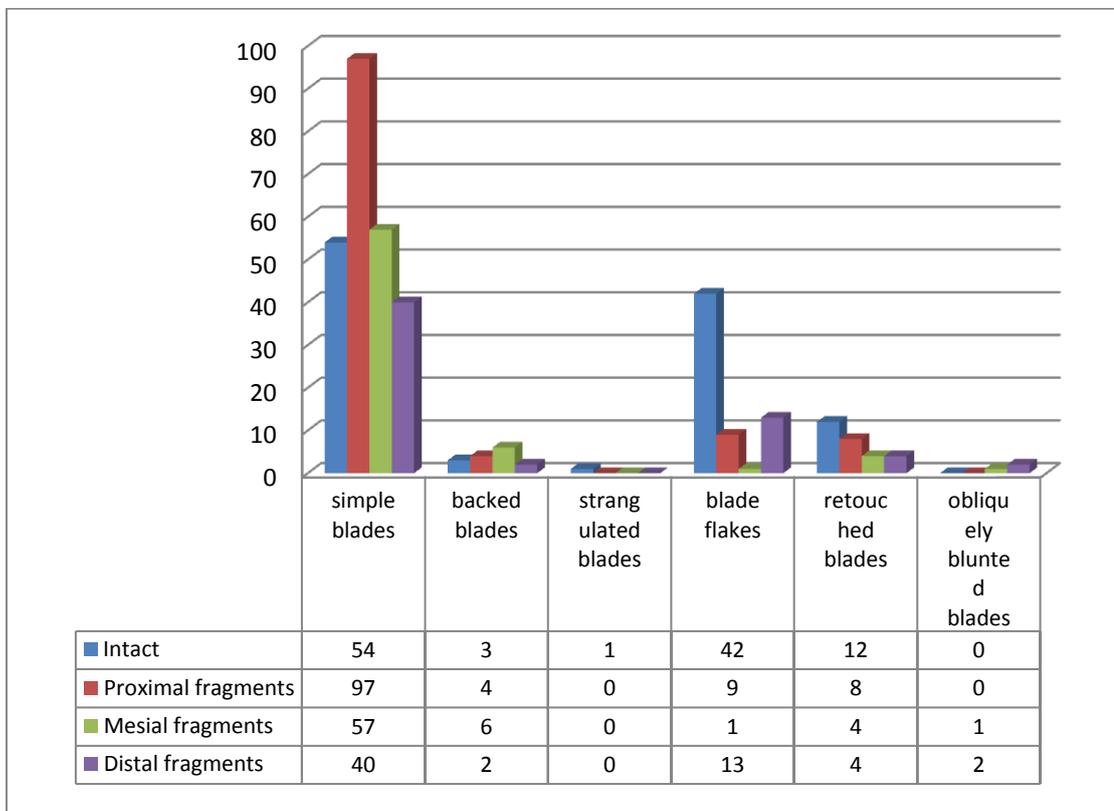


Figure 3.77: Condition of blades during the Mesolithic period at Pithad

Table 3.72: Proximal conditions of intact as well as proximal fragments of blades during Mesolithic period at Pithad

Form	No.	Percent	Type	No.	Percent	Shape	No.	Percent
Rectangular	32	14.0%	Single	145	82.4%	Lipped	99	56.3%
Lenticular	49	21.5%	Dihedral	10	5.7%	Pointed	54	30.7%
Irregularly lenticular	52	22.8%	Multiple	17	9.7%	Bulb scar	23	13.1%
Triangular	41	18.0%	Cortex/patina	4	2.03%	Total	176	100.0%
Irregularly triangular	1	0.4%	Total	176	100.0%			
Gull winged	1	0.4%						
Semi-circular	3	1.3%						
Irregularly shaped wide platform	48	21.1%						
Retouched	1	0.4%						
Total	228	100.0%						

Proximal end platform width and thickness

As can be clearly seen from the table 3.73, proximal width varies a lot between blades while the thickness was more or less of standardized size.

Table 3.73: Metrics in mm of platform width and thickness of blades during Mesolithic period at Pithad

	Mean	Median	Mode	Std dev	Variance
Width	4.86	3.73	2.76	3.23	10.47
Thickness	2.3	1.77	1.14	1.59	2.53

Types of distal end terminations

Distal portion of intact blades and distally broken blades have been classified for different distal end terminations such as feathered, hinged, stepped, plunging, retouched, used or both retouched as well as used. Feathered, hinged and plunging terminations indicate that the blade or flake is intact while step terminations indicate a broken blade (Andrefsky 2005: 88). 'Retouched', 'used' and 'retouched plus used' can be assigned to both intact as well as broken blade categories.

Intact Blades and Distal Blade Fragments

Almost half (79 blades 45.4%) of the distal end terminations for the intact and distal fragments belonged to the category of ‘feathered’. Not many were retouched at their distal ends (15 blades or 8.6%) and very few (4 blades 2.3%) were used from their distal ends (figure 3.78).

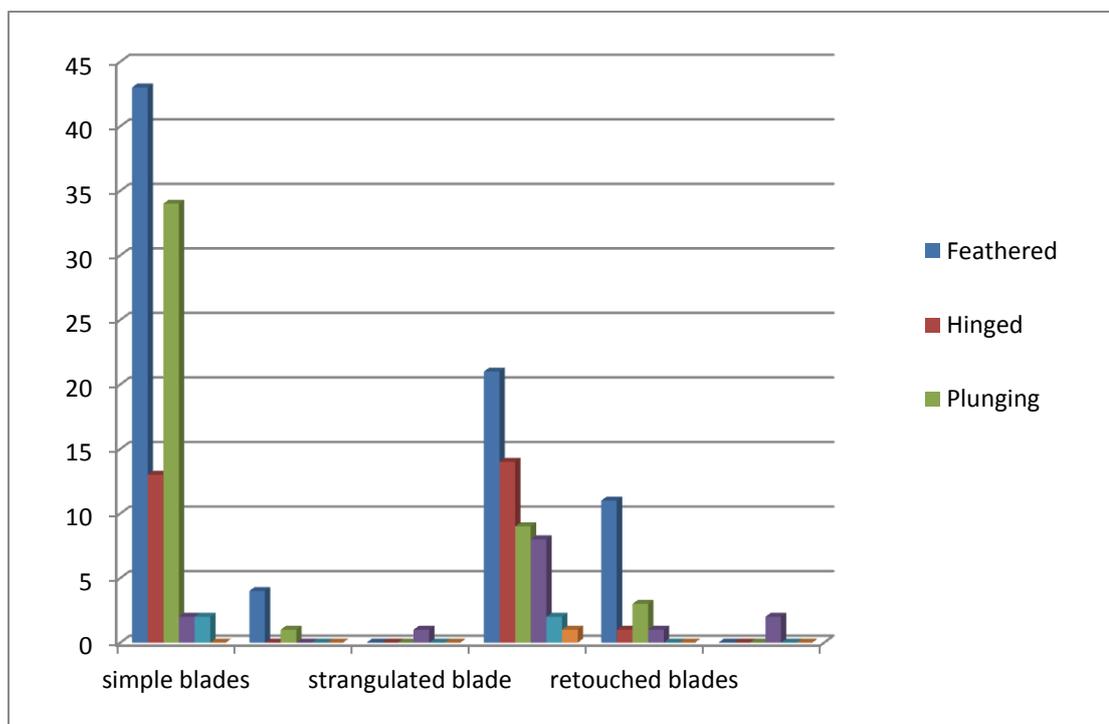


Figure 3.78: Distal end types for intact and distal blade fragments of Mesolithic period at Pithad

Proximal and Mesial Blade Fragments

Clean snapping of blades was the most common (166 blades 88.8%) (figure 3.79). Can we presume that they broke while they were in use and were discarded? Or were these intentionally broken? Intentional breakage, however, does not seem the plausible answer as these blades are quite small in measurement. We will see that when we have a look at the measurements. Stepped fracture, represented in 14 blades (7.5%) denotes a breakage while removal (Andrefsky 2005: 88).

Presence of cortex on blades

Simple blades (32 or 12.9%) and blade flakes (25 or 38.5%) show varying amount of cortex on their dorsal surface, leading to the conclusion that they were manufactured at the site itself. Secondary blades were preferred to carry out further retouching on them (figure 3.80).

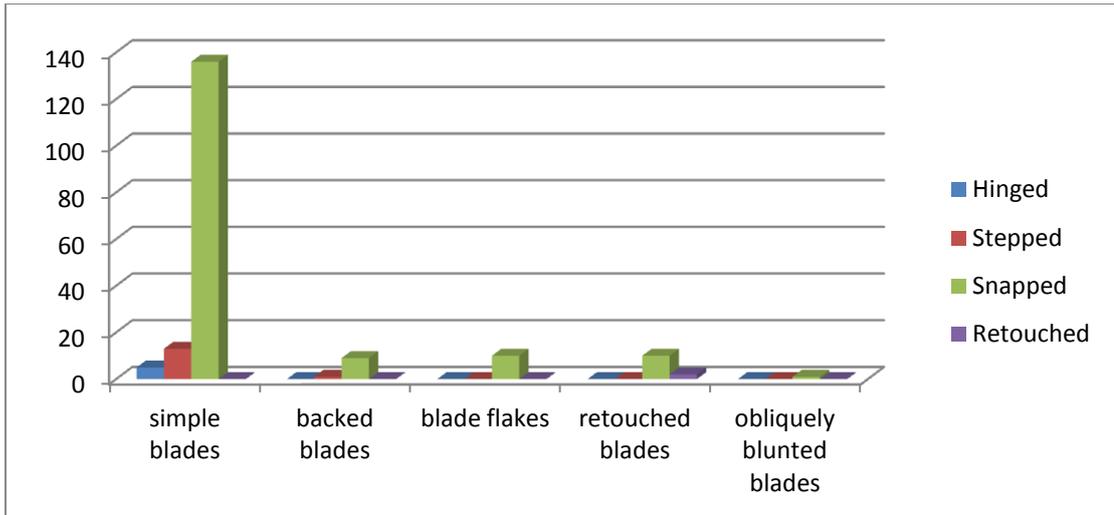


Figure 3.79: Distal end terminations for proximal and mesial blade fragments of Mesolithic period at Pithad

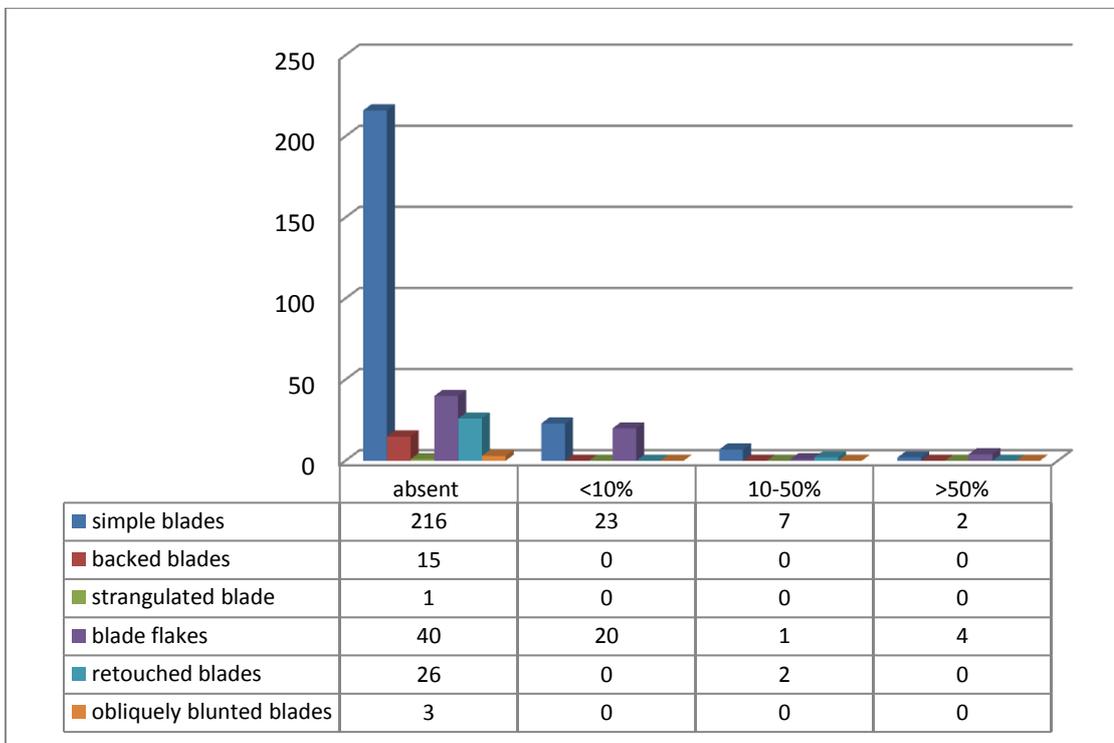


Figure 3.80: Representation of cortex on various blade types of Mesolithic period at Pithad

Edge damage and retouches

Almost half of the blades (158 blades or 43.8%) do not show any kind of edge damage leading to the conclusion that they were not utilized. This is in stark contrast to Mesolithic period of Loteshwar where a majority of blades showed evidence of utilization. It is also seen here that retouched blades were utilized most of the times (figure 3.81).

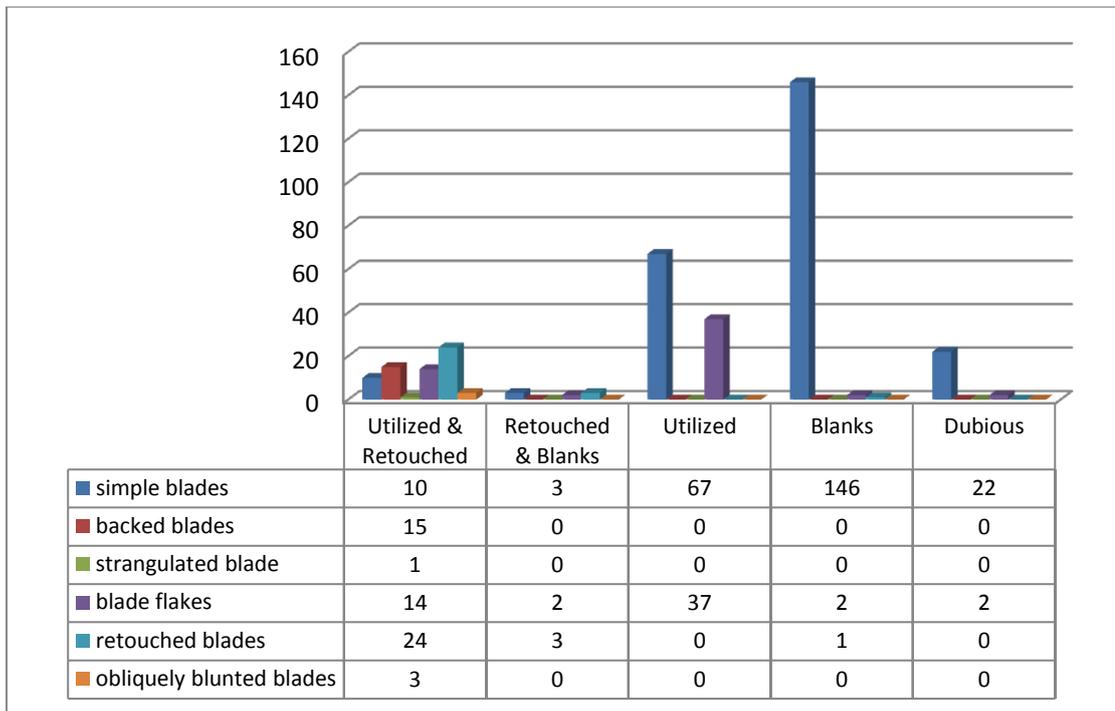


Figure 3.81: Representation of edge damages and retouches on blades during Mesolithic period at Pithad

Edge condition – Utilization

It appears that more (106) blades were utilized through their right edges than through their left edges (100). Edge damage was more frequent on the dorsal side (128 blades) than ventral side (29 blades). Bifacial utilization, whenever seen, was almost the same for both the sides.

Edge condition- Retouches

Very surprisingly it was seen that no retouches were carried out on the right edge of blades. Whatever retouches were done, were done only on the left edge of the blade. Here again it was observed that secondary retouches were carried out more on the dorsal surface (25 blades) than on the ventral surface (14 blades).

Metric comparison between different types of intact blades

Length

As can be seen from the table 3.74, the standard deviation values of all the blades are very high, suggesting a big difference in their lengths. Blade flakes are the longest blades recorded, strangulated blade is the shortest. Simple blades and backed blades follow similar types of measurement values, corroborating the fact that backed blades were made out of simple blades.

Table 3.74: Metric (in mm) comparison of lengths of different intact blades of Mesolithic period at Pithad

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	54	16.37	15.6	9.39	4.49	20.25
Backed blades	3	16.37	15.22	11.38	5.66	32.02
Strangulated blade	1	12.67				
Blade flakes	42	19.25	18.41	22.94	6.68	44.6
Retouched blades	12	17.93	17.18	9.32	8.72	75.99

Breadth

Except the standard deviation value of simple blades, other blades show high values, suggesting big differences in their breadths (table 3.75). Blade flakes are the broadest of blades while simple blades are the narrowest (not considering the single value of strangulated blade). Since retouched blades show a mean value of breadth more than the value for simple blades, it seems that broad blades were selected for retouching.

Table 3.75: Metric (in mm) comparison of breadths of different intact blades at Mesolithic period of Pithad

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	54	6.4	6.21	5.91	1.9	3.63
Backed blades	3	8.08	8.14	4.42	3.64	13.25
Strangulated blade	1	5.03				
Blade flakes	42	13.92	11.73	3.98	6.6	43.63
Retouched blades	12	11.44	11.86	6.18	4.55	20.78

Thickness

The standard deviation values between different types of blades do not show a big difference, suggesting that their breadths were more or less of standard size (table 3.76). Here again it can be seen that blade flakes are the thickest blades. Simple blades appear to be the thinnest blades of all. Retouched blades show values higher than simple blades, could it be possible that thicker blades were selected for retouching?

