Microlithic Industry of Odisha with Particular Reference to Bhalugarh, District- Jharsuguda, Odisha: A Preliminary Report

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Abstract*: The antiquity of microlithic research in Odisha goes back to pre-independence era, and has brought to light extensive remains of lithic assemblages from the post-Pleistocene deposits in different parts of the state. All these sites have been reported from three distinct geomorphologic contexts, viz. along the banks of the rivers and its tributaries of different orders, on the raised surfaces with massive exposure of rock out crops, and on the foothills. Some of these sites have also been found to be associated with rock shelter habitats. The assemblages are predominantly geometric-microlithic in character and are represented mostly by backed and truncated tools i.e. lunates, scrapers, denticulates, burins and notches. While typical trapeze is a rare occurrence, majority of the assemblages contain isosceles and scalene triangles in varying proportions. In all the cases, the prehistoric knappers had exploited locally available sources, which occur in the form of nodules and pebbles in the rivers and stream beds as well as cobbles on the foothills, for tool manufacture. Our preliminary study on Bhalugarh microlithic site situated in the Sapai river, gives some information about the characteristic feature of the lithic assemblages composition and different tool technology used by prehistoric knappers during the time of tool production.*

Keywords: Bhalugarh, Human Colonization, Odisha, Sapai River, Late Pleistocene, Microlithic Technology, Raw Material

Introduction

Microlith is a narrow flake blunted on one or both edge by steep, secondary chopping but devoid of secondary work on any face (Clark 1932), some time retouched and backed, and usually measured as a part of composite hafted tools. The nature and function of microliths has been confusing, however, they are often standardized and precisely made relative to other classes of stone tools; sometime they are used as projectile hunting weapon (Elston and Kuhn, 2002). Emergence of microlithic technology not only plays a major role to give adequate data to know about the origins of modern human and their dispersal in different parts of the world , but also development of human capacities for complex behavior and symbolic thoughts. (Clark 1969, Neeley & Barton 1994, 275-288, Bar-Yosef & Kuhn 1999: 322-38, Kuhn & Stiner

1999: 505-17, Klein 2000: 17-36, Hiscock 2002: 163-77, Foley & Lahr 2004: 108-22, James & Petraglia 2005: 23-27, Mellars 2006: 796-800, Anikovitch *et al*. 2007: 223-25, Seong 2008: 871-83).

Although, several theories have been proposed by scholars throughout the world to explain the emergence and function of microliths; many of them have recognized it as a composite tool, only designed for hunting particular prey species (Ambrose 2002: 9-29), for exchange network and ethnic symbols (Deacon 1992: 177-83, Wurz, 1999: 38-50), relationship with fine grained raw material (Neeley 2002),as a Surgical scalpels (Etheridge and Whitelegge 1907: 233-50), for large game hunting (McBryde 1974), individual hunting strategies (Morwood 1986: 88-132) and/or for intensity of warfare/violent behavior (McDonald et al. 2007: 877-85), and these may have been used as vehicle for poison (Lombard and Pargeter, 2008: 2523-31). Some of them focus how microlithic technology is strongly associated with latitude (Bamforth and Bleed 1997, Bettinger et al. 1994: 74–101, Derev'anko 1998, Elston 2002, Kuzmin and Orlova 1998: 1–53, Kuzmin and Tankersley 1996: 577–585, Lu 1998: 85–112, 1999, Morlan 1970: 17–37, occurring from about 33°N to above 70°N, and from far western China and Siberia to the Pacific coast, Sakhalin Island, and the islands of Japan. We have very few accounts on comparative studies of microlithic industries, between one to another region. Recent archaeological researches carried out in different parts of the world (Deraniyagala 1992, Mellars 2006, Hiscock et al., 2011:660-71) have pointed out that, microlithic industries as monolithic entity, ignoring different method used for tool production and their probable function.