Metric comparison between different types of broken blade

It can be seen from the table 3.77 that lengths as well as breadths of these broken blades vary in size, which is reflected in their high values of standard deviation. Thicknesses appear to be standardized, except in the case of retouched blades.

Table 3.76: Metric (in mm) comparison of thicknesses of different intact blades of Mesolithic period at Pithad

Blade types	No	Mean	Median	Mode	Std dev	Variance
Simple blades	54	2.43	2.12	1.4	1.05	1.11
Backed blades	3	4.12	3.77	2.69	1.63	2.67
Strangulated blade	1	2.78				
Blade flakes	42	5.49	4.73	4.23	2.71	7.37
Retouched blades	12	4.92	5.06	2.92	1.46	2.14

Table 3.77: Metric (in mm) comparison of different broken blades of Mesolithic period at Pithad

Blade types No		Mean	Median	Mode	Std dev	Variance
Simple blades 194	Length	12.73	11.54	6.89	4.92	24.19
	Breadth	7.19	6.02	5.04	4.22	17.88
	Thickness	2.54	2.05	1.79	1.57	2.49
Backed blades 12	Length	13.36	12.81	6.57	4.85	23.59
	Breadth	7.27	7.53	4.19	2.25	5.05
	Thickness	3.57	3.60	1.06	1.74	3.01
Blade flakes 23	Length	17.46	16.41	8.68	6.36	40.43
	Breadth	16.90	16.45	7.42	7.17	51.45
	Thickness	5.16	5.04	1.96	1.96	3.86
Retouched blades 16	Length	15.08	13.33	8.60	6.09	37.2
	Breadth	12.98	11.58	5.06	6.63	43.94
	Thickness	5.41	4.57	1.98	3.52	12.37
Obliquely blunted blade 3	Length	9.13	8.67	8.26	1.16	1.35
	Breadth	5.68	5.89	3.98	1.61	2.57
	Thickness	2.00	1.52	1.44	0.9	0.81

Geometric and non-geometric tools

The microlithic tool assemblage of the Mesolithic period at Pithad is dominated by non-geometric variety, specifically by various types of scrapers 97 or 60%. This dominance of scrapers is in stark contrast with microlithic tool Mesolithic period assemblage found from Loteshwar. Other than the scrapers; points (19), burins (24) and borers (14) are also found in good quantity. Geometric tools, however, are very few (6) in number (figure 3.82).

It was also observed that almost all the scrapers were made by retouching old, abraded scrapers. This re-use of old tools suggests two theories. 1. There must have been older Stone Age sites in the vicinity of Pithad and thus these tools were available for further use. 2. Since these are heavily abraded, it is also possible that they were found from the nearby river. It has often been suggested that raw material were usually acquired from river beds. Scraping hide, most probably, was not the only function of scrapers. Experiments have shown that scrapers could have carried out various activities such as scraping, graving, boring, chopping and use as a projectile. It has also been observed by scholars that scrapers could have been used on wood, to clean bone, to slit bone, to slit hide, clean hide of hair and antler (Odell 1981, Siegel 1984). Microwear studies have also shown that scrapers were multifunctional tools (Andrefsky 2005: 62).

Metric analysis of geometric and non-geometric tools

Isosceles triangle

The one and only triangle recovered from the excavations was in intact condition. This was made on a primary blade and did not show any edge damage leading to the conclusion that it was not utilized. This triangle was found to be 12.15mm long, 5.78mm broad and 4.2mm thick.

Lunate

The lunates, 2 in total, were found in intact condition. They were made on secondary blades and showed edge damages thus most probably were utilized. The high standard deviation values for their lengths suggest variation in the lengths of both the lunates while low standard deviation values for breadth and thickness suggests that they were similar in these aspects of their size (table 3.78).

Table 3.78: Metric analysis of lunates in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	2	14.95	14.95	11.72	4.57	20.93
Breadth		7.2	7.5	6.44	1.08	1.17
Thickness		4.91	4.91	3.67	1.76	3.1

Trapezium

Two trapeziums were found to be in intact while one was found to be in broken

condition. 2 of these were made on secondary blades while one showed presence of cortex. All three showed edge damages and most probably were utilized for some purpose. Lengths of these three seem to vary a little but breadths and thickness appear to be similar for all of them (table 3.79).

Table 3.79: Metric analysis of trapeziums in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	3	11.89	12.35	10.21	1.5	2.26
Breadth		5.04	4.8	4.71	0.47	0.22
Thickness		1.62	1.61	1.45	0.17	0.03

Point

17 points were found to be in intact condition while 2 were broken. 18 were made out of secondary flakes while 1 had some cortex present on the dorsal side. Most probably all were utilized. High values for the measurements suggest a variation in all the aspects of their size (table 3.80).

Table 3.80: Metric analysis of points in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	19	16.69	15.99	6.32	7.27	52.96
Breadth		8.2	7.17	2.77	5.7	32.49
Thickness		4.13	3.11	1.38	2.84	8.07

Burin

23 burins were found in intact condition while one was found broken. 22 were made on secondary flakes while 2 showed presence of varying amount of cortex. 22 showed signs of utilization while 2 were difficult to see. High values for their lengths and breadths suggest variation in these but comparatively low value of thickness suggests uniformity (table 3.81).

Table 3.81: Metric analysis of burins in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	24	13.2	12.96	6.57	3.87	14.99
Breadth		7.32	6.61	4.44	2.95	8.68
Thickness		4.16	4.08	3.54	1.69	2.87

Borer

None of the borers were found in broken condition. 13 were made from secondary flakes while 1 was made out of a primary flake. Most probably all were utilized. Here again high standard deviation values for lengths and breadths suggest variation in these values while low standard deviation value for thickness points towards uniformity (table 3.82).

Table 3.82: Metric analysis of borers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	14	17.34	15.88	9.05	6.84	46.9
Breadth		7.85	6.22	5.82	4.34	18.8
Thickness		4.8	4.61	2.65	1.8	3.26

End scraper

11 end scrapers were intact while one was broken. Half of the scrapers were found to be devoid of any cortex while the other half showed varying amount of presence of cortex. Looking at the edge damages it can be concluded that most probably these were utilized. High standard deviation values for all the measurements suggest variation in all the aspects of size (table 3.83).

Table 3.83: Metric analysis of end scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	12	19.4	21.47	9.00	6.28	39.52
Breadth		24.41	25.51	10.21	9.58	91.78
Thickness		8.46	8.57	3.37	3.95	15.59

Side scraper

24 side scrapers were found intact, 2 had their proximal ends broken, 1 was a mesial fragment while 8 had their distal ends broken. 20 were found without any cortex, 13 had different amount of cortex present on the dorsal side. Most probably all of them were utilized. Here too high standard deviation values for all the measurements suggest variation in all the aspects of size (table 3.84).

Table 3.84: Metric analysis of side scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	33	30.98	29.35	13.92	9.61	92.4
Breadth		23.29	22.46	13.3	8.43	71.02
Thickness		10.33	8.76	12.96	5.38	28.94

Double sided scraper

23 double sided scrapers were found intact, 2 with proximal ends missing while 3 had their distal ends broken. 18 did not have any cortex while 11 showed presence of cortex in varying amount. As all showed edge damages, it appears that all of them were utilized. High standard deviation values suggest variation in sizes (table 3.85).

Table 3.85: Metric analysis of double sided scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	29	31.36	28.47	15.23	11.01	121.37
Breadth		22.1	21.38	27.37	5.83	33.97
Thickness		9.47	9.1	4.67	3.08	9.5

Concave scraper

All three concave scrapers were found intact. 3 were made on secondary flakes while one was made out of a primary flake. Most probably all were utilized. Breadth and thickness of these scrapers appear to be very varied while length is comparatively standard (table 3.86).

Table 3.86: Metric analysis of concave scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	3	27.83	26.31	25.25	3.59	12.93
Breadth		32.79	35.58	26.54	5.43	29.48
Thickness		8.5	5.29	5.06	5.76	33.25

Convex scraper

All three convex scrapers were in intact condition. 2 were made on secondary flakes while one was made out of a primary flake. It appears that all were utilized. High standard deviation values suggest great amount of variation in their sizes (table 3.87).

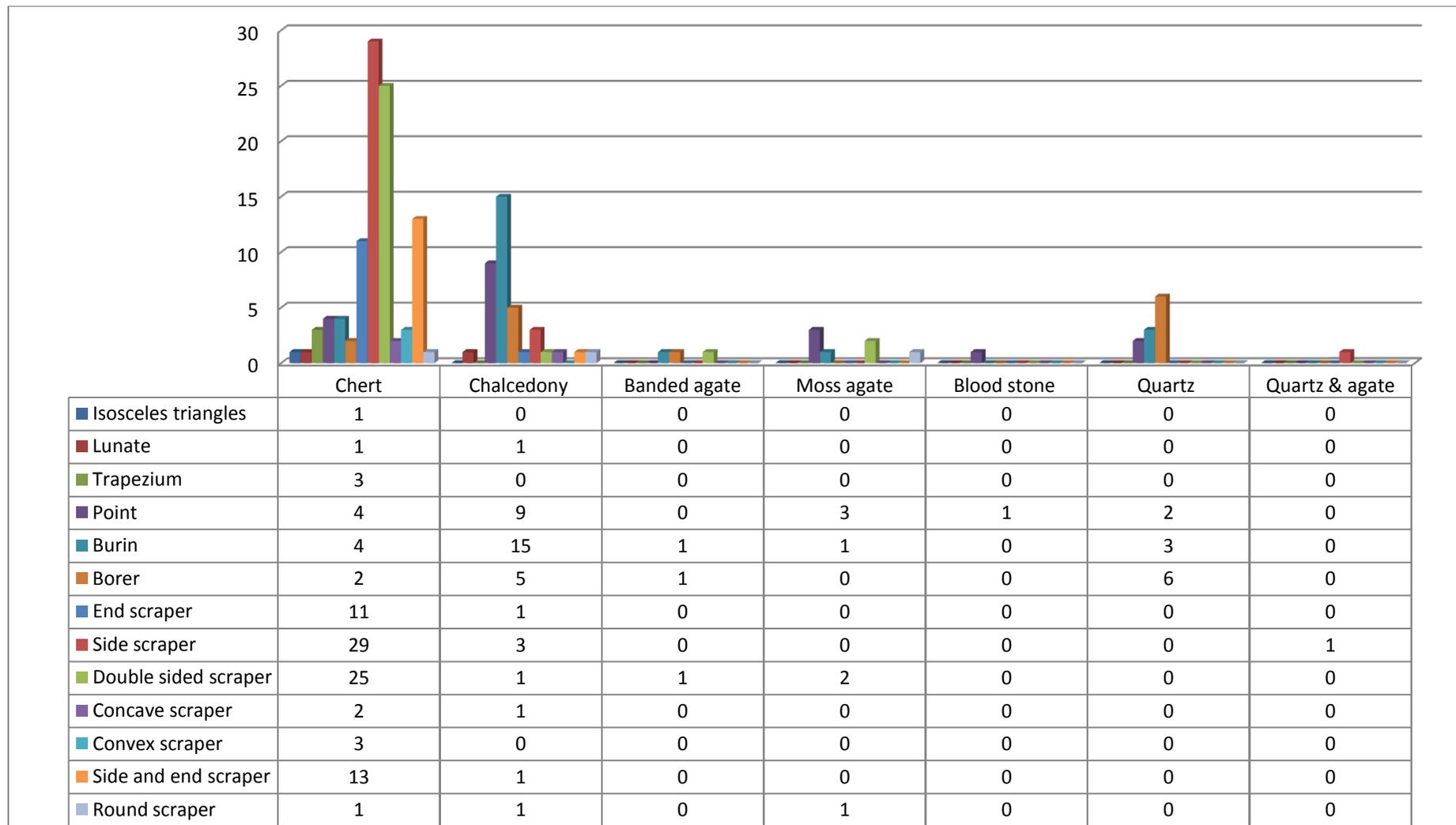


Figure 3.82: Representation of geometric and non-geometric tools according to raw materials for the Mesolithic period at Pithad

Table 3.87: Metric analysis of convex scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	3	18.07	13.38	12.81	8.62	74.43
Breadth		27.14	26.7	20.16	7.2	51.91
Thickness		8.31	6.15	5.86	3.99	15.96

Side and end scraper

12 side and end scrapers were intact while 2 had their proximal ends broken. 10 did not show cortex while 4 had varying amount of cortex present on their dorsal side. As all showed damage on their edges, most probably all of them were utilized. High standard deviation values suggest great amount of variation in their sizes (table 3.88).

Table 3.88: Metric analysis of side and end scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	14	31.28	28.1	17.2	10.56	111.59
Breadth		26.9	24.63	13.17	9.46	89.49
Thickness		10.02	10.99	4.13	3.32	11.05

Round scraper

All three round scrapers were in intact condition. All three were made on secondary flakes and all of them were utilized. High standard deviation values for lengths and thickness suggest variation while breadth appears to be standard (table 3.89).

Table 3.89: Metric analysis of round scrapers in mm from Mesolithic period at Pithad

	No.	Mean	Median	Mode	Std Dev	Variance
Length	3	17.48	16.83	12.51	5.33	28.46
Breadth		16.63	17.57	14.62	1.74	3.045
Thickness		5.9	5.29	3.84	2.43	5.92

Lithic debitage

Lithic debitage includes all the wastage produced during tools manufacture. As mentioned earlier, cores have been included in this category. Figure 3.86 gives the general classification of lithic debitage from the site.

Flakes

A total of 2598 flakes of different raw material were recovered. Mostly (2248 or 86.5%) they were found to be in intact condition. A striking feature was the high percentage (22%) of flakes which were actually flaked cores and thus they showed many negative flake scars on their dorsal side. Many of these flakes were flaked out of abraded nodules/flakes and a lot of times bore evidence of abrading on their dorsal surface. 25% flakes were found to be in abraded condition. Since quite a few flakes were reworked, re-flaked abraded flakes, it could be assumed that these abraded flakes were most probably gathered precisely for this purpose of reutilizing them. Figure 3.83 gives the representation of condition of flakes according to raw materials.

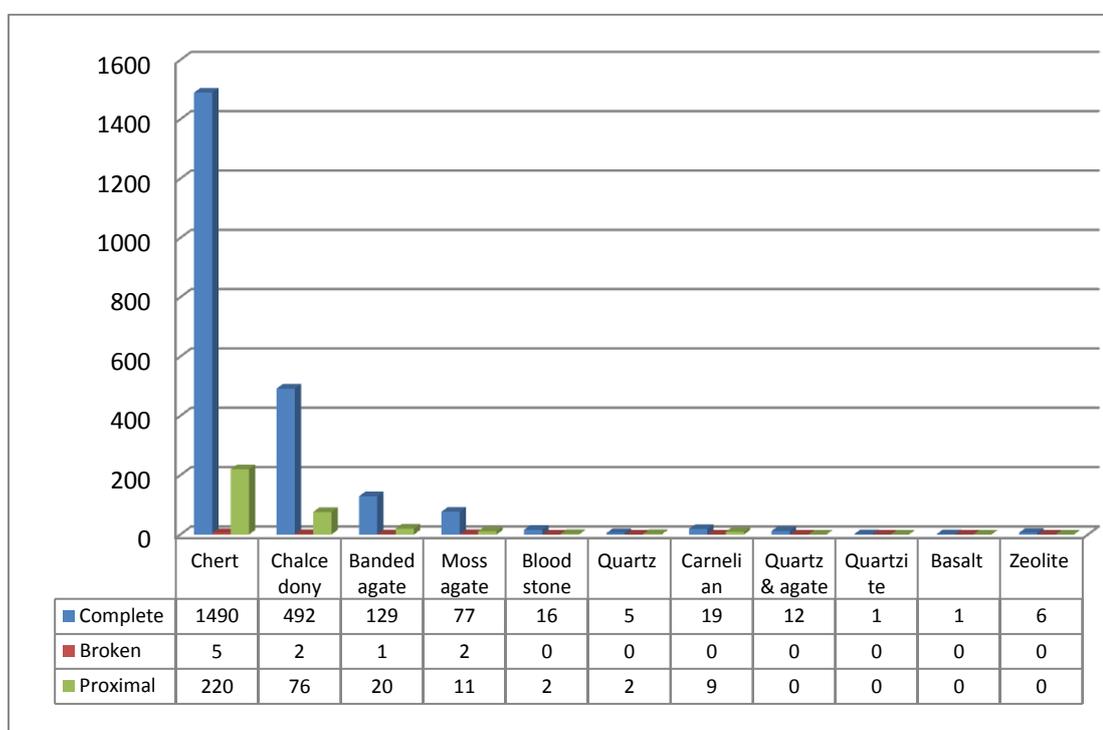


Figure 3.83: Representation of flakes conditions during Mesolithic period at Pithad

Cortex

It can be seen from the figure 3.84 that more than 56% flakes belong to the category of primary flakes, where varying amount of cortex was found on the dorsal surface of the flakes. This large percentage of primary flakes is taken to represent stone working/tool making at the site itself. If a flake debitage specimen contains a dorsal surface with mechanical or chemical weathering it is said to have cortex present.

Chemical weathering usually occurs as a result of exposure to moisture and/or heat causing the actual composition of the rock to change while mechanical weathering usually changes only the texture of the stone surface (Andrefsky 2005: 103). In my definition of cortex, I have considered only the chemical weathering to be representative of cortex and thus abraded specimens have not been put under the category of primary flakes.

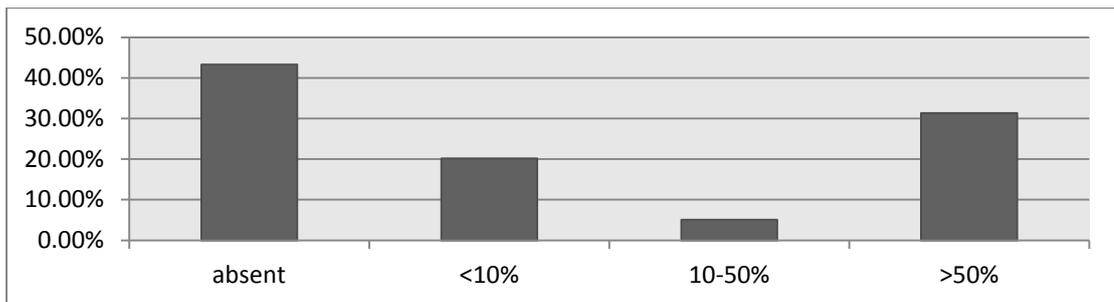


Figure 3.84: Representation of cortex on flakes during Mesolithic period at Pithad

Edge condition

Though 2496 or 96.1% flakes, as expected, were found to be devoid of any edge damages, 98 or 3.8% were found to have some amount of edge damages leading to the conclusion that they were utilized and around 17 or 0.7% were retouched.

Nodules

164 nodules were found (figure 3.85). About half (77) of these nodules were found to be broken into pieces (mostly broken into halves) but not flaked. Complete nodules are very few (18) in number. Many (69) were found to have been randomly flaked. 10% nodules were found to be in abraded condition. A few abraded nodules were found to have been flaked.

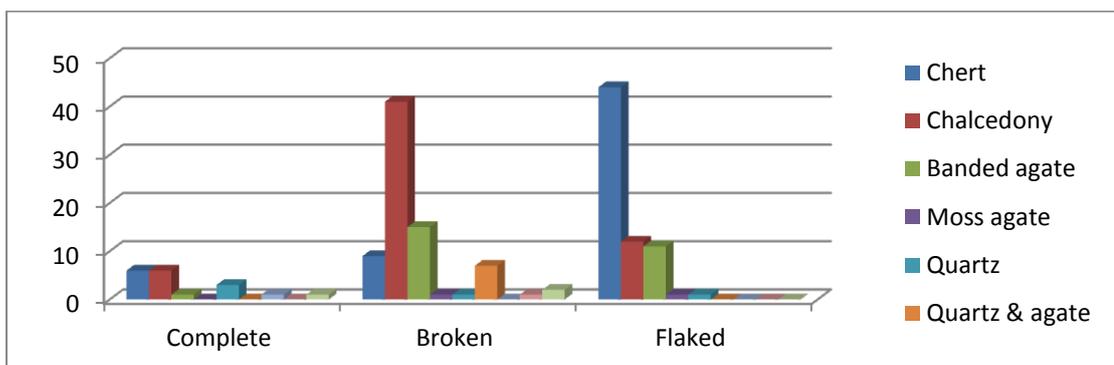


Figure 3.85: Representation of nodules belonging to Mesolithic period at Pithad

Core Rejuvenation Flakes

A total of 18 core rejuvenation flakes (CRF) were identified amongst the lithic debitage assemblage. 16 CRF were made out of chert, one from moss agate and one from blood stone. 14 were found intact, 3 had their distal ends broken while 1 was a mesial fragment. Measurements were taken only of intact flakes. 8 were found to be without cortex while 10 had varying amount of cortex present on their dorsal side. None had been utilized as tools, leaving their edges blank.

The core rejuvenation flake made out of blood stone, though is an isolated example, and appears to be longer, broader and thicker than all the other core rejuvenation flakes. The CRFs made out of chert have high standard deviation values for all three categories suggesting variation in their measurements (table 3.90).

Table 3.90: Metrics of core rejuvenation blades (in mm) of Mesolithic period at Pithad

	R.M.	No.	Mean	Median	Mode	Std dev	Variance
Length	Chert	12	20.31	22.93	29.19	8.18	66.85
	Moss agate	1	13.86			0.00	0.00
	Blood stone	1	21.79			0.00	0.00
Breadth	Chert	12	15.57	14.7	18.5	4.95	24.53
	Moss agate	1	9.3			0.00	0.00
	Blood stone	1	12.06			0.00	0.00
Thickness	Chert	12	7.2	7.83	9.23	2.2	4.85
	Moss agate	1	3.48			0.00	0.00
	Blood stone	1	12.87			0.00	0.00

Waste

It is interesting to observe that the waste fragments of lithic debitage either have very little (69 or 15.9%) or no cortex (188 or 43.2%) or have very high amount of cortex present (172 or 39.5%). The presence of different amount of cortex (figure 3.87) in this category most probably indicates that nodules were being worked at the site.

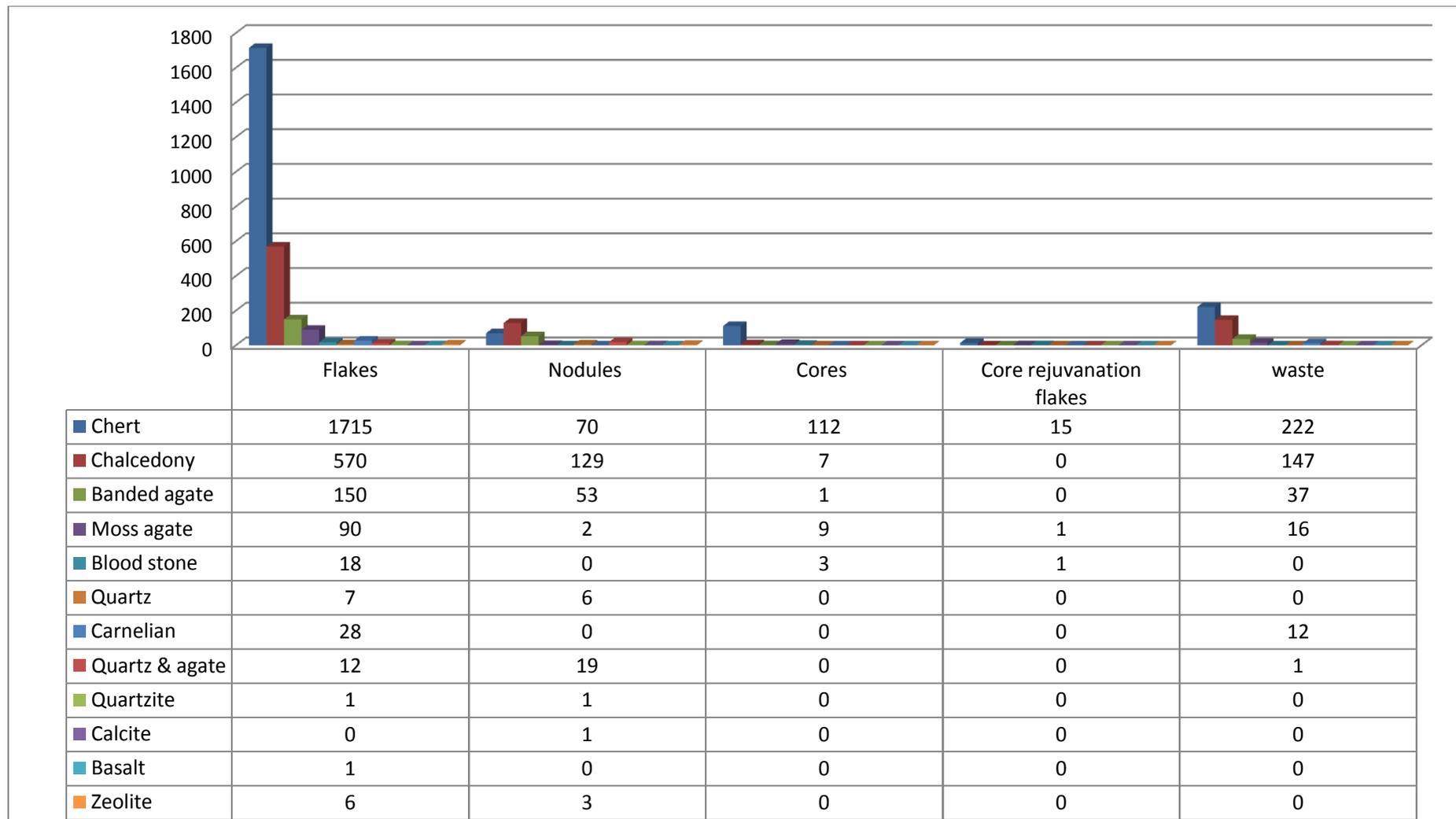


Figure 3.86: Representation of lithic debitage according to raw materials for the Mesolithic period at Pithad

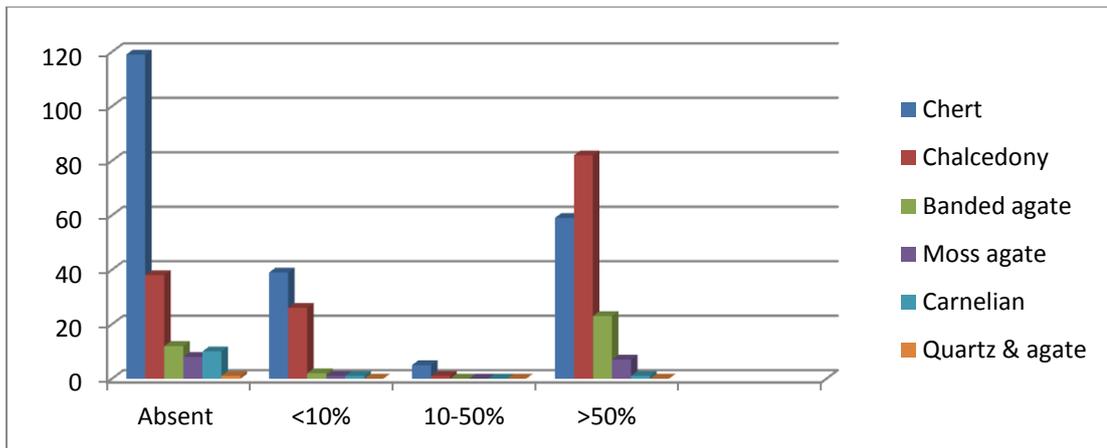


Figure 3.87: Representation of cortex on waste during Mesolithic period at Pithad

Cores

The intact cores found from Pithad Mesolithic period lithic assemblage are classified in two categories; blade cores and flake cores (figure 3.89). A total of 98 cores were identified from the assemblage, 78 (79.6%) are blade cores (figures 3.90, 3.91 & 3.92) while 20 (20.4%) are flake cores. As can be seen from the figure 3.88, majority of cores belong to raw material chert.

Core shape

Core shapes (figure 3.32) such as conical (29 cores 37.2%), cylindrical (13 cores 16.7%), wedge (18 cores 23.1%) and semi-conical cores (18 or 23.1%) were observed in blade core category while flake core category was dominated by conical (4 or 20%) and block type of cores (4 or 20%).

Blade removal pattern

It was observed that majority of blade cores had their blades removed in ‘rotated’ way 61 (78.21%), ‘sliced’ way 14 (17.95%) or in very rare case ‘flexible’ way 3 (3.85%). Flakes were removed either in rotated way or in flexible way for flake cores.

Blade removal direction

It was observed for blade cores that mostly they had their blades removed unidirectionally 67 or (85.9%), sometimes bidirectionally 10 or (12.8%) and very rarely multi-directionally 1 core (1.28%). While for flake cores it was observed that most of the time their flakes were removed in multipliedirection (45%) otherwise unidirectionally (20%) or bidirectionally (25%).

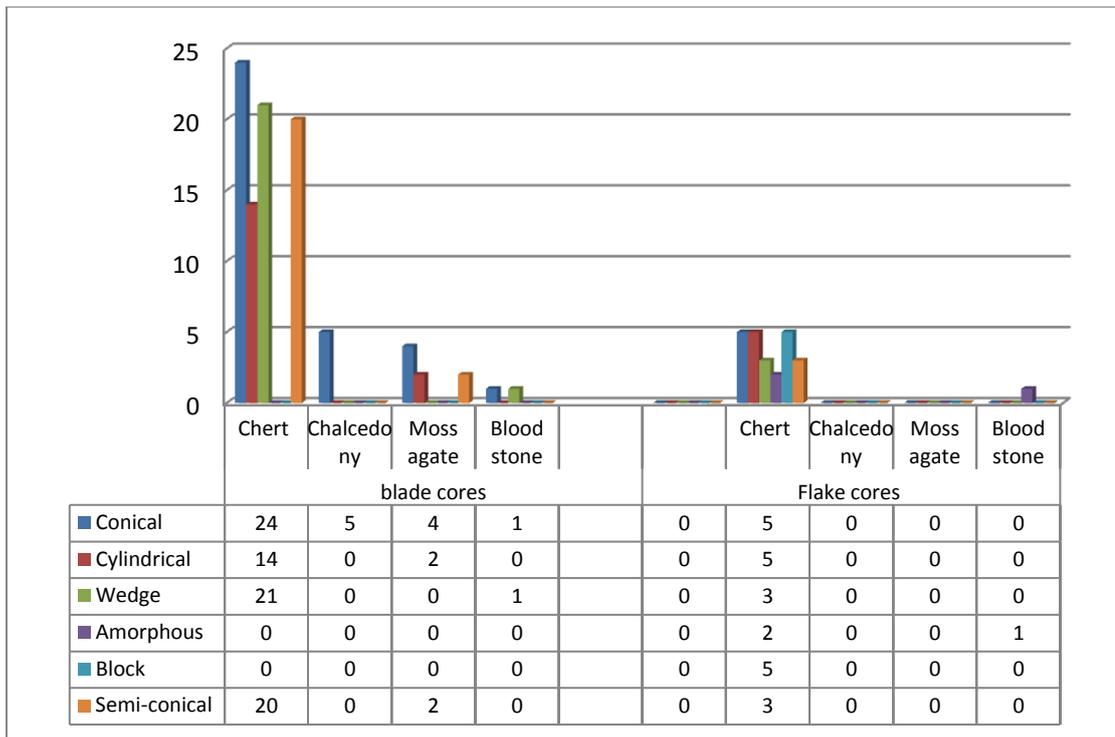


Figure 3.88: Cores according to raw materials during Mesolithic period at Pithad

Core platform preparation

The platforms of blade cores were prepared mostly by removing a single flake 59 cores or (75.6%), by removing multiple flakes 13 cores or (16.67%) or were not prepared at all 6 or (7.69%). The preparation of platform by removal of a single flake could be due to the removal of core rejuvenation flake, which gives it an appearance of the removal of a single flake.

For flake cores it was observed that most of the time their platforms were not prepared (50%), were prepared by removing a single flake (40%) or rarely were prepared by removing multiple flakes (10%).

Core platform count

Most (91%) of the blade cores, as expected, were found to have a single platform. A few, specially the bidirectional cores showed the presence of two platforms and a single core gave evidence of three different platforms.

Flake cores, on the other hand, showed presence of single platform (45%), double platform (25%), three platforms (25%) and even more than three platforms in a single case.



Figure 3.89: Blade and flake cores from the Mesolithic period at Pithad
 (courtesy: Department of Archaeology and Ancient History, the M.S.U. of Baroda,
 Vadodara)

Core butt condition

For blade cores it was observed that their distal ends/butts showed no retouches or damage suggestive of their being further used for any particular work (39.7%), a tiny flake removal (37.2%), presence of cortex (11.5%), having been used as a platform (10.3%) or in rare case having a rudimentary crest.

For flake cores it was observed that 50% of their butt areas were used as platforms for further flake removal, none showed utilization, 15% had cortex present and 15% showed removal of a tiny flake.

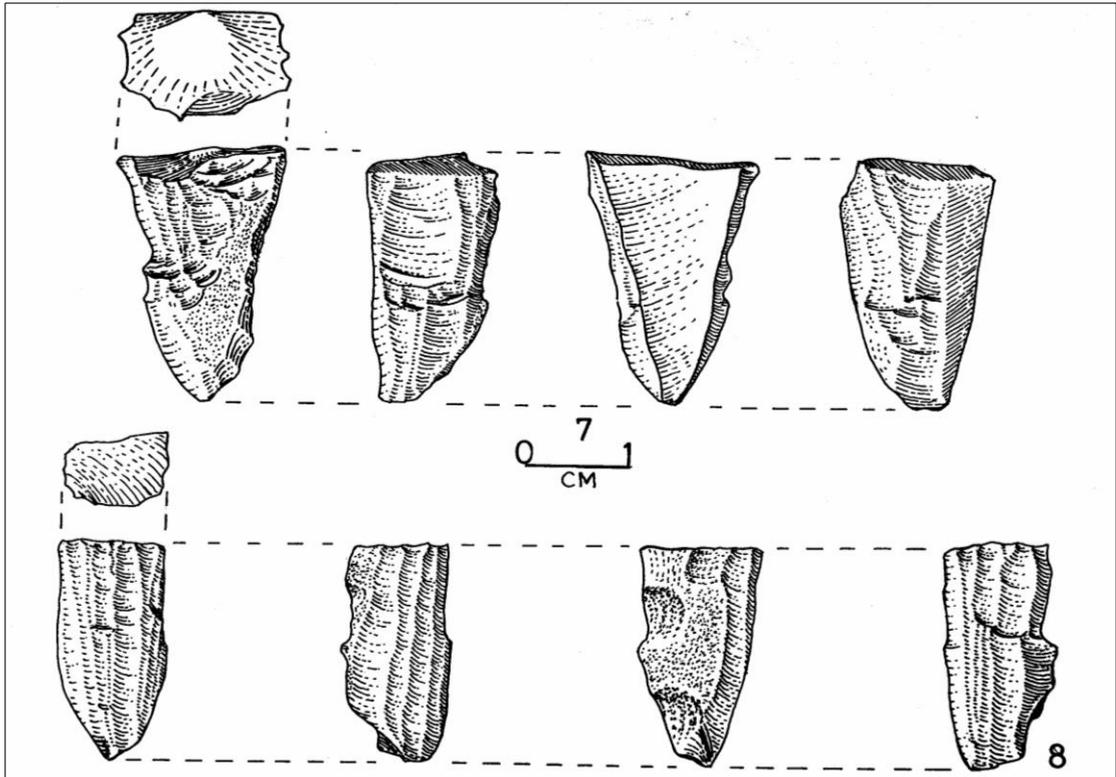


Figure 3.90: Cores from Mesolithic period at Pithad I (courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