In Indian subcontinent, the antiquity of Microliths have been pushed back to 48,000 BP at Mehtakheri in Madhya Pradesh (Mishra 2013: 1-14), 35,000 BP at 'Jwalapuram 9' in Andhra Pradesh and 34-25,000 BP (Clarkson et al., 2009: 326-48) at Kana and Mahadebbera (Basak 2014: 1167-1171) in West Bengal. This is similar with Microlithic industry reported from Batadoma-lena, which preserves evidence for the presence of *H. sapiens* foragers in the rainforest of southern Sri Lanka from ca. 36,000 BP onwards to the end of the Pleistocene (Perera *et. al.*, 2011: 254-69). Odisha has also yielded a large number of Microlithic sites, situated in various geo-morphological contexts, viz. rock shelters, foothills, piedmont areas and cliff surfaces of various rivers and their numerous tributaries. Most of them are found to be associated with microlithic industries with or without the occurrence of heavy-duty pebble/cobble tools (Ota 1986: 79-85, Mohanty 1993: 85-104, Behera 1989, 2006: 1-62).

History of Microlithic Research in Odisha

Since the late 1950's Odisha has been attracting the attention of many research scholars engaged in pre-history, proto-history as well as different ethnographic studies. Mahapatra's work "The Stone Age Culture of Odisha", published in 1962 stands out prominently. The significance of Mahapatra's work is that, it has for the first time, brought to light a succession of Stone Age Culture in Odisha, and demonstrated that the Palaeolithic industry extended beyond the frontiers of Mayurbhanj district and

flourished over a larger part of the state. He discovered twenty-two Early Stone Age sites, twenty-five Middle Stone Age sites and eight Late Stone Age sites.

Mahapatra's investigations extended over an area of 38,560 square kilometers comprising the districts of Mayurbhanj, Keonjhar, Sundargarh, Sambalpur, and Dhenkanal. The rivers Burhabalanga, Baitarani, Bramhani and the Mahanadi, with their tributaries flowing through the above-mentioned districts were surveyed for Pleistocene deposits, containing Stone Age antiquity (I.A.R. 1959: 36-38; Mahapatra 1962, 1972, 1990). The stone tools of Early Stone Age culture comprised of hand axes, Cleavers, Scrapers, Cores, Points, flakes and irregularly flaked pebbles, hand axes predominate in the collection. The typology of these tools shows that, overall, this culture belonged to the tradition of bifacial tools in which the flakes and pebbles form an integral part. The stratigraphic horizon of this culture is course gravel at the bottom of the sections. Stratigraphically the Middle Stone Age tools occur in a layer of fine gravel above a layer of clay of red silt. This red silt distinctly separates the fine gravels from yielding the tools of the Early Stone Age. Scraper, borer, burin and scraper-borer of the regular tool types, utilized flakes, nodules, cores and blades, occur in suitable preparation. Chart, jasper, opal, chalcedony and fine grain quartzite are the principal raw material used for tool manufacture. Blades, scrapers, points, burins, and flakes characterize the late Stone Age or microlithic culture. Chert, quartz and chalcedony were the principal raw materials used for tool production.

During late 50's and early 60's, quite a few isolated discoveries of Stone Age sites have reported microlithic industries from Kaneha in Talcher sub-division, (I.A.R. 1958-59: 36); Baramandir, Danguapsi and Bonaikela in Keonjhor district (I.A.R. 1961-62: 36-37); the river Tel and its tributaries (I.A.R. 1963-64: 27); a few microlithic sites were also reported from Vani vihar campus in Bhubaneswar (Tripathy 1970) and from Bolangir (I.A.R 1968-69:68).

The work of Tripathy during the early 70's in south-western Odisha has made known several Stone Age sites, from the Tel river basin. He discovered three sites of pebble tools industry, sixteen sites giving flake tools industries of Middle Palaeolithic culture and twenty seven sites of flake blade industry (Microlithic culture) covering the district of Phulbani, Bolangir, Kalahandi and Sambalpur. The total collection from all these sites consisted of 1781 artefacts. Chert and Quartz was the most common raw material followed by Quartzite, Chalcedony, Jasper and Opal, out of the total collection, 37% are backed tools. The tool type comprised backed blades, truncated blades, retouch blades, crescents, a variety of Scrapers, burins, borers, utilized flakes and fluted cores (Tripathy, 1972, 1973:43-59, 1977, 1980, Tripathy and Mahanty, 1972:9-12). Exploration on river Indravati, and its tributaries in the eastern part of Koraput district has brought to lighted 85 microlithic sites, and the main characteristics features of the Microlithic industry are (i) Chert and Quartz are the predominant raw materials used by flint knappers during the tool production. (ii) Blades occur in high proportion, (iii) Backed blade is the predominate type of tool among the microlithic sites, (iv) Fluted core is

predominant among the core variants, and (v) scrapers, denticulate, knives, etc., were made on large flakes with length ~~is~~ more than six (6) cm (Nanda 1982-83, 1984,1985).

The Phulbani district of central Odisha has revealed thirty open-air Microlithic sites (Ota, 1982-83, 1986:79-85). All these sites have produced a typical microlithic industry essentially made on quartz. The finished tool types include both geometric and non-geometric types, like triangles, trapezes, lunates, points, backed blades, retouched blades and variety of scrapers etc. In association with these artefacts are found a large number of heavy duty implements made on quartzite. They are horse-hoof core or scrapers, choppers and pointed tools. Ota has given a plausible ecological explanation of the occurrence of heavy implements.

Similarly, intensive exploration in the Champua, Ghasipura, Ghatgan, Palaspal and Patna *taluks* of Keonjhar district, (Mohanty 1985: 103-112, 1986-87: 54-55, 1988a, 1988b, 1988-89: 223-227, 1989, 1992: 207-232), resulted in the discovery of as many as 58 Microlithic sites. Most of these sites are associated with granitic out crops, while a few are found in the foot hill region laying close to the streams, and associated with microliths and a variety of heavy-duty pebble tools. Mohanty claimed that majority of these sites discovered in the area are primary in nature. Besides, a well-developed blade-bladelet technology is the most outstanding features of the microlithic assemblages of Keonjhar. The lithic components is characterized by backed blades, obliquely truncated blades, retouched blades, knives, triangles, trapezes, crescents, lunates, side-scrapers and scrapers, round-scraper, steep-scrapers, thumbnail-scrapers, flake cores, blade cores, micro-blade cores, utilized blades, flakes and chips (Mohanty, 1992).

A large numbers of pointed as well as engraved rock-shelters occur in the sand stone bearing areas from western border of the state of Odisha, also reported to have yielded numerous microliths on their floor (Behera, 1991-92:7-16, Erwin, 1992).

The researches pertaining to the study of Rock-Art and associated features in this part of Odisha are still in their infant stage. Some painted Rock-Shelter sites, unassociated with microliths have been reported from Mayurbhanj (I.A.R. 1975-76, p.37), Keonjhar (I.A.R. 1984-85, p. 58), Sambalpur (I.A.R., 1969-70, p. 30) and Kalahandi (Singh Deo, 1976) districts of Odisha. So far, no detailed accounts of these discoveries are available.

Besides the above mention sites, occurrence of microlithic industries were also reported from the Jira valley, a tributary of the river Mahanadi, in the western part of Odisha. Tripathy (1971) first reported the occurrence of Late Stone Age (microlithic assemblages) in this valley. However, except a few broad generalizations, he never published full data. Subsequently, S.K. Mishra discovered a large number of microlithic bearing sites in the Jira valley (Mishra, 1977, 1978a, 1978b, 1982-83: 31-42). However, except reporting the discoveries, the work of S.K. Mishra did not contain any detailed information.

Behera's (2001-2002: 1-11, 2006: 1-22) intensive survey in the Middle Mahanadi valley has brought to light as many as 35 localities yielding Microlithic as well as heavy duty pebble tools belonging to Microlithic cultural phase.

Subsequently many other scholars carried out explorations in different parts of Odisha and tributaries of the Mahanadi river valley and reported many sites as belonging to the microlithic cultural phase i.e. Jira (Mishra 2001-02, Seth 1995-96), Ong valley (Panda 1996), Bheden valley (Naik 2002), Girisul River (Mendaly 2012, 2014: 79-82), Jonk river (Padhan 2014: 405-420) and made sizable collections from a number of sites in this region. The assemblage found by them from these sites contained both geometric and non-geometric microliths.