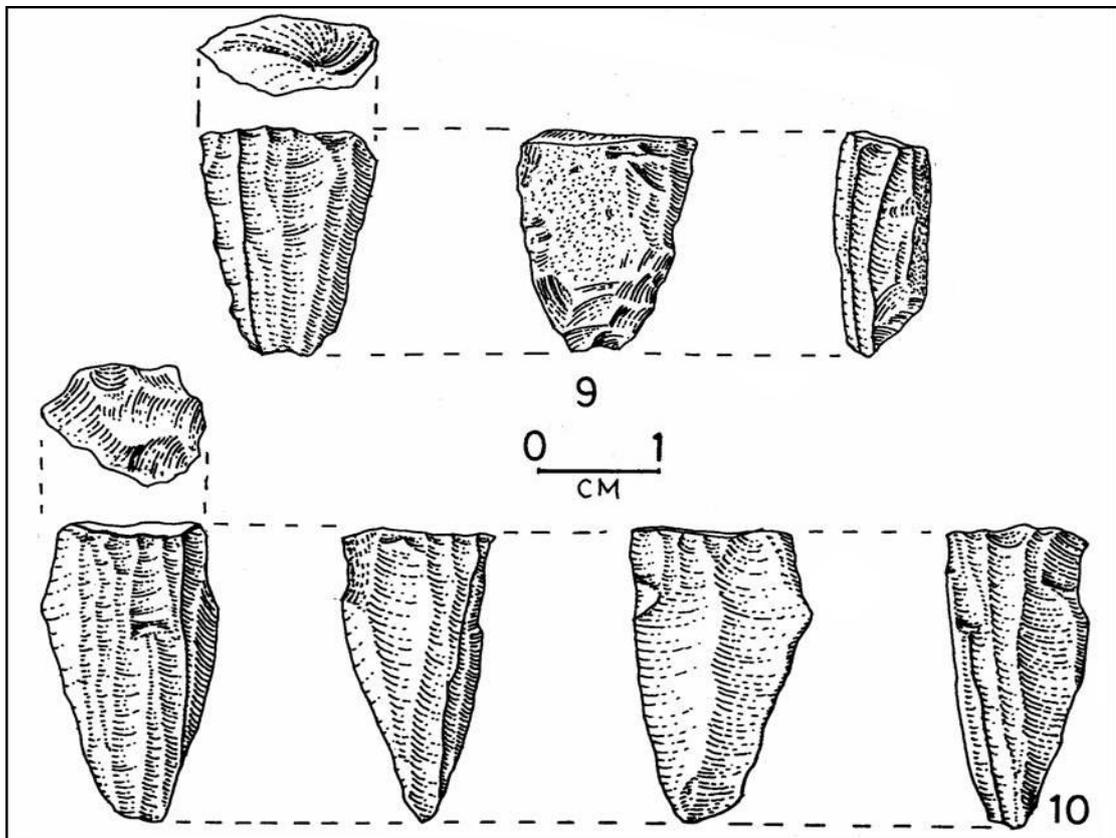


Figure 3.91: Cores from Mesolithic period at Pithad II (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

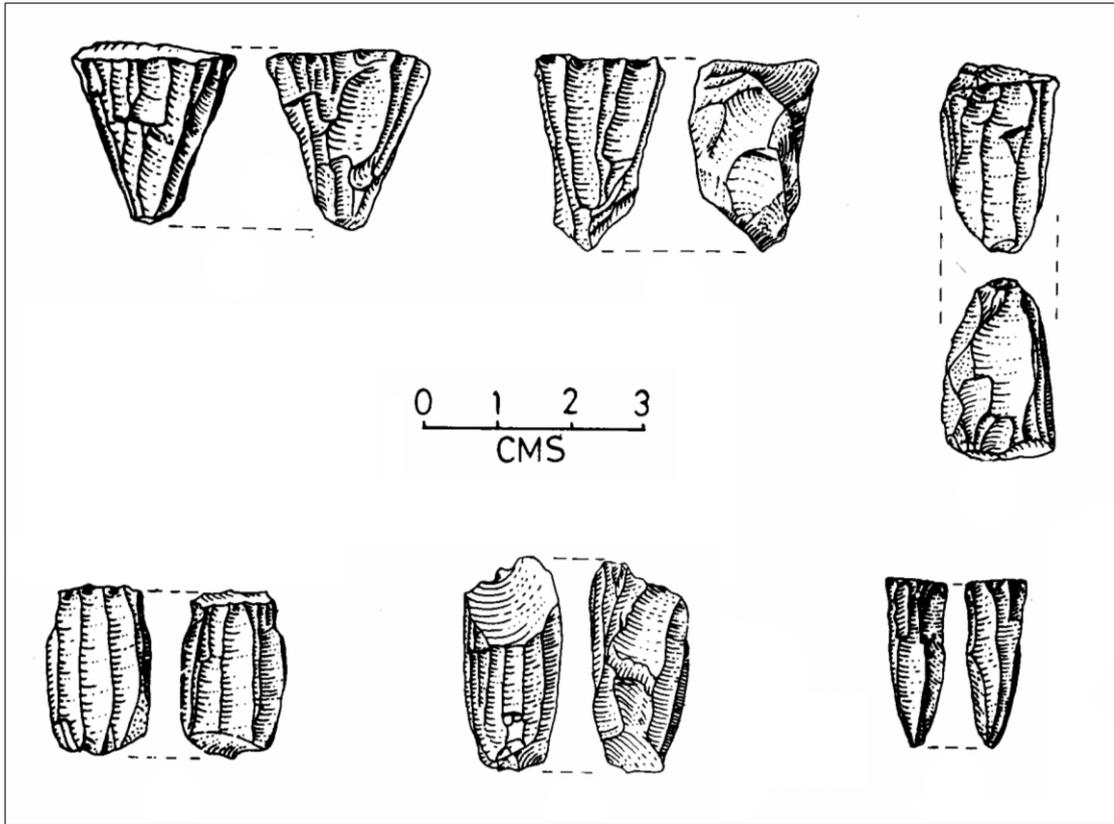


Figure 3.92: Cores from Mesolithic period at Pithad II (Courtesy: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

Cortex

Mostly both types of cores had some amount of cortex present on their body (figure 3.93). Presence of cortex on cores strongly supports local/on site manufacturing of blades.

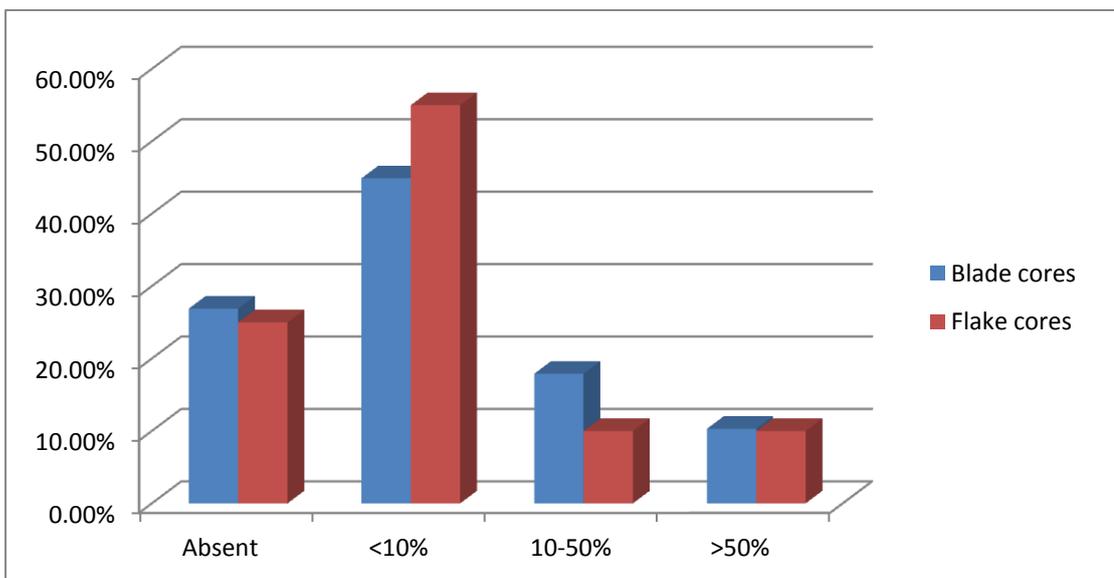


Figure 3.93: Representation of cortex on cores from Mesolithic period at Pithad

Metric analysis of cores

Blade cores

Length

Wedge cores appear to be the longest of blade cores while cylindrical cores are the shortest. But high standard deviation values clearly suggest variation in their lengths (table 3.91).

Table 3.91: Metric of blade core lengths in mm of Mesolithic period at Pithad

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	29	19.88	19.33	19.01	3.89	15.2
Cylindrical	13	19.25	20.38	14.35	3.42	11.69
Wedge	18	23.62	21.86	17.28	6.02	36.27
Semi-conical	18	23.46	22.65	16.55	5.53	30.65

Breadth

Here too wedge cores have the maximum breadth but now conical cores are the narrowest of blade cores. But high standard deviation values clearly suggest variation in their breadths (table 3.92).

Table 3.92: Metric of blade core breadths in mm of Mesolithic period at Pithad

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	29	15.38	14.64	7.66	4.68	21.96
Cylindrical	13	15.99	16.07	9.27	3.07	9.44
Wedge	18	20.75	19.89	15.29	3.64	13.29
Semi-conical	18	18.06	17.26	17.26	4.54	20.68

Thickness

Conical cores are the thinnest while wedge cores appear to be the thickest of cores. But high standard deviation values clearly suggest variation in their thickness (table 3.93).

Table 3.93: Metric of blade core thicknesses in mm of Mesolithic period at Pithad

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	29	12.95	10.68	5.83	5.55	30.83
Cylindrical	13	14.37	14.93	8.87	4.6	21.16
Wedge	18	17.22	16.08	12.53	3.7	13.75
Semi-conical	18	14.1	14.44	17.73	3.66	13.4

Flake cores

Length

Flake core has more variation in their types but are less in terms of numbers. Semi-conical cores appear to be the longest of flake cores and conical cores the shortest. Conical cores also have low standard deviation values, making their measurements more standard. Block cores have a very high standard deviation values, suggesting great variation on their lengths (table 3.94).

Table 3.94: Metric of flake core lengths in mm of Mesolithic period at Pithad

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	4	19.46	19.19	17.55	1.86	3.47
Cylindrical	3	26.25	25.27	23.41	3.44	11.84
Wedge	3	20.81	22.45	16.66	3.62	13.1
Amorphous	3	25.64	26.25	19.07	6.28	39.52
Block	4	30.26	27.61	20.99	11.02	121.36
Semi-conical	3	25.87	24.35	22.62	4.22	17.81

Breadth

Block cores are the broadest while amorphous cores appear to be the narrowest. Semi-conical cores seem to have certain standardization in their breadths. Amorphous cores have very varied measurements (table 3.95).

Table 3.95: Metric of flake core breadths in mm of Mesolithic period at Pithad

Core Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	4	25.27	25.04	20.47	4.33	18.78
Cylindrical	3	23.01	24.03	19.49	3.14	9.86
Wedge	3	22.75	19.14	18.01	7.26	52.77
Amorphous	3	21.46	18.76	11.97	11.1	123.21
Block	4	29.82	30.11	22.22	6.16	37.94
Semi-conical	3	23.88	24.4	21.76	1.92	3.69

Thickness

Semi-conical cores appear to be thinnest while amorphous cores are the thickest of cores. Cylindrical cores have very standardized measurements while amorphous cores have very varied measurements (table 3.96).

Table 3.96: Metric of flake core thicknesses in mm of Mesolithic period at Pithad

Shape	No	Mean	Median	Mode	Std Dev	Variance
Conical	4	19.02	18.89	16.63	2.28	5.21
Cylindrical	3	16.2	16.17	16.13	0.1	0.1
Wedge	3	21.1	18.35	16.56	6.38	40.73
Amorphous	3	24.58	16.34	14.3	16.07	258.46
Block	4	22.07	21.48	18.56	3.62	13.09
Semi-conical	3	15.69	14.68	14.54	1.87	3.5

Summary

The Mesolithic period lithic assemblage recovered during 1991-92 field season at Pithad is represented by blades, geometric and non-geometric tools and lithic debitage. The assemblage, however, is dominated by non-geometrical tools, especially by different variety of scrapers.

Simple blades and blade flakes are the main category of blades found from the blade assemblage. Retouched blade types such as backed blades, retouched blades and obliquely blunted blades are represented by a very small number. Chert was exploited most to make different types of blades. Moss agate, chalcedony, banded agate, carnelian and blood stone are some of the other raw material which were utilized for blade manufacturing activity. It appears that blood stone and carnelian were exclusively used for simple blades and blade flakes. The maximum numbers of blades were represented by their proximal ends, closely followed by intact blades. The proximal ends of intact blades show that proximal type category 'single' was most frequently seen, which forms when flakes are removed from unidirectional cores. Proximal shape was dominated by 'lipped' category which in turn suggests soft hammer percussion method. It was also observed that proximal width varied a lot between blades while the thickness was more or less of standardized size. For distal end terminations it was noted that almost half of the distal ends belonged to the category of 'feathered'. Hardly any retouching or utilization marks were seen on distal ends of blades. For broken blades it was seen that they broke in a clean way. Simple blades were mostly made out of secondary blades while blade flakes showed more cortex on them. Secondary blades were chosen exclusively for further retouching. It was observed that almost half of the blades did not show any kind of

edge damage leading to the conclusion that they were not utilized. This high percentage of non-utilized blades in the assemblage is very interesting as it suggests that most probably utilization of these tools was not carried out at the site itself. It was also observed that the blades which were made into specialized tools by retouching them had edge damages and were most probably utilized at the site. Blades were being utilized through their right edges more than their left edges. Edge damage was more frequent on the dorsal side of the blade than on the ventral side. Bifacial utilization, however, was almost the same for both the edges. Retouches were carried out exclusively on the dorsal left edge of the blades. Blade flakes were the longest, broadest and thickest of all blades. A lot of variation was observed in the lengths and breadths of blades while thickness was seen to be comparatively of standard size.

As mentioned earlier, Pithad was dominated by non-geometric variety, specifically by various types of scrapers. Points, burins and borers were also found in good quantity. True geometric tools, however, were very few in number.

True geometric tools, triangles, trapeziums and lunates are very rare in the assemblage. The single triangle found from the assemblage was made out of a primary blade and was not utilized. Lunates were made on secondary blades and most probably were utilized. Their lengths vary but breadth and thickness show similar values. Trapeziums follow the same pattern as of lunates in their measurements. Points were found to be comprising of varying sizes. High standard deviation values for lengths and breadths of burins suggest variation but comparatively low Std dev value for thickness suggests uniformity. Borers were seen to follow measurement pattern of burins; variation in their lengths and breadths but standardization in their thickness.

Almost all the scrapers were made by retouching old, abraded scrapers. More than half of these tools were made out of chert. One third out of chalcedony and the rest out of quartz, moss agate, banded agate and blood stone. All the scrapers identified from the lithic assemblage seem to have been utilized at the site. This in contrast to unutilized blades most probably suggests that sturdier tools such as scrapers were preferred tools at the site. End scrapers, side scrapers and double sided scrapers, all follow a similar pattern in their measurements. They were made of various sizes but

most probably all of them were utilized. Concave scrapers comparatively had standard lengths.

Lithic debitage at the site was divided into categories of flakes, nodules, cores, core rejuvenation flakes and waste. More than half of the flakes were primary flakes. A striking feature was the high percentage (22%) of flakes which were actually flaked cores and thus they showed many negative flake scars on their dorsal side. Many of these flakes were flaked out of abraded nodules/flakes and a lot of times bore evidence of rolling on their dorsal surface. 25% flakes were found to be in abraded condition. Very rarely they were either utilized or retouched. Complete nodules were very few in number; mostly they were broken into two parts. Chert, moss agate and blood stone core rejuvenation flakes were identified from the assemblage. Waste/shatter was comparatively low from the site. Majority of cores were blade cores. Conical shape was the most common amongst them. Blades were removed out of these cores by rotating them unidirectionally. Single flake removal seen on blade core platforms might suggest the removal of core rejuvenation flake. Most of the blade cores had single platforms. Cortex was found to be present on almost all the cores. Wedge cores were found to be longest, broadest and thickest of all cores.

PITHAD/JAIDAK NO TIMBO (Sorath Harappan Period)

The lithic assemblage belonging to the Chalcolithic period recovered during the excavations of 2005-06 and 2006-27 at Pithad comprises of 37 blades, 84 geometric and non-geometric tools and 1449 fragments of lithic debitage including exhausted cores. One important point to be kept in mind before we proceed further is that the above mentioned lithic assemblage does not comprise the whole of lithic assemblage recovered from the site. Researcher was unable to locate about 30% of the excavated lithic assemblage. Most of these missing artefacts belong to deep trenches and secure contexts. Analysis has still been done for the limited lithic assemblage since it was found that the inclusion of even the partial data from these trenches which have secure contexts was important to understand the site. More than 40 trenches were excavated during above mentioned field seasons. A distribution of tools and lithic debitage according to the trenches from which they were found is presented here first. This lithic assemblage comprises of 37 (2.35%) blades (figure 3.94), 84 (5.35%) geometric

and non-geometric tools (figure 3.95) and 1448 (92.29%) of lithic debitage (figure 3.96).