The Study Area

The river Sapai is a second order tributary of the Mahanadi, located in North-Eastern Odisha. It merges with the Ib River, flowing directly into the Mahanadi. The river originates from the hills near Bamra-Gangpur reserve forest at an elevation of 314 m. It covers the eastern part of Jharsuguda district and the western part of Sundergarh district. The microlithic site of Bhalugarh (Fig. 1a and 1b) is situated on the right bank of Sapai stream, which is 10 km from Jharsuguda town and 1 km from Bhalugarh village. The site is nearly 300 meters long in East –West and 120 meters width in North-South direction (Fig. 2). The oldest rock formation of the area belongs to the Archaean series, followed by those of the Dharwarian and Cuddapah series. Overlying Cuddapah, the sediments of the Gondwana formations represented by Talchirs, Damuda, etc. were deposited on a Precambrian platform, almost separating the Eastern Ghats and the North Orissa craton (Mahalik 1994: 41-51; Goswami 2002). The Quaternary formations are represented by thin to thick deposits of secondary laterite, colluviums and alluvium of variable extent (Table 1).

Previous Works in the Study Area

Sporadic investigations were carried out in Ib River by earlier scholars (Mohapatra 1960, Tripathy 1982-83: 60-66, Naik 2002). They have not only reported microlithic bearing sites but have also found material remains belonging to other cultural periods, which indicates the prehistoric potentiality of this part of the Indian sub-continent. However, they selected a very wide region for their field research; they could not examine any particular area intensively for obvious reasons. Therefore, in order to locate sites in primary context with a marked emphasis on their dispersal pattern and techno-typological nature, investigations have been carried out in the Sapai river. We particularly chose microlithic bearing assemblage for a detailed study, not only for a better understanding on the techno-typological character of lithic assemblage, but also to know human adaptive strategies in this region during the prehistoric period.

Methodology

During the course of our exploration which began in the month of May 2014 and continued up to October 2014, we thoroughly surveyed the selected area and

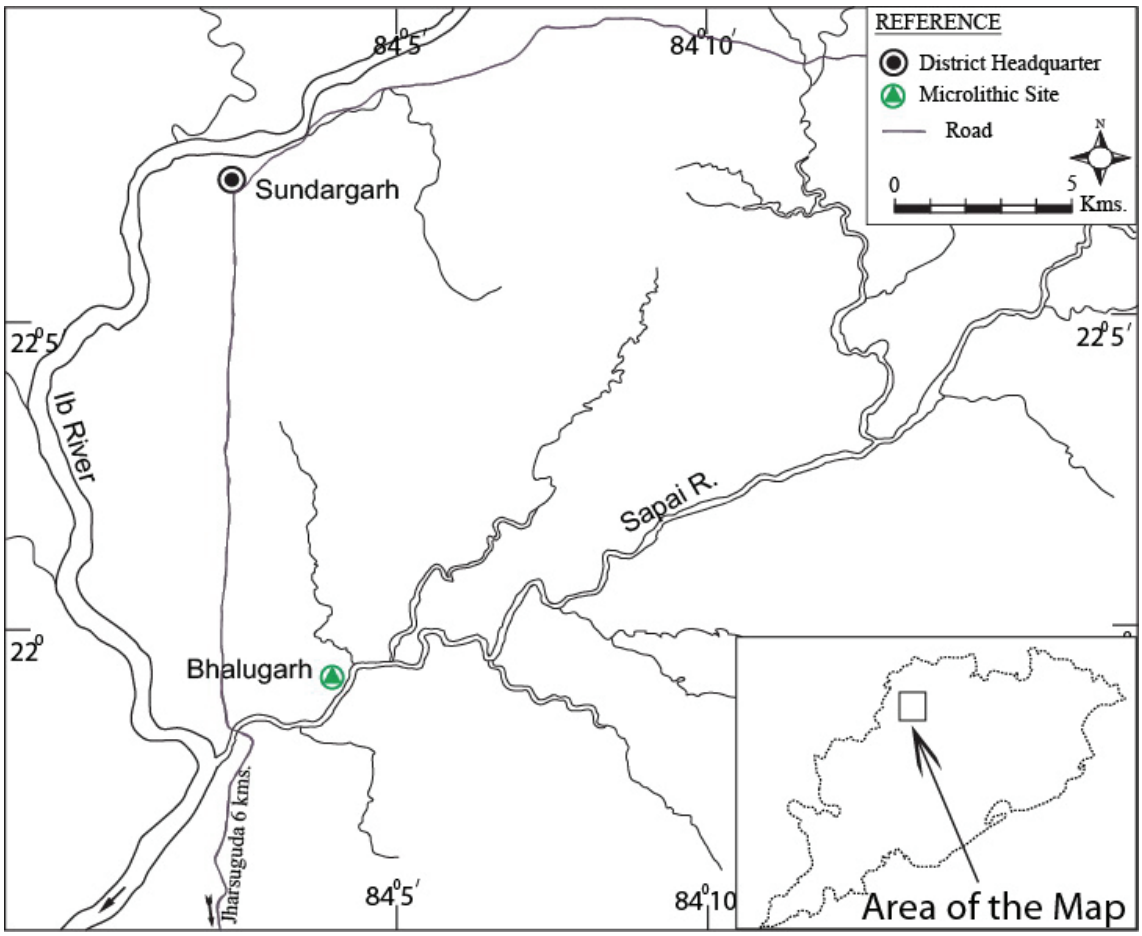

Figure 1a: Location of Bhalugarh

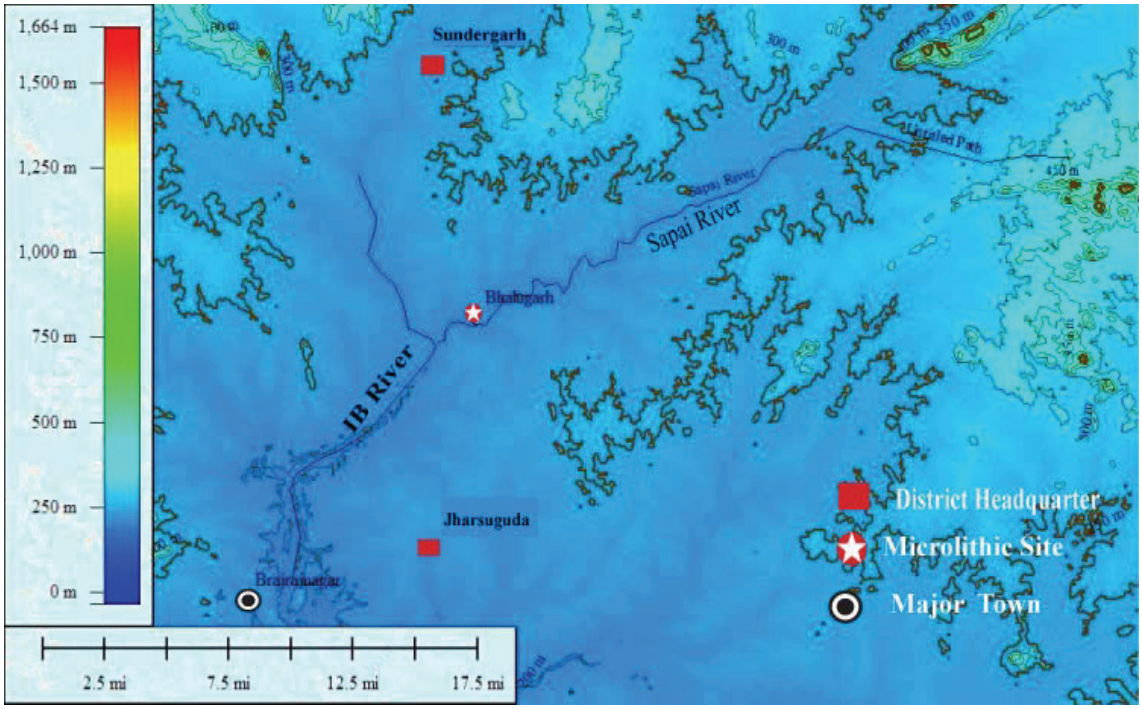

Figure 1b: Map of IB and Sapai Rivers

Table 1: Geological formation and fossils remain reported from the river IB and its tributary (After Goswami 2002)