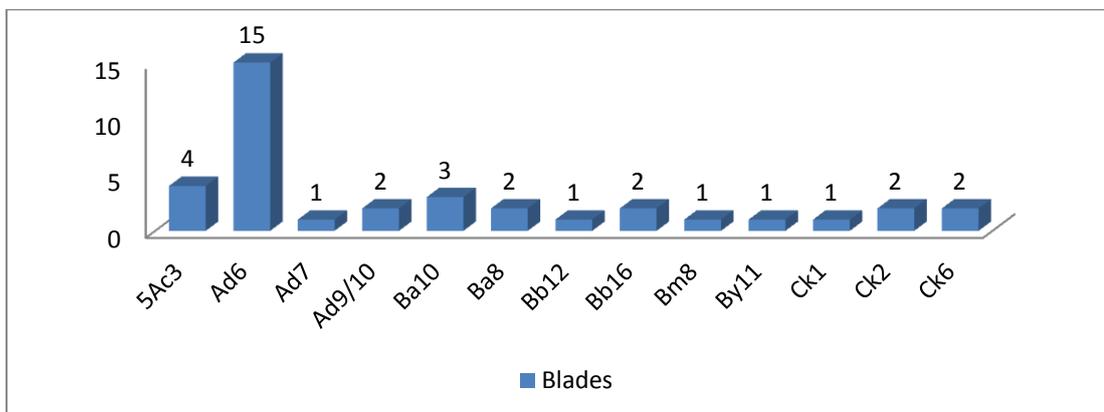


Figure 3.94: Distribution of blades from Chalcolithic period at Pithad (2005-06/2006-07)

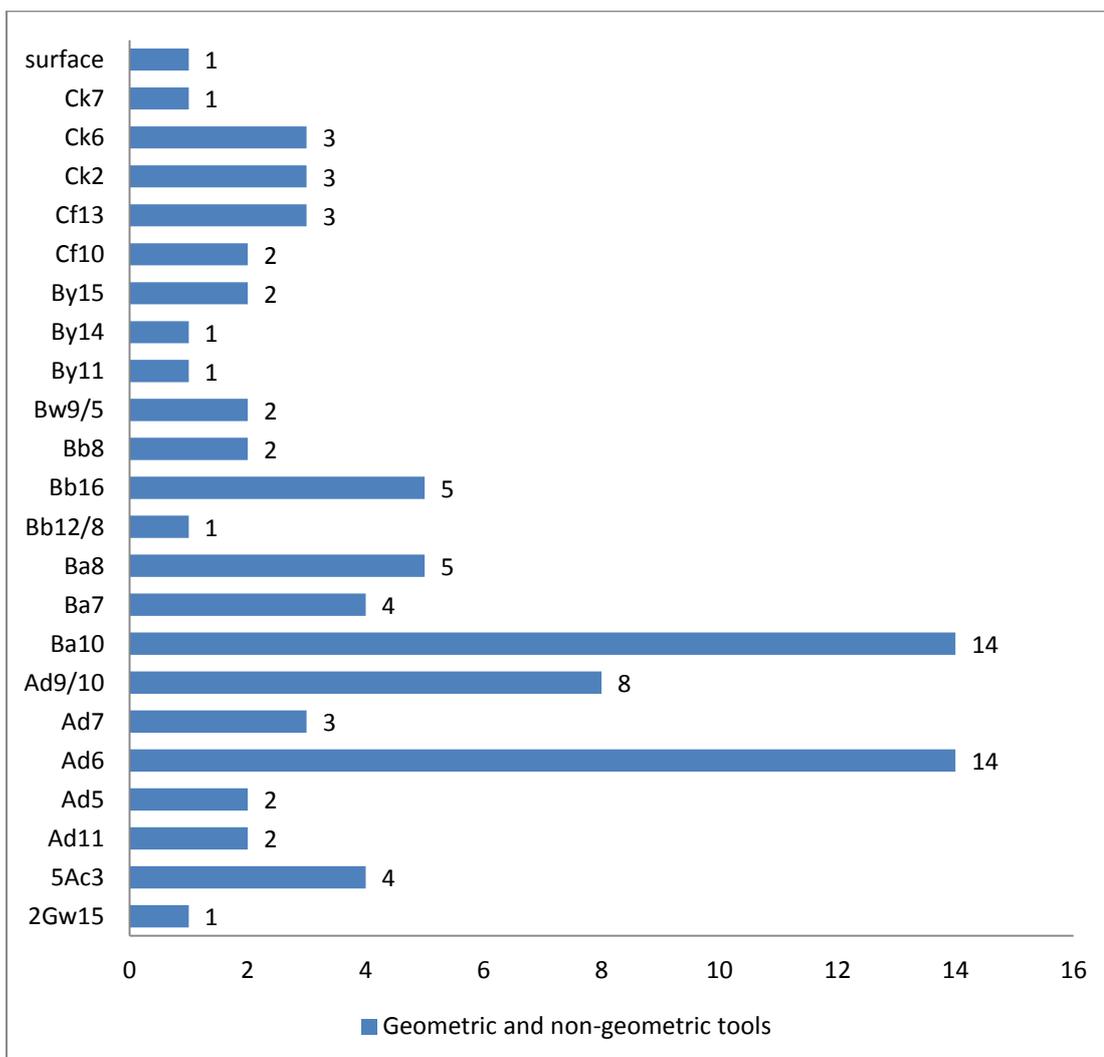


Figure: 3.95: Distribution of geometric and non-geometric tools from Chalcolithic period at Pithad (2005-06/2006-07)

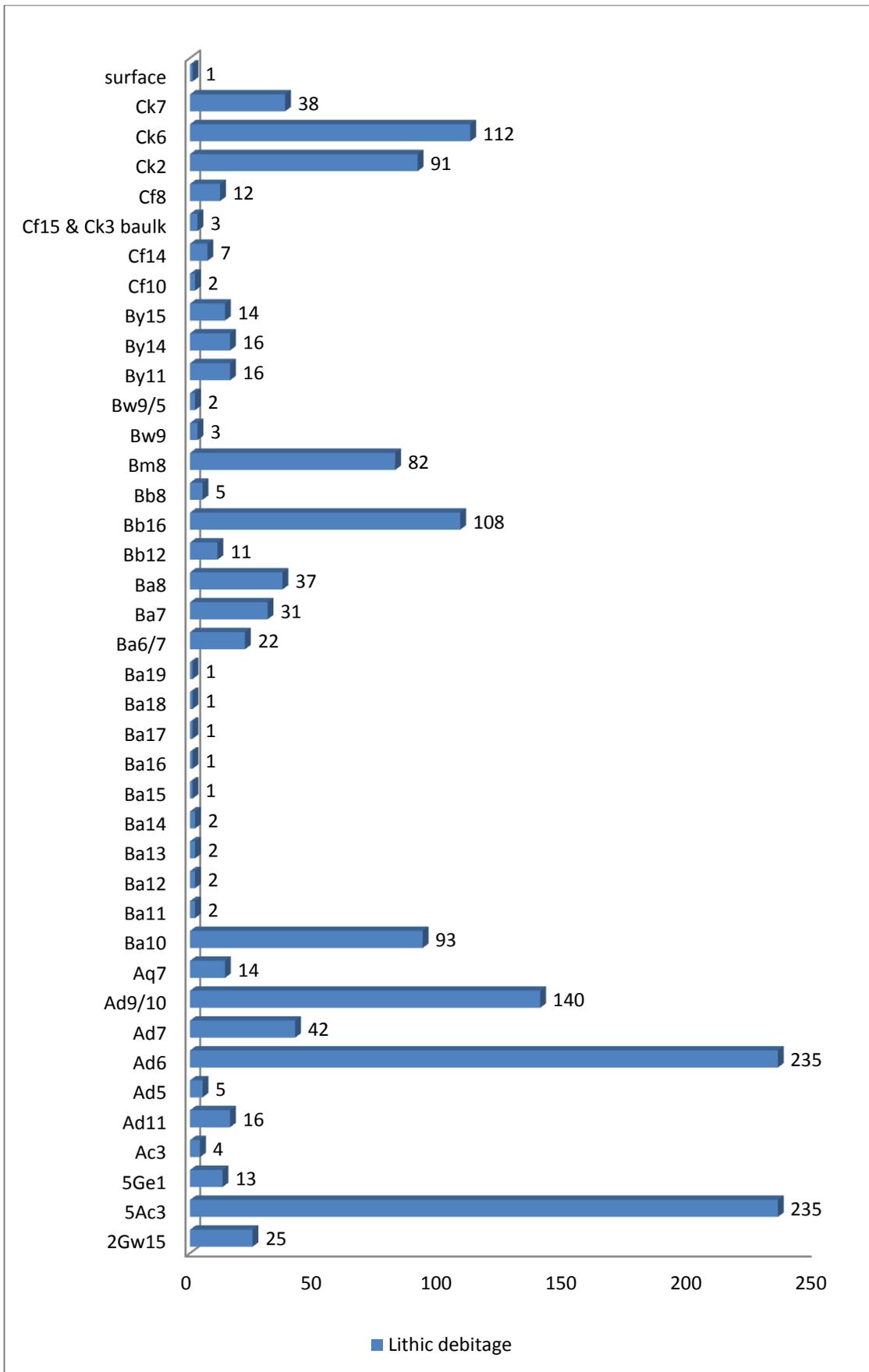


Figure 3.96: Distribution of lithic debitage from Chalcolithic period at Pithad (2005-06/2006-07)

As had been mentioned earlier, during the field season 1991-92, a Chalcolithic period level was encountered at the site along with the Mesolithic period level (IAR 1991-92). 19 (6.76%) blades, 12 (4.27%) geometric and non-geometric tools and 250 (88.96%) fragments comprise the lithic assemblage belonging to 1992 excavation.

After this quick look at the Chalcolithic period lithic assemblage recovered from three different excavation years, further analysis has been conducted of the assemblage as a whole without taking into consideration the separate excavation years since understanding the Chalcolithic period lithic assemblage is the main objective of this study.

Overview of tool types

Blades

The blades assemblage during the Chalcolithic period is dominated by simple blades (41) and blade flakes (12) (figures 3.97 & 3.98). Retouched blade types such as Backed blades and retouched blades are represented by very small numbers (2). A



Figure 3.97: Blades from the Chalcolithic period at Pithad (courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

single crested ridge blade was also recovered from the site. Unlike the half crested ridge blade found during the Mesolithic period, this crested ridge blade has an accurately made crest. This crested blade was made of chert. The retouched blades, falling into the categories of backed blade and simple retouched blade, were found to have been made out of chalcedony. Simple blades and blade flakes were found to have been made out of chert, banded agate and moss agate.



Figure 3.98: Blade and blade flakes from Chalcolithic period at Pithad (courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

Raw materials

Raw materials are represented by four types of cryptocrystalline silicates (figure 3.99). The most exploited raw material at 57.14% (32 blades) was chert, followed by chalcedony at 23.21% (13 blades), moss agate by 16.07% (9 blades) and finally banded agate by 3.57% (2 blades).

Condition of blades

It was found that majority of the blades (40 blades) were found in broken condition (figure 3.100). 24 (42.86%) of the fragments belong to proximal ends, 9 or 16.07% to the mesial fragments and 7 or 12.5% to the distal end fragments. Intact blades were found to comprise a little more than one fourth of the assemblage (16 or 28.57%). Backed blades, the retouched blades and the crested ridge blades were found in intact condition while the simple blades and blade flakes were found mainly in broken condition.

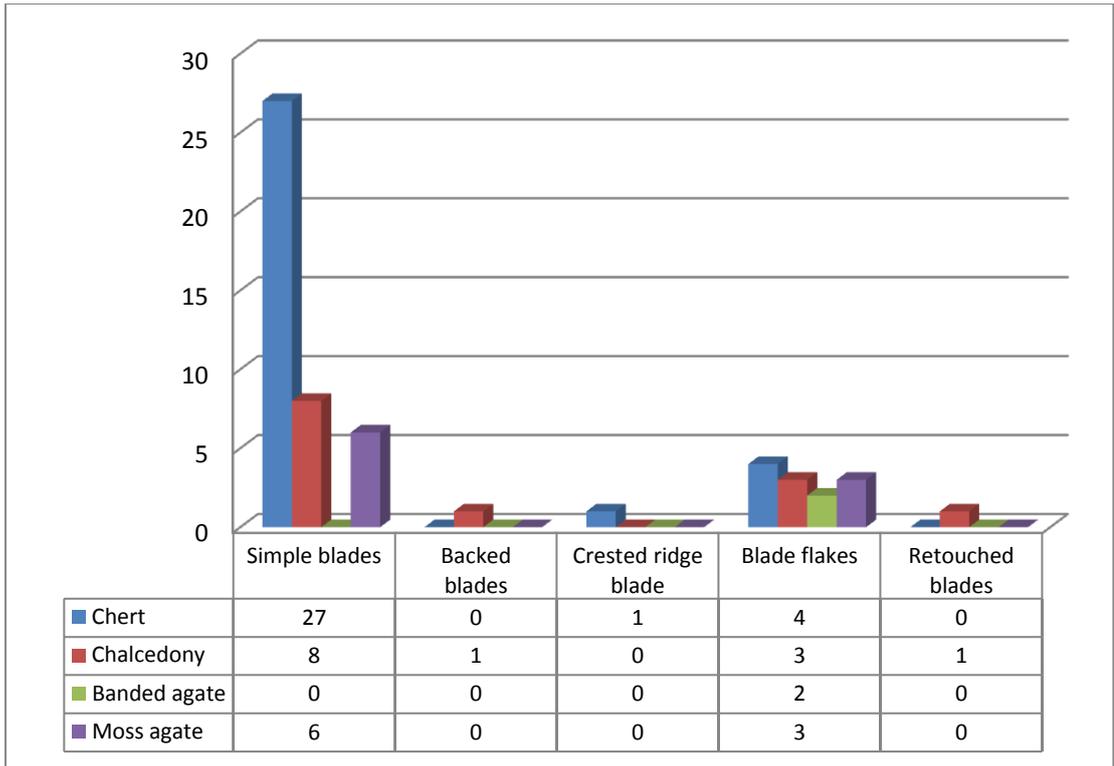


Figure 3.99: Blade types vs raw material during Chalcolithic period at Pithad

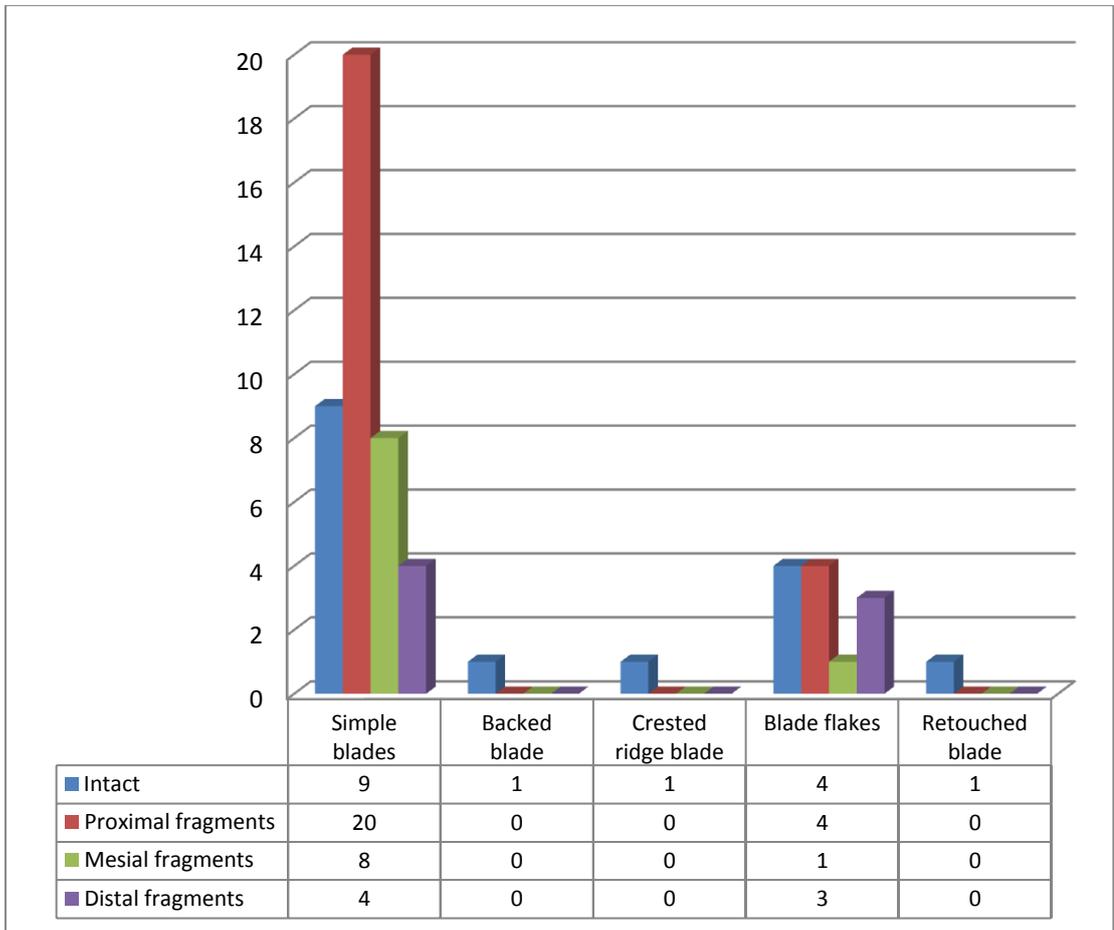


Figure 3.100: Blade conditions from Chalcolithic period at Pithad

Proximal conditions

Proximal end conditions were noted for all the intact blades (table 3.97). Proximal end type and shape were noted for all the proximal end forms other than ‘difficult to see’. However as one of the proximal end shape was prominent in this category, it was also recorded. It was noted that majority of the proximal end forms were difficult to see and identify. The proximal end forms which could be identified, majority were found to fall into the category of lenticular while the others were distributed almost equally between rectangular, triangular and irregularly triangular.

Table 3.97: Proximal end conditions during Chalcolithic period at Pithad

Proximal end form			Proximal end type			Proximal end shape		
Rectangular	2	12.50%	Single	6	60.00%	Lipped	3	27.27%
Lenticular	3	18.75%				Pointed	5	45.45%
Triangular	2	12.50%	Dihedral	2	20.00%	Bulb-scar	3	27.27%
Irregularly triangular	2	12.50%	Multiple	2	20.00%			
Semi-circular	1	6.25%	Total	10	100.00%	Total	11	100.00%
Difficult to see	6	37.50%						
Total	16	100.00%						

Proximal end width and thickness

Out of 40 blades (intact as well as proximal fragments) 32 proximal ends were measured for their width and thicknesses. Their metrics are given in table 3.98. As can be seen, it was found that the widths vary a lot between blades but the thickness was of a more standardized size.

Distal end conditions

Intact and distal blade fragments

Plunging type of distal end termination was the most common amongst these blades 8 or (36.36%), followed by feathered termination 7 or (31.82%), hinged termination 5 or (22.73%) and retouched distal ends 2 or (9.09%). It was further observed that all afore mentioned termination categories were found only in simple blades. Crested ridge blade and retouched blade showed feathered termination, blade flakes showed feathered, plunging and retouched terminations while backed blade showed retouched termination.

Table 3.98: Metrics in mm of platform width and thickness values of Chalcolithic period at Pithad

	Mean	Median	Mode	Std Dev	Variance
Width	5.85	4.47	3.48	3.76	14.03
Thickness	2.33	2.1	1.41	1.07	1.16

Proximal and mesial blade fragments

32 or 94.12% fragments showed evidence of clean snapped distal end terminations. Remaining 2 or 5.88% showed evidence of stepped termination. All these fragments belong either to simple blade or blade flake category of blades. Most of the simple blade fragments (27) as well as blade flakes (5) showed evidence of clean snapping, only two blades belonging to either category showed stepped termination.

Presence of cortex

Majority of the blades 48 or (85.71%) showed no evidence of cortex. Very few blades 5 or (8.93%) showed evidence of <10% cortex and even fewer blades 3 or (5.36%) showed presence of >50% cortex. It was further observed that retouched blades were made exclusively out of secondary blades. The crested ridge blade was also found without cortex. Simple blades and blade flakes showed different amount of cortex on their dorsal edges, though even in them majority of the blades were found to be without cortex (figure 3.101).

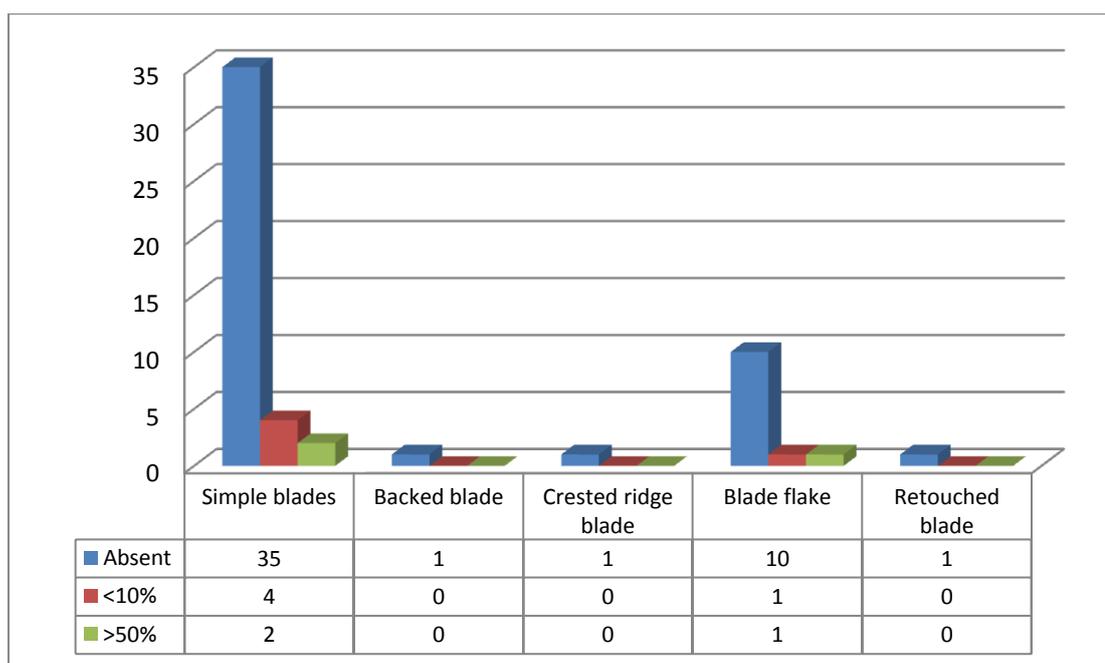


Figure 3.101: Cortex on blades from Chalcolithic period at Pithad

Edge damage and retouches

It was found that 30 or 53.57% blades showed evidence of edge damage and thus these blades appear to have been utilized. In 7 or 12.50% blades it was difficult to decide about their edge condition. 19 or 33.93% blades were found to have been blanks. In 3 retouched blades (5.36%) it was observed that the retouches were always prepared on the right edges of the blades.

Metric comparison between blades

Intact blades

Intact simple blades and intact blade flakes are found in greater numbers than one and thus these two categories were analyzed statistically. It was found that lengths and breadths of both the categories show a lot of variation while the thickness was more standardized (table 3.99). Though a single example has been found, crested ridge blade was the biggest blade in the assemblage.

Table 3.99: Metrics of intact blades in mm of Chalcolithic period at Pithad

Blade type	No		Mean	Median	Mode	Std Dev	Variance
Simple blades	9	Length	21.48	17.02	10.95	9.64	93.05
		Breadth	8.43	6.94	5.28	4.29	18.44
		Thickness	3.27	2.81	2.32	1.41	2.00
Blade flakes	3	Length	22.2	21.86	12.04	4.14	17.16
		Breadth	15.85	15.2	8.65	4.28	18.34
		Thickness	5.75	5.7	2.86	1.74	3.03
Crested ridge blade	1	Length	34.73				
		Breadth	9.86				
		Thickness	6.15				
Backed blade	1	Length	19.29				
		Breadth	7.84				
		Thickness	3.71				
Retouched blade	1	Length	8.12				
		Breadth	4.14				
		Thickness	2.54				

Broken blades

Even in the broken blade category it was observed that the lengths and breadths show a lot of variation while the thickness was more standardized (table 3.100). It is surprising to see higher value of standard deviation and in turn more variation in lengths of simple blades than blade flakes. The standard deviation value for breadth was found to be higher amongst blade flakes.

Table 3.100: Metrics of broken blades in mm of Chalcolithic period at Pithad

Blade type	No		Mean	Median	Mode	Std Dev	Variance
Simple blades	32	Length	15.69	14.87	13.1	6.45	41.61
		Breadth	7.87	7.57	3.18	3.6	12.96
		Thickness	2.97	2.85	1.2	1.35	1.83
Blade flakes	9	Length	23.39	22.18	20.15	2.99	8.99
		Breadth	16.23	14.35	8.65	4.75	22.6
		Thickness	6.22	5.93	2.86	1.72	2.97

Geometric and non-geometric tools

Though geometric tools (figures 3.102a & 102b) such as lunates (12) and trapeziums (2) were found from the Chalcolithic period lithic assemblage, the geometric and non-geometric tools category was dominated by various types of scrapers (figures 3.104 & 3.105) 64 in number (end, side, double sided, concave, convex, side and end, notched, round). 67.37% non geometric tools belong to this category. Points (9), burins (5) and borers (3) make up 17.89% of this tool category (figure 3.103).

Most of the tools of this category were made out of chert 57 or (60.00%), followed by chalcedony 17 or (17.89%), moss agate 7 or (7.37%), banded agate 6 Or (6.32%), quartz 6 or (6.32%) and blood stone 2 or (2.11%). It was observed that the geometric tools were made out of chert, chalcedony, banded agate and moss agate. Points, borers and burins were made out of chert, chalcedony, banded agate and quartz. Scrapers were made out of all the raw materials mentioned in the beginning of the paragraph.

Analysis of geometric and non-geometric tools

Lunates

All the lunates were found in intact condition. All of them were made on secondary blades. All of them showed edge damages so most probably all of them were utilized.

All of them appear to be more or less standardized, except for their lengths which are reflected in the high values of standard deviation in that category (table 3.101). Majority of them (66.66%) were retouched on their right edges to give them the shape of a lunate. A few (4 or 33.33%) were found to have been retouched on their left edges.

Table 3.101: Metrics of lunates in mm of Chalcolithic period at Pithad

	No	Mean	Median	Mode	Std Dev	Variance
Length	12	18.17	18.85	13.57	3.07	9.42
Breadth		7.52	7.58	5.6	1.19	1.42
Thickness		2.9	2.73	1.63	1.08	1.17

Trapeziums

Only two specimens of this geometric tool were found from the site. Both of them were found in intact condition. Both were made on mesial fragments of secondary blades and both were retouched on their left edges as well as distal and proximal ends. These were made out of different raw materials; one was made out of chert and the other from banded agate. It was observed that their lengths differed a lot, trapezium made out of chert was much longer than the one made out of banded agate. But there was no noticeable difference in their breadths and thicknesses (table 3.102). Does this mean that they were made by professionals?

Table 3.102: Metrics of trapeziums in mm of Chalcolithic period at Pithad

	No	Mean	Median	Mode	Std Dev	Variance
Length	2	20.72	20.72	15.74	7.05	49.7
Breadth		7.35	7.35	6.92	0.61	0.37
Thickness		3.69	3.69	3.01	0.96	0.92

Points

It was observed that 7 points were intact while 2 were found in broken condition. The broken points were made out of chert while the intact ones were made out of apart from chert, chalcedony, banded agate and quartz. Only one point was found to have <10% cortex on its surface, all the others were found to have been devoid of cortex. It appears that the intact points were smaller than the broken points. High standard deviation values for all the measured categories suggest variation in their sizes (table 3.103).



Figure 3.102a: Geometric tools from Chalcolithic period at Pithad



Figure 3.102b: Geometric tools from Chalcolithic period at Pithad (courtesy for figures 3.102a & 3.102b: Department of Archaeology and Ancient History, The M.S.University of Baroda, Vadodara)

Table 3.103: Metrics of points in mm from Chalcolithic period at Pithad

	No		Mean	Median	Mode	Std Dev	Variance
Intact points	7	Length	17.92	17.14	10.94	4.66	21.77
		Breadth	6.25	5.47	4.22	2.07	4.32
		Thickness	4.51	3.95	2.25	2.28	5.21
Broken points	2	Length	18.42	18.42	15.85	3.63	13.21
		Breadth	7.44	7.44	5.8	2.32	5.38
		Thickness	5.19	5.19	2.76	3.44	11.81

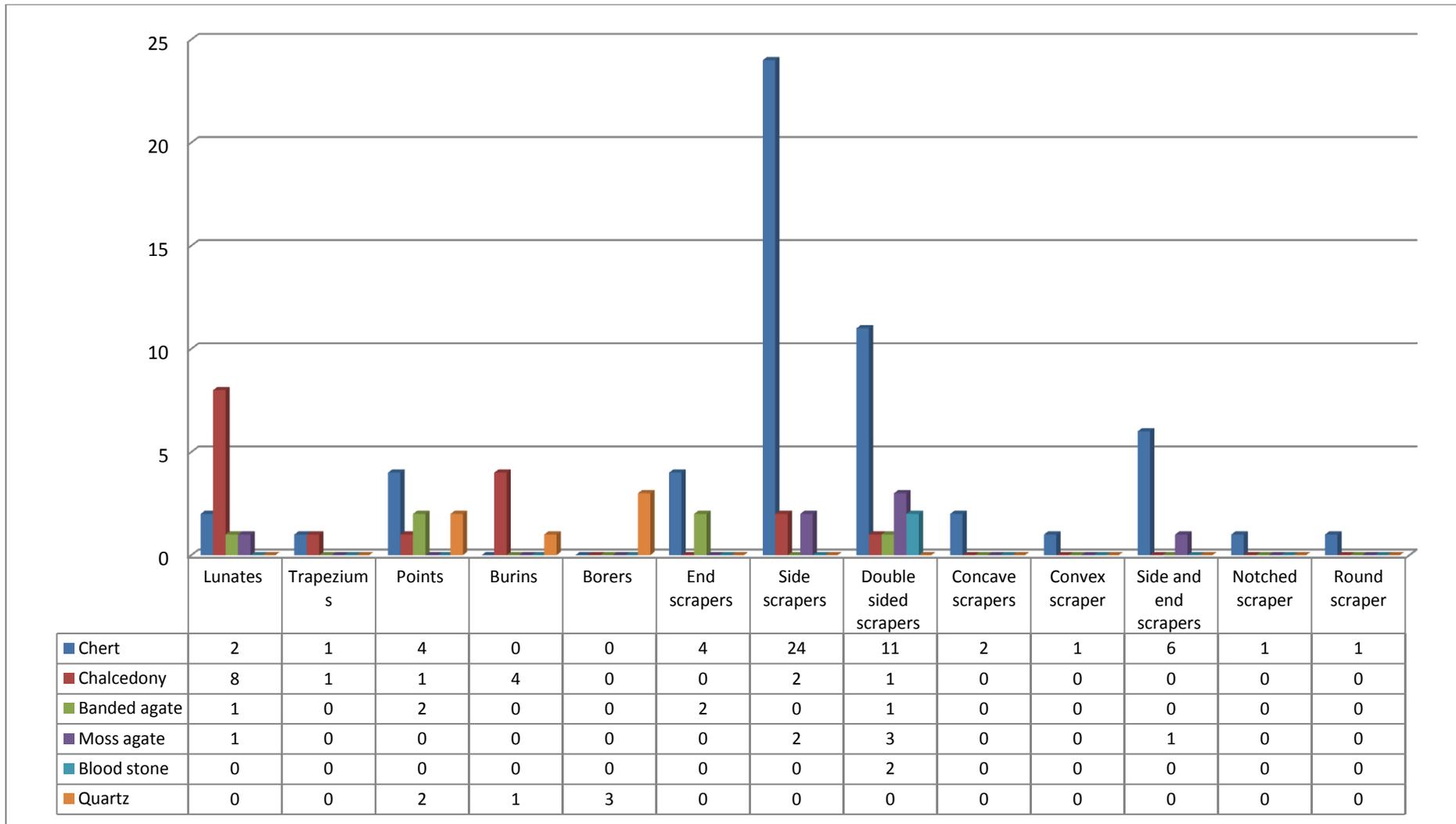


Figure 3.103: Representation of geometric and non-geometric tools from Chalcolithic period at Pithad

Burins

Out of the five burins found amongst the lithic assemblage, two were found to be intact while three were in broken condition. The intact burins were made out of secondary flakes while one of the broken burin showed presence of a little (<10%) cortex. All the burins, intact as well as broken were found to be very different in their sizes. This can be seen by looking at their standard deviation values in the table 3.104.

Table 3.104: Metrics of burins in mm from Chalcolithic period at Pithad

	No		Mean	Median	Mode	Std Dev	Variance
Intact burins	2	Length	21.63	21.63	11.18	14.78	218.41
		Breadth	15.69	15.69	4.74	15.49	240.02
		Thickness	13.39	13.39	4.49	12.58	158.42
Broken burins	3	Length	12.92	10.94	9.04	5.17	26.72
		Breadth	6.01	6.22	2.24	3.67	13.46
		Thickness	3.93	2.45	2.07	2.89	8.35

Borers

All three borers were made out of quartz, were found in intact condition and were devoid of any amount of cortex. It was observed that the lengths of these borers were very diverse. Compared to that the breadths and thicknesses were standardized (table 3.105).

Table 3.105: Metric analysis of borers in mm from Chalcolithic period at Pithad

	No	Mean	Median	Mode	Std Dev	Variance
Length	3	21.44	20.64	16.65	5.24	27.47
Breadth		9.8	10.42	8.27	1.34	1.78
Thickness		8.44	7.71	6.25	2.64	6.96

End scrapers

Six end scrapers were identified in the non-geometric tool category. All were found in intact condition, five were found to have been made out of secondary flakes while one showed a little cortex present at the dorsal surface. Four were made out of chert while two were made out of banded agate. Table 3.106 gives their metric analysis.

Table 3.106: Metric analysis of end scrapers in mm from Chalcolithic period at Pithad

	No	Mean	Median	Mode	Std Dev	Variance
Length	6	25.66	25.19	10.81	12.26	150.38
Breadth		26.29	26.44	12.45	9.84	96.73
Thickness		9.98	10.15	4.32	3.49	12.16

Side scrapers

22 (78.75%) of these scrapers were found in intact condition. Five were proximal fragments while one was a mesial fragment of a flake. It was observed that though majority (14) of the intact scrapers were devoid of cortex, various amount of cortex was noticed from other scrapers. Majority of the proximal fragments (4) were found to be without any cortex while one had a little cortex on its dorsal side. The mesial fragment was found to be totally devoid of cortex. Their metrics are given in table 3.107.

Table 3.107: Metric analysis of side scrapers in mm from Chalcolithic period at Pithad

	No		Mean	Median	Mode	Std Dev	Variance
Intact scrapers	22	Length	37.73	37.47	18.24	12.66	160.38
		Breadth	30.67	29.41	13.43	11.37	129.24
		Thickness	12.57	12.08	6.14	4.42	19.52
Broken scrapers	6	Length	34.09	29.82	25.05	10.88	118.36
		Breadth	27.92	25.24	14.69	11.15	124.48
		Thickness	11.06	11.59	6.43	2.72	7.41

Double sided scrapers

Out of the 18 specimens of this category, 15 were intact while 3 were proximal fragments. Though most (10) of the intact scrapers were found to be made out of secondary flakes, a few (5) were made out of primary flakes. The proximal fragments belonged to secondary flakes. Metric analysis has shown that these scrapers differed a lot in their sizes (table 3.108).

Table 3.108: Metrics of double sided scrapers in mm from Chalcolithic period at Pithad

	No		Mean	Median	Mode	Std Dev	Variance
Intact scrapers	15	Length	39.12	39.4	16.6	10.93	119.46
		Breadth	31.85	31.43	15.98	11.12	123.56
		Thickness	12.02	11.08	7.75	3.97	15.82
Broken scrapers	3	Length	32.22	34.09	17.97	13.41	179.91
		Breadth	27.93	30.49	21.23	5.86	34.33
		Thickness	10.04	10.45	6.52	3.33	11.12

Concave scrapers

Both of these scrapers were found in intact condition, both were made out of secondary flakes of chert. These scrapers too varied a lot in their measurements, especially in their breadths (table 3.109).