Age	Group	Formation	Lithology and Fossils Remain
Recent		Alluviam/ Laterite	Recent gravel and conglomerate
Early to middle Triassic	Upper Gondawana	Upper Kamthi= Kamthi	Conglomerate , red shale with Dicroidium flora and coarse ferruginous-sand stone with clasts (150 m +)
-	-	Unconformity	-
Late Permian	Lower Gondawana	Unconformity	Fine to medium grained well sorted, sandstone, siltstone, clay bed, coal, shale with broad mesh forms, Glossopteris species, some ferms. Pelynofloral assemblage is dominated by Striatopodocarpities, Crescentipollenites, Faunipollenites, Arcuatipollenites and Densipollenites (180 m).
Middle Permian	-	Barren Measures	Grey shale, carbonaceous shale, Fine to coarse-grained sandstone, clay and ironstone nodules/shale (250 m+)
Early Permian	-	Upper Barakar	Micaceous subarkosic sandstone, grey and carbonaceous shales with plenty of Glossopteries. Some ferns and arthophytes, fireclay and thick coal seams. Palynofloral assemblage is dominated by Scheuringipollenites ,Striatopodocarpites, Punctatisporites and Horriditriletes etc.
-	-	Lower Barakar	Feldspathic sandstone, gray and carbonaceous shales with Gangamopteris-Noeggerathiopsis - Euryphyllum fossil assemblage and thick coal seams. Palynofloral assemblage is dominated by Brijrajisporties, Lahirites, Rhizomaspora, Platysaccus, Sulcatisporites, Cuneatisporites, Primuspollenites and Apiculatisporis (350-500 m)
Early Permian	-	Karharbari	Conglomerate, carbonaceous sandstone with fresh feldspar grains containing thin coal bands only along the NW margin of the basin (30-65 m)
Early Permian	-	Talchir	Diamictite, greenish sandstone, olive and chocolate colored needle shales and rhythmites (130 m+)
Proterozoic	-	Cuddapah	Quartzite, sandstone and shale
-	-	Unconformity	-
Archaean	-	-	Granites, Gneiss, Schist, Amphibolites, Quartzite and Migmat

Figure 2: General View of Bhalugarh Microlithic Site

microlithic bearing sites were discovered on the bank of the Sapai river. In these sites, the cultural material occurs in the form of clusters, which signify the manufacturing areas of pre-historic people. In view of the large area covered by these sites and their huge cultural assemblage, it was neither possible for us to collect each and every material from the exposed clusters, nor to divide into various groups and to pick up all the artefacts from every third, fourth or fifth groups. For this reason, an attempt was made to collect all the artefacts from four representative clusters from this site. Every cluster represents density of artefacts. This was done with a view to make the collection representative from both technological and typological points of view. With regard to the technological aspects the entire blank as well as cores were classified on the basis of observable measurements and morphological attributes.

Lithic Assemblage Composition

Total 1518 (Fig. 3) artifacts were collected from the site. Among which Cores consist of 27%, flakes 51%, blades comprise only 2% of the assemblage whereas bladelets are 4%, including some backed tools. The percentage of retouched tool is very less, it comprises only 1%. Waste products cover 15% of the total lithic assemblage of Bhalugarh microlithic site.

Raw Material

Raw material plays the most significant role on the production of stone tool (Jayaswal 1970: 64-70, Dibble 1991: 33-48, Dobosi 1991: 197-204), and the quality of lithic raw material is significant for artifact function (Crabtree 1967: 8-24). But some time high

availability of raw material may complicate the simple pattern of selection as well as lithic tool production system (Bamforth 1990: 70-104, Bar-Yosef 1991: 235-50). The raw material properties like quality, shapes and sizes, relative abundance and the distance of sites from their source significantly influence execution of the stone tool technologies and the typological composition of Microlithic assemblages (Anderfsky 1998).

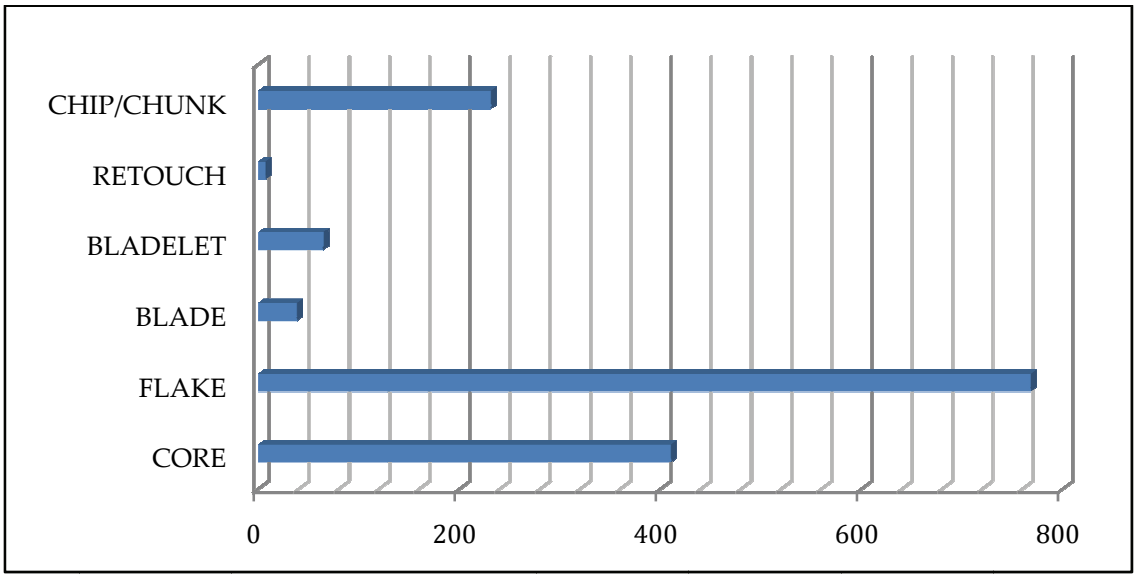

Figure 3: Lithic Assemblage found from Bhalugarh

Principal raw material in Bhalugarh Microlithic site is Quartz, which represents 98.4% (milky quartz 96% and crystal quartz is 2%) whereas only 1.5 % of artefacts were made of black chert. River pebbles were collected in addition to tabular pieces quarried directly from outcrops; two types of quartz have been distinguished: milky and crystal quartz, which are quite different in terms of knapping and functional qualities. As a result of its internal structure, quartz does not break according to the mechanics of concoidal fracture like the other hard rocks and its breakage is quite unpredictable during the process of flint knapping (Anderfsky 1998, Seong 2004:73-91). Nonetheless, its cutting edges are notably smoother and sharper than those of other rock types. Both types of quartz probably come from the same outcrops, because we have observed some pieces with a milky portion adjoining a crystal one. Here it is noticed that the maximum number of backed tools were made from fine grained quartz.

Cores

Core (Fig. 4) is made from different type of raw materials and it covers 410 (27%) of the total lithic assemblage, out of which 68% are chunk, 11.50% pebble, 12% nodule, and 8% indeterminate. The cores are characterized by single platform 43%, double platform 10%, multiple platform 41%, and indeterminate 6%. Flake core 59%, blade-bladelet core 2%, bladelet core 12%, flake-bladelet cores 15% and 12% is indeterminate (remove small fragment with length less then 2mm). Single directional cores are 63%, cores in opposed 12%, bidirectional 22%, and bipolar flake-bladelets cores are present 2.4%. The length of Cores range between 17-42mm with an average of 26.43mm, and width

of flake is between 10-33 mm, in an average of 17.83 mm (Table 2). It indicates the size of core used by prehistoric people to detach stone tool. Flake-Bladelet cores having upto six striking platforms seem to have been utilized. In most of the cases, the core striking platform is prepared but in exceptional cases some bladelets were also detached with non prepared cortical platforms may be, they utilized the advantage of natural shape of the raw material. Majority of the cores have at least 2 - 5 bladelet scars and a maximum up to 6 bladelet scars have been observed on some of them.