Table 3.109: Metrics of concave scrapers in mm from Chalcolithic period at Pithad

	No	Mean	Mode	Std Dev	Variance
Length	2	27.06	23.93	4.43	19.65
Breadth		36.76	26.31	14.78	218.4
Thickness		12.4	5.88	9.22	85.02

Convex scraper

This scraper was found in broken condition and showed presence of cortex (<10%). Its measurements were 32.53mm length, 35.75mm breadth and 17.19mm thickness.

Side and end scrapers

Out of the seven scrapers which fall in this category, 6 were intact while one was broken. The broken scraper was made out of a secondary flake. For intact scrapers it was observed that two were made out of secondary flakes while the rest of the four were made out of primary flakes with varying amount of cortex present on their surface. As can be seen from the table 3.110 all the scrapers show a lot of variation in their sizes.

Table 3.110: Metrics of side and end scrapers in mm from Chalcolithic period at Pithad

	No		Mean	Median	Mode	Std Dev	Variance
Intact scrapers	6	Length	35.97	32.46	13.48	13.05	170.24
		Breadth	31.78	34.06	14.6	12.00	144.0
		Thickness	14.35	12.66	8.89	5.46	29.86
Broken scrapers	1	Length	32.5				
		Breadth	35.6				
		Thickness	5.24				

Notched scraper

The single example found in this category was found in intact condition and was made out of a secondary flake. Its measurement is as following: 28.08mm length, 39.06mm breadth and 13.74mm thickness.

Round scraper

The single example found in this category was made out of a secondary flake and was found to have been in intact condition. Its measurement is as following: 8.57mm length, 8.65mm breadth and 3.86mm thickness.

Since more than 20 trenches were excavated for the Chalcolithic period at Pithad during the excavation years of 2005-06/2006-07 a trench-wise analysis has been conducted here. It was found that 30.25% tools were recovered from layer 2 belonging to various trenches. 23.53% tools were recovered from pit situated in trench Ad6. 14.29% tools were recovered from dumps belonging to trenches Ad7, Ad9/10, Ba10, Ba7 and Ba8. 11.76% tools were recovered from layer 1 of trenches Ad11, Ad5, Ba10, Ba7, Bb12/8, Bb16, Bb8, By11, Ck2 and Ck7. 10.92% tools belonged to layer 4 of 5Ac3, Ad6, Ad9/10 and Bb16. 5.88% tools were found from layer 3 of trenches 5Ac3, Ad9/10, Bb16, Bm8, By14 and By15 and 3.36% tools were found from layer 5 of trenches 5Ac3 and Bb16.

Thus it can be seen that out of 25 trenches giving evidence of lithic tools, trenches Ad6 and Ba10 showed major concentration of lithic tools while trenches 5Ac3, Ad9/10, Ba8 and Bb16 has shown significant amount of lithic tools.



Figure 3.104: Various scrapers from the Chalcolithic period at Pithad (courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

Lithic debitage

As mentioned earlier, lithic debitage recovered during all the excavation season belonging to the Chalcolithic period has been taken here together for the analysis. Figure 3.106 is the classification of lithic debitage by raw materials. Lithic debitage recovered from the site has been classified into flakes (primary, secondary and core rejuvenation flakes), nodules, cores and waste/shatter. The assemblage is dominated by flakes 1281 (73.58%). Chert and chalcedony dominate the raw materials, together they represent 84.21%.



Figure 3.105: Various scrapers from the Chalcolithic period at Pithad (courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

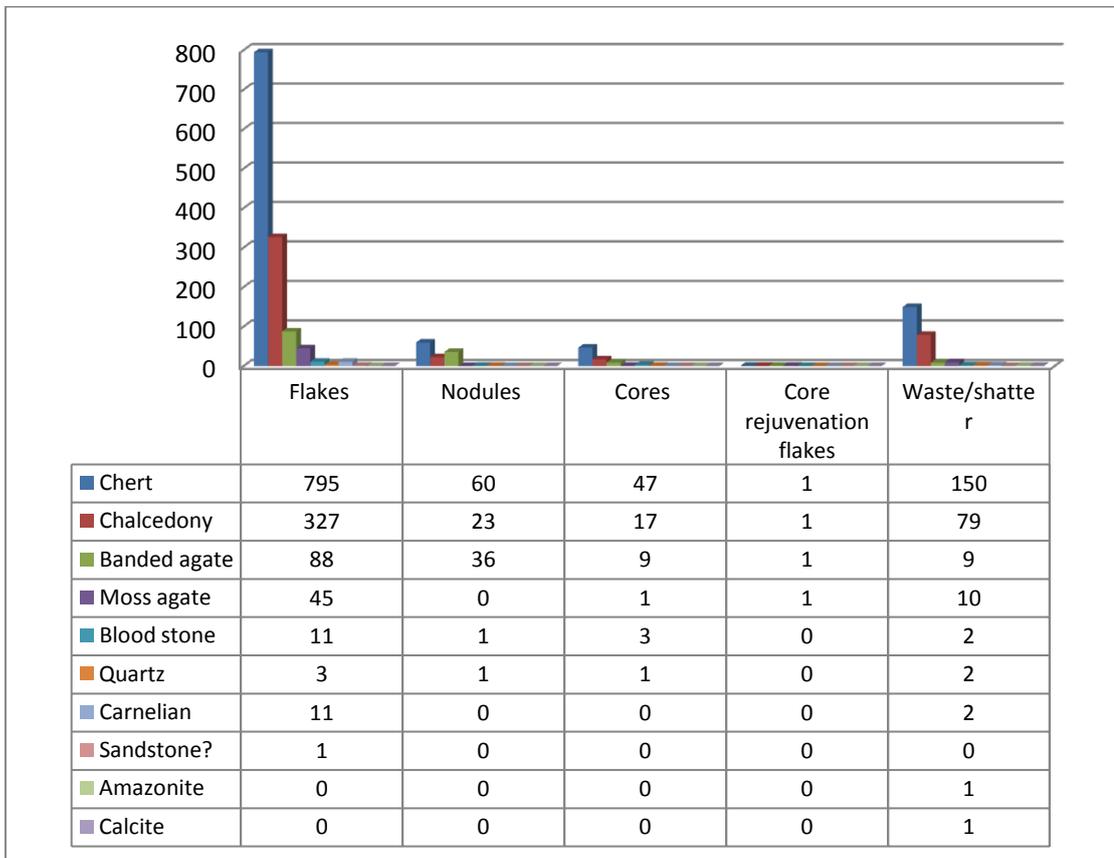


Figure 3.106: Lithic debitage vs raw materials from Chalcolithic period at Pithad

Flakes

A total 1281 flakes belonging to different raw materials were identified from the lithic assemblage. 507 or 39.58% of these were primary flakes with varying percentages of cortex present on their surface while 774 or 60.42% flakes belonged to the category of secondary flakes. 1056 or 82.44% flakes were found in intact condition, 212 or 16.55% were proximal fragments and 13 or 1.01% were broken fragments. It was observed that carnelian and sandstone were the only two raw materials, flakes of which did not show the presence of cortex in any amount. All the other raw materials, specially chert, chalcedony, banded agate and moss agate showed varying percentages (<10%, 10-50% and >50%) of cortex on their flakes. 1167 or 91.1% flakes were found without any utilization or retouches and thus belong to the category of debitage. But 106 or 8.29% flakes were found with edge damages suggesting utilization and 8 or 0.76% flakes were found to have been randomly retouched. It was further observed that flakes made out of chert, chalcedony and banded agate were retouched and flakes of chert, chalcedony, banded agate and moss agate showed edge damages. These flakes have been categorized into sizes and it was observed that size frequency of flakes (primary and secondary flakes) showed that majority of the intact flakes belonged to the size 1.5-2cm (178 fragments or 16.90%), 1-1.5cm (172 or 16.33%), 2-2.5cm (164 or 15.57%), 2.5-3cm (163 or 15.48%), 3-3.5cm (115 or 10.92%) and 0.5-1cm (86 or 8.17%). Remaining 15.5% flakes were divided into sizes 0.5cm (5 or 0.47%), 4cm (74 or 7.03%), 4.5cm (33 or 3.13%), 5cm (20 or 1.90%), 5.5cm (21 or 1.99%), 6cm (13 or 1.23%), 6.5cm (2 or 0.19%), 7cm (5 or 0.47%), 7.5cm (1 or 0.09%) and 9cm (1 or 0.09%). The broken blades on the other hand showed very few large flakes. The proximal fragments were found to be 54 or 25.96% for 1.5-2cm, 41 or 19.71% for 1-1.5cm, 37 or 17.79% for 2-2.5cm, 36 or 17.31% for 0.5-1cm, 17 or 8.17% for 0-0.5cm, 10 or 4.81% for 2.5-3cm, 8 or 3.85% for 3-3.5cm, 3 (1.44%) for 4cm, 1 (0.48%) for 5cm and 1 for 6.5cm. figure 3.107 gives a graphic representation of the same.

Nodules

122 nodules belong to the Chalcolithic period lithic debitage. Only 4 were found in intact condition. 44 (36.07%) were found in broken condition while 74 (60.66%) were randomly flaked (figure 3.108). Raw materials are represented by chert (61 or 49.59%), chalcedony (23 or 19.01%), banded agate (39 or 29.75%), blood stone (1 or

0.83%) and quartz (1 or 0.83%). 23 or 18.85% nodules were found to be without cortex while the others showed varying amount of cortex present, <10% cortex was present for 18 or 14.75%, 10-50% cortex was present for 11 or 9.09% and >50% cortex was present in 70 or 57.38% of the nodules.

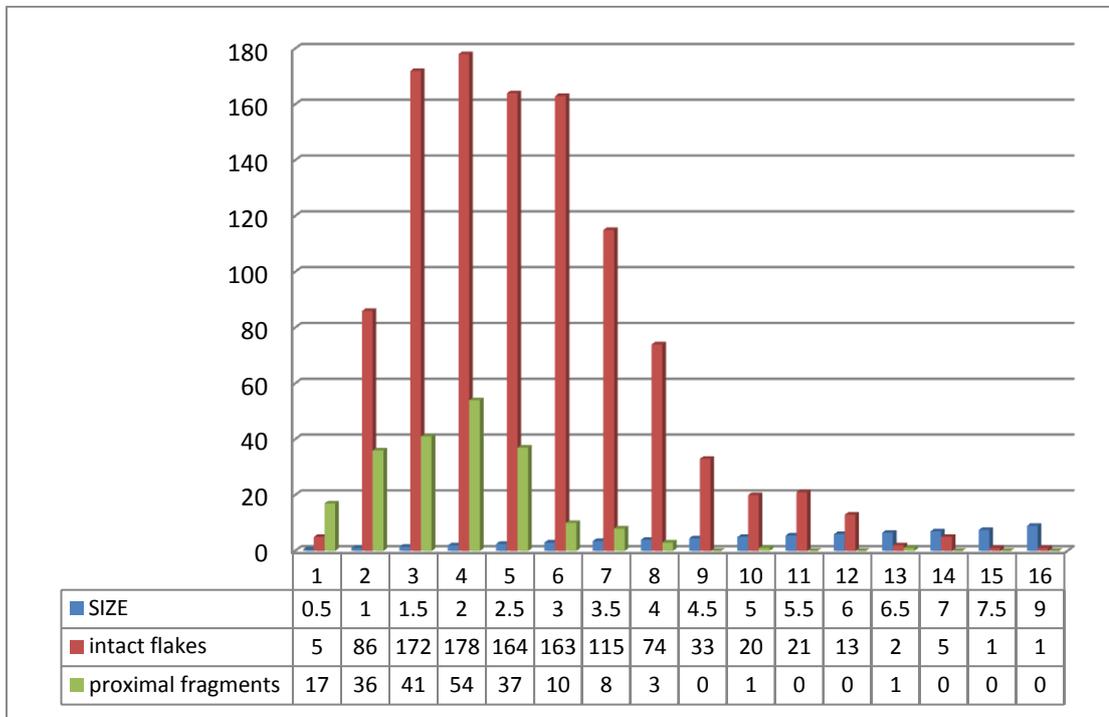


Figure: 3.107: Size distribution of intact and proximal flakes from Chalcolithic period at Pithad

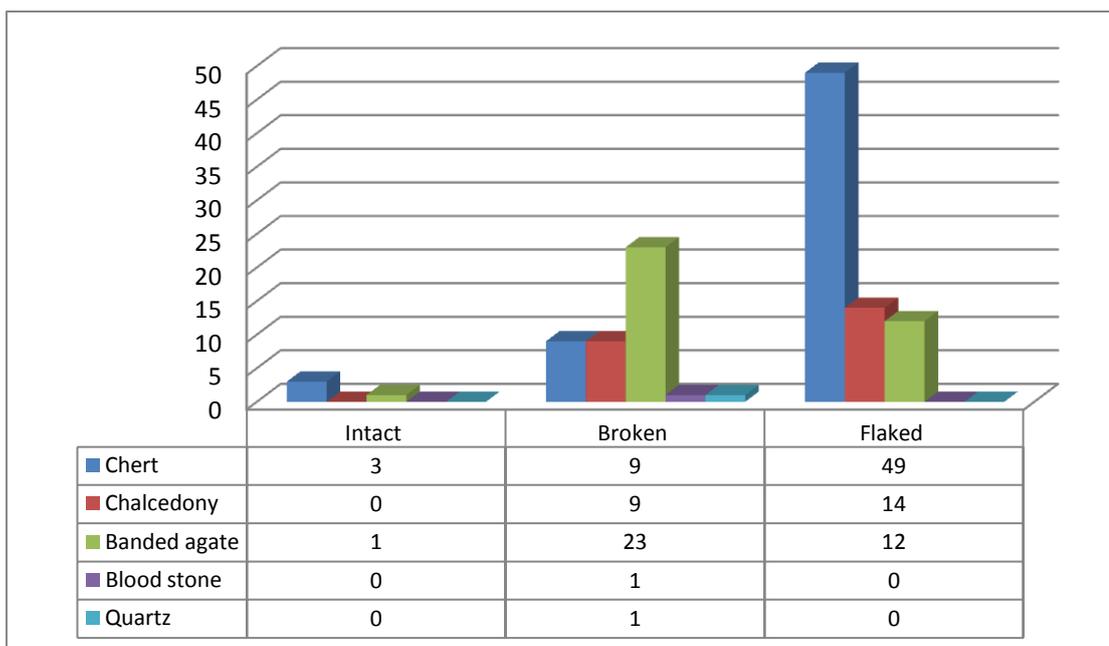


Figure 3.108: Condition of nodules vs raw material from Chalcolithic period at Pithad

Core rejuvenation flakes

One flake each of raw materials chert, chalcedony, banded agate and moss agate was found in this flake category. All were found in intact condition and were devoid of cortex, except the banded agate flake where <10% cortex was observed. Their measurements are as given below in table 3.111.

Table 3.111: Metrics of core rejuvenation flakes in mm from Chalcolithic period at Pithad

Raw materials	No	Length	Breadth	Thickness
Chert	1	18.41	11.9	3.66
Chalcedony	1	30.19	10.34	18.97
Banded agate	1	17.28	20.91	6.41
Moss agate	1	8.11	15.63	9.32

Waste/shatter

Undiagnostic fragments belonging to raw materials chert (150 or 58.59%), chalcedony (79 or 30.86%), moss agate (10 or 3.91%) and banded agate (9 or 3.52%) have been classified in this category. Rest of the 3.12% (8 fragments) belong to blood stone, quartz, carnelian, amazonite and calcite. It was observed that majority (176 or 68.75%) of the shatter was found without any cortex. The presence of cortex in the remaining 31.25% (80 fragments) waste in varying amount on major raw materials such as chert, chalcedony, banded agate and moss agate gives evidence that these raw materials were being worked at the site (figure 3.109).

Cores

78 cores belonging to raw materials chert (47 or 60.26%), chalcedony (17 or 21.79%), banded agate (9 or 11.54%), moss agate (1 or 1.28%), blood stone (3 or 3.85%) and quartz (1 or 1.28%) have been recovered from the site. 52 belonged to blade core category and 26 belonged to flake core category (figure 3.112). Out of 52 blade cores, 32 were intact (figure 3.110) while 20 were broken. And out of 26 flake cores, 16 were intact (figure 3.111) while 10 were broken. Metric analysis was carried out for all the intact cores, blades cores as well as flakes cores.

Blade cores belonged to raw materials chert (32 or 61.54%), chalcedony (12 or 23.08%), banded agate (5 or 9.62%), moss agate (1 or 1.92%), blood stone (1 or 1.92%) and quartz (1 or 1.92%), while flake cores belonged to chert (65%), chalcedony (15%), banded agate (10%) and blood stone (10%).

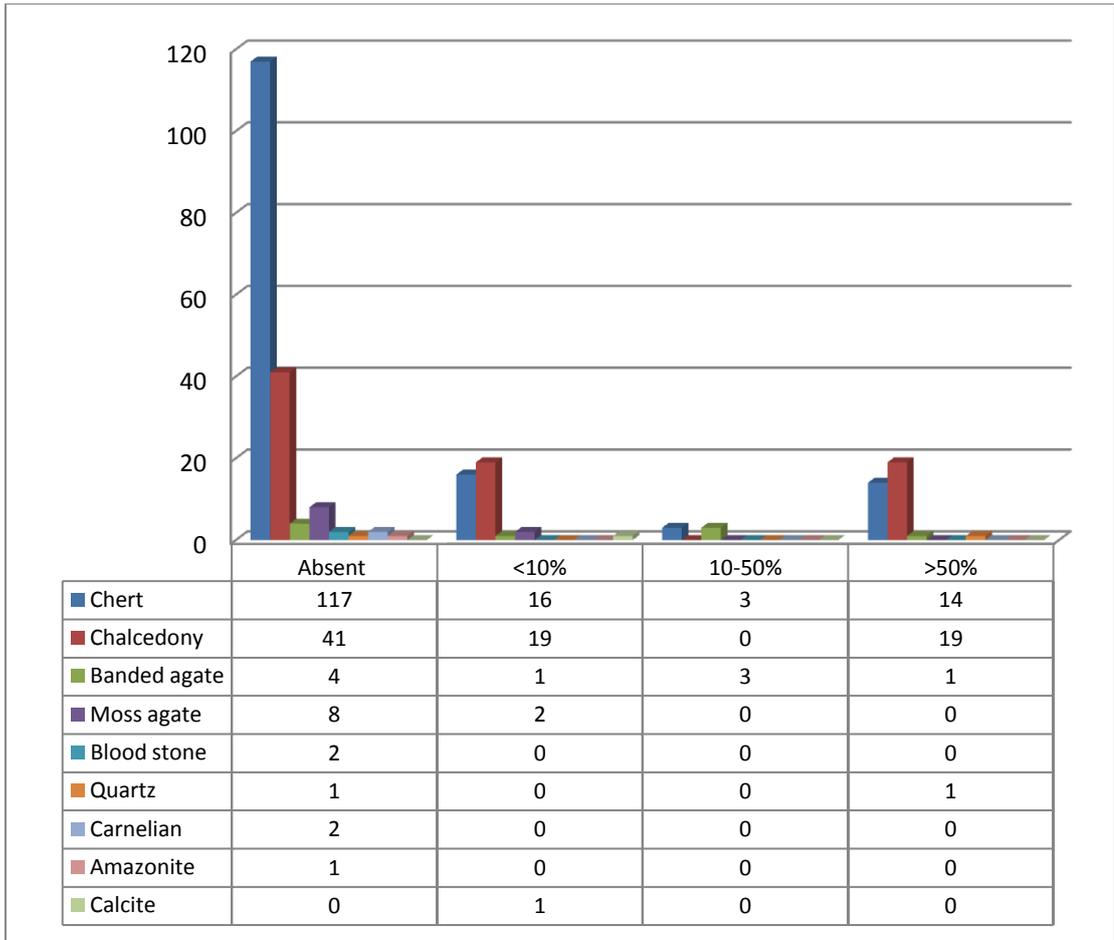


Figure 3.109: Representation of cortex on waste from Chalcolithic period at Pithad

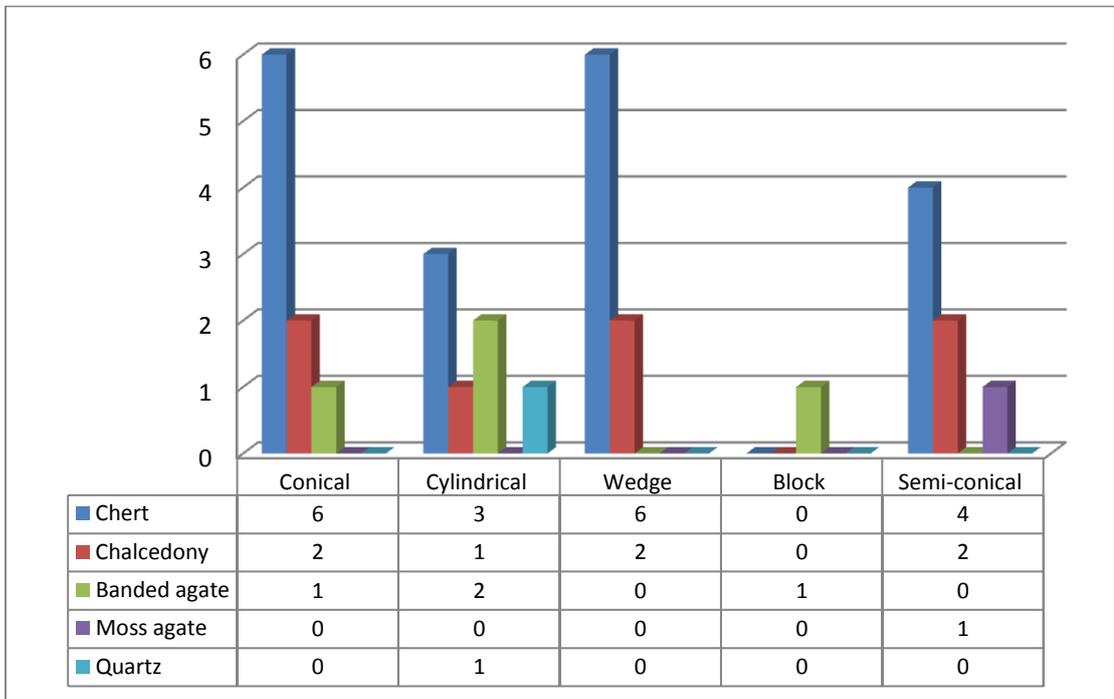


Figure 3.110: Intact blade cores according to their shapes from Chalcolithic period at Pithad

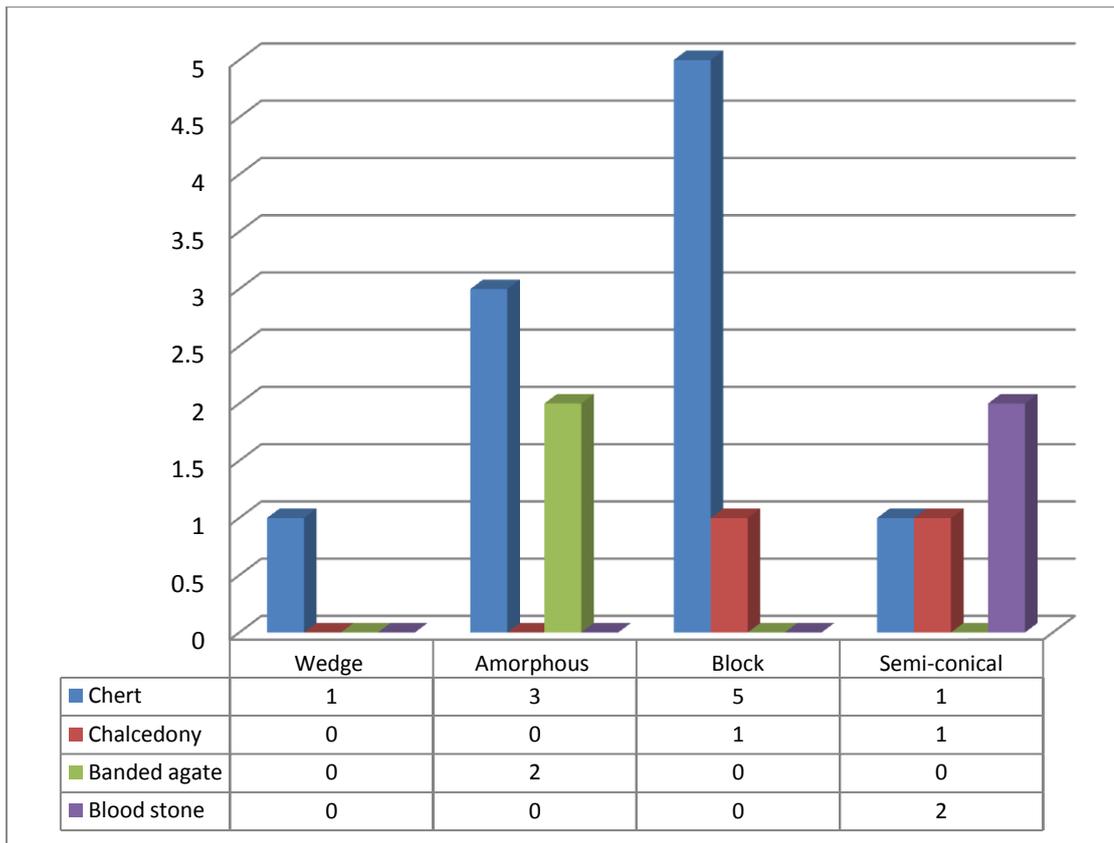


Figure 3.111: Intact flake cores according to their shapes from Chalcolithic period at Pithad

Majority (37 or 71.15%) of the blade cores were found to have been devoid of cortex. Though 7(13.46%) cores did show <10% cortex, 3 (5.77%) cores showed 10-50% cortex and 5 (9.62%) cores showed >50% cortex on their surface. Flake cores either did not have cortex (45%) or had <10% (55%) cortex on their surface.

Intact blade cores according to their shape were classified into conical (9 or 28.13%), cylindrical (7 or 21.88%), wedge (8 or 25%), block (1 or 3.13%) and semi-conical (7 or 21.88%). Intact flake cores have been classified into wedge (1 or 6.25%), amorphous (5 or 31.25%), block (6 or 37.5%) and semi-conical (4 or 25%).

Blade removal patterns and blade removal direction

Blades from intact blade cores were mostly (30 or 93.75%) taken out by rotating the core. A single example each of sliced and flexible blade removal was observed amongst these cores. Intact flake core on the other hand showed blade removal pattern to be mostly (13 or 81.25%) flexible. Three flake cores were observed to have been rotated to remove flakes. Majority (24 or 75%) of the intact blade cores were found to

have been unidirectional, a few were found to have been bidirectional (7 or 21.88%) and a single core showed evidence of multiple-directional flaking. Intact flake cores on the other hand gave evidence of multidirectional flaking at 68.75% (11 flake cores), bidirectional flaking at 18.75% (3 cores) and unidirectional flaking only at 12.5% (2 cores).

Platform preparation and platform count

The intact blade cores showed multiple flaking/chipping (15 or 46.88%) and a single flake removal (15 or 46.88%) in equal percentages to make the platform, only two blade cores were found to have no platform preparations. Intact flake cores on the other hand majority (11 or 68.75%) of the time showed no preparation of platform, very few cores were prepared either by a single flake removal (3 cores 18.75%) or multiple flaking/chipping (2 cores 12.5%). Most (28 or 87.5%) of the intact blade cores showed a single platform while 4 blade cores (12.5%) showed presence of two platforms. Intact flake cores on the other hand showed single platform (2 cores 13.33%), two platforms (7 cores 46.67%), three platforms (4 cores 26.67%) and more than three platforms (2 cores 13.33%).

Core butts

Butts or the distal ends of the intact blade cores showed features of 'no significant feature or wear' (13 or 40.63%), removal of a flake (11 or 34.34%), platform (5 or 15.63%), broken (2 or 6.25%) and cortex (1 or 3.13%). Intact flake cores on the other hand showed features of distal end being the platform (11 cores 68.75%), removal of a flake (4 cores 25%) and no significant feature or wear (1 core 6.25%).

Discard causes

It was observed that majority (23 or 71.88%) of the intact blade cores were discarded after they became exhausted. A few (6 or 18.75%) were found to have raw material flows and the rest showed hinge fracture. Intact flake cores too most of the time were discarded after they became exhausted (9 cores 56.25%) but a few examples of discard due to raw material flows were also encountered.

Metric analysis

Metric analysis of the cores has been carried out according to their shape. By observing the standard deviation values, it is clear that all the cores were very

different in their sizes (table 3.112). No standardization is evident in any of the cores neither blade nor flake.

Table 3.112: Metrics of cores in mm from Chalcolithic period at Pithad

Core type	Core shape		Mean	Median	Mode	Std Dev	Variance
Blade cores	Conical	Length	21.07	23.11	12.28	6.27	39.32
		Breadth	16.92	16.93	11.11	4.68	21.92
		Thickness	12.29	15.58	10.79	5.94	35.34
	Cylindrical	Length	30.95	27.57	19.65	10.68	114.15
		Breadth	21.28	21.56	12.6	5.48	30.1
		Thickness	16.71	17.1	15.53	4.2	17.66
	Wedge	Length	20.35	18.86	12.57	7.38	54.45
		Breadth	21.31	21.18	15.85	3.75	14.1
		Thickness	18.11	17.93	14.18	3.58	12.84
	Block	Length	22.38				
		Breadth	19.59				
		Thickness	21.22				
	Semi-conical	Length	20.97	20.6	15.94	4.79	22.94
		Breadth	19.00	19.88	13.32	3.76	14.14
		Thickness	16.56	15.25	11.92	3.63	13.16
Flake cores	Amorphous	Length	23.23	20.19	15.41	7.09	50.28
		Breadth	27.53	29.49	16.05	8.73	76.24
		Thickness	17.04	15.01	11.34	5.35	28.68
	Block	Length	30.56	29.06	16.44	20.13	102.62
		Breadth	44.26	46.94	31.36	7.67	58.84
		Thickness	33.22	32.31	24.07	9.38	88.14
	Semi-conical	Length	29.81	30.41	17.19	10.11	102.35
		Breadth	29.54	29.94	19.37	8.38	70.26
		Thickness	21.77	23.22	13.6	5.75	33.02
	Wedge	Length	53.36				
		Breadth	66.79				
		Thickness	46.82				



Figure 3.112: Cores from the Chalcolithic period at Pithad (courtesy: Department of Archaeology and Ancient History, The M.S.U. of Baroda, Vadodara)

40 trenches have given evidence of lithic debitage though in very varying amount. As was found during tool distribution, majority of the lithic assemblage (42.09%) was found from layer 2 of various trenches, 13.67% and 13.14% respectively from the dumps situated in trenches Ad7, Ad9/10, Ba10, Ba7, Ba6/7, Ba8, Bb16 and the pit of trench Ad6. Layer 1 constitutes 10.08%, layer 3 comprises 10.16%, layer 4 contains 8.48% and layer 5 shows 2.37% of the total lithic debitage. Over all it was found that trenches 5Ac3 (15.74%), Ad6 (13.37%), Ad9/10 (9.78%), Ba10 (8.33%) and Bb16 (8.48%) showed presence of substantial amount of lithic debitage. Ad7 (3.28%), Ba8 (3.21%), Bm8 (5.12%), Ck2 (6.26%), Ck6 (5.65%) were some of the other trenches from where respectable amount of lithic debitage has been recovered. Rest of the trenches have shown insignificant amount of presence of lithic debitage. It is interesting that more trenches have shown presence of lithic debitage than tools.

Summary

The Chalcolithic period lithic assemblage recovered during 1991-92, 2005-06, 2006-07 field seasons at Pithad is represented by blades (56), geometric and non-geometric

tools (96) and lithic debitage (1698). Simple blades and blade flakes are the main category of blades found amongst the blade assemblage. Retouched blade types such as backed blades and retouched blades are very few in number. A single crested ridge blade was also identified from the assemblage. Raw material category is dominated by Chert, and it was exploited most to make different types of blades. Chalcedony, moss agate and banded agate are the other raw materials which were utilized for blade manufacturing activity. The maximum numbers of blades were represented by their proximal ends, closely followed by mesial fragments. The proximal end forms were characterized 'difficult to see or identify'. Proximal ends types were mostly found to be 'single'. Proximal shape was dominated by 'pointed' category which in turn suggests hard hammer percussion method. It was also observed that proximal width varied a lot between blades while the thickness was more or less of standardized size. For intact and distal fragments of blades it was observed that their distal end terminations showed characteristics of 'plunging' and 'feathered' types almost in equal quantity. Hardly any retouching or utilization marks were seen on distal ends of blades. For broken blades it was seen that they broke in a clean way. Majority of the blades (85.71%) showed no evidence of cortex. 48.21% blades showed evidence of edge damage and thus these blades appear to have been utilized. In 46.43% blades, a very high percentage, it was difficult to decide about their edge condition. Only 5.36% blades were retouched as well as utilized and it was further observed that the retouching was always carried out on the right edges of the blades. Lengths and breadths of intact as well as broken blades show a lot of variation while the thickness was found to have been comparatively standardized. Blade flakes were the longest, broadest and thickest of all blades.

As mentioned earlier, tools in Pithad are dominated by non-geometric variety, specifically by various types of scrapers. Points, burins and borers were represented by 17.89%. True geometric tools, however, were found to be very few in number. 14 geometric tools (12 lunates and 2 trapeziums) were found amongst the geometric tool variety. The tools of this category were made out of chert (60.00%), followed by chalcedony (17.89%), moss agate (7.37%), banded agate (6.32%), quartz (6.32%) and blood stone (2.11%).

Lunates were made on secondary blades and most probably were utilized. Their

lengths vary but breadth and thickness show similar values. Trapeziums follow the same pattern as of lunates in their measurements. Points were found to be comprising of varying sizes. High standard deviation values for lengths and breadths of burins suggest variation. Borers showed variation in their lengths and breadths but standardization in their thickness.

A few of the scrapers were made by retouching old, abraded flakes. More than 75% of these scrapers were made out of chert. The rest belonged to raw materials such as chalcedony, banded agate, moss agate, and blood stone. All the scrapers identified from the lithic assemblage seem to have been utilized. This in contrast to unutilized blades most probably suggests that sturdier tools such as scrapers were preferred tools at the site. Almost all the scrapers follow similar pattern in their measurements. They were made of various sizes and most probably all of them were utilized.

Lithic debitage at the site was divided into categories of flakes (primary, secondary, core rejuvenation), nodules, cores and waste/shatter. Almost 40% flakes were primary flakes with varying amount of cortex on their dorsal side. 89.9% flakes were found without any utilization or retouches. 9.33% flakes were found with edge damages suggesting utilization and 0.76% flakes were found to have been randomly retouched. Size frequency of flakes (primary and secondary flakes) showed size categories 1.5cm, 2cm, 2.5cm, 3cm and 3.5cm represent 75.81% assemblage.

Complete nodules were very few in numbers; mostly they were found either broken into two parts or randomly flaked. Core rejuvenation flakes belonged to raw materials chert, chalcedony, banded agate and moss agate. Waste/shatter comprised almost 15% of the lithic debitage recovered from the site.

Majority of cores found from the assemblage belonged to the category of blade cores. Conical shape was the most common amongst them. Blades were removed out of these cores by rotating them unidirectionally. Single flake removal seen on blade core platforms might suggest the removal of core rejuvenation flake. Most of the blade cores had single platforms. Cortex was present on almost all the cores. Blade as well as flake cores showed a lot of variation in their sizes.