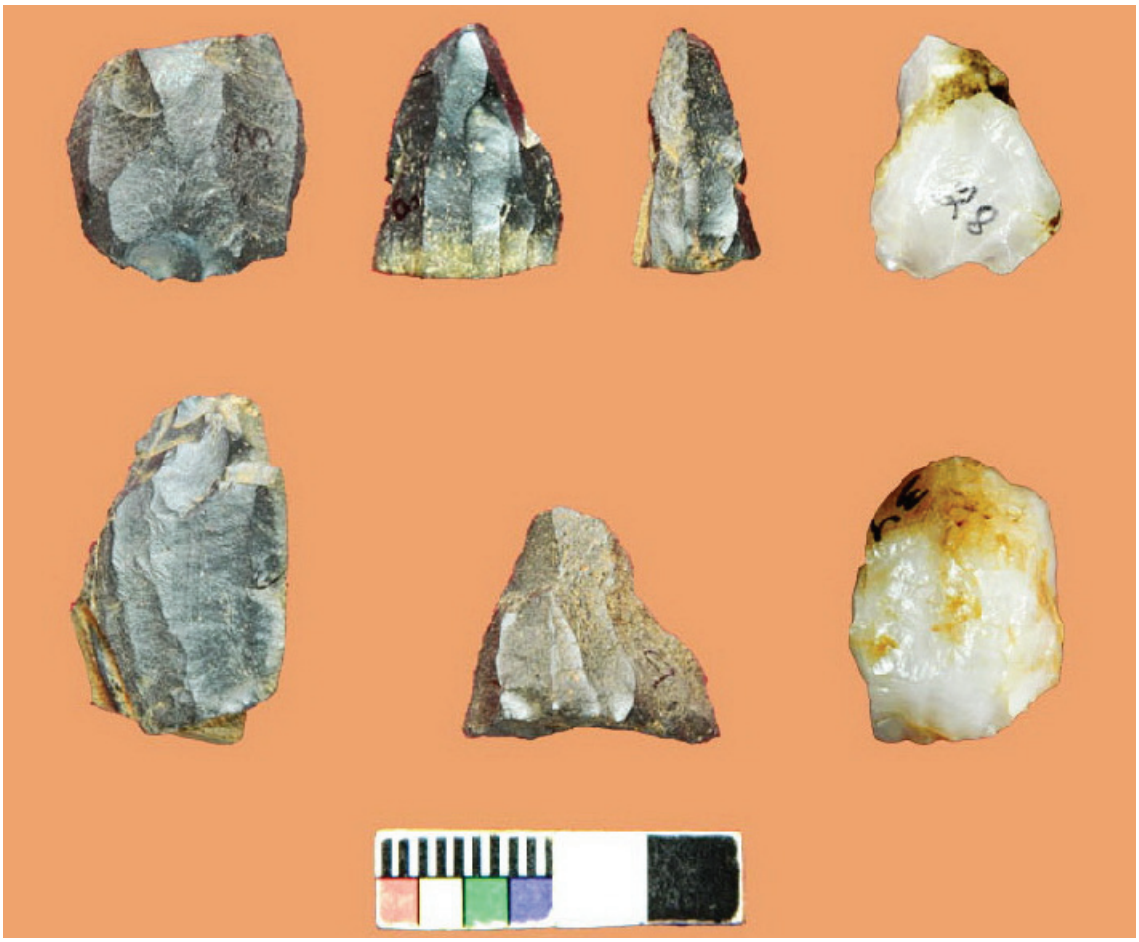

Figure 4: Blade and Bladelet Cores from Bhalugarh

Table 2: Dimensions (Length, Width and Thickness) of Cores in mm

In mmw	Maximum	Minimum	Average	Median	St. Dev.
Length	60.00	17.00	26.65	26.00	5.22
Width	33.00	10.00	17.83	16.5	5.01
Thickness	25.00	6.00	13.70	13.00	4.29

Flakes

Flakes retain all the features of manufacturing process such as striking platform, bulb of percussion and also provide information about the technology used and nature

of raw material (Fig. 5). It consists of 768 (51%) of the total lithic assemblage collected from the site, which is made on quartz (95%), crystal quartz (2%), smoky quartz (1.2%) and chert (1.8%). In consideration of blank form of the flake (233 nos.), 28% are made from nodule, 51% from chunk, 16.25% from pebble and 3% are indeterminate. 79% flakes are complete and 21 % are broken (distal end 9% and proximal end 12%). The broken condition of the flakes indicates that this site is a tool manufacturing site.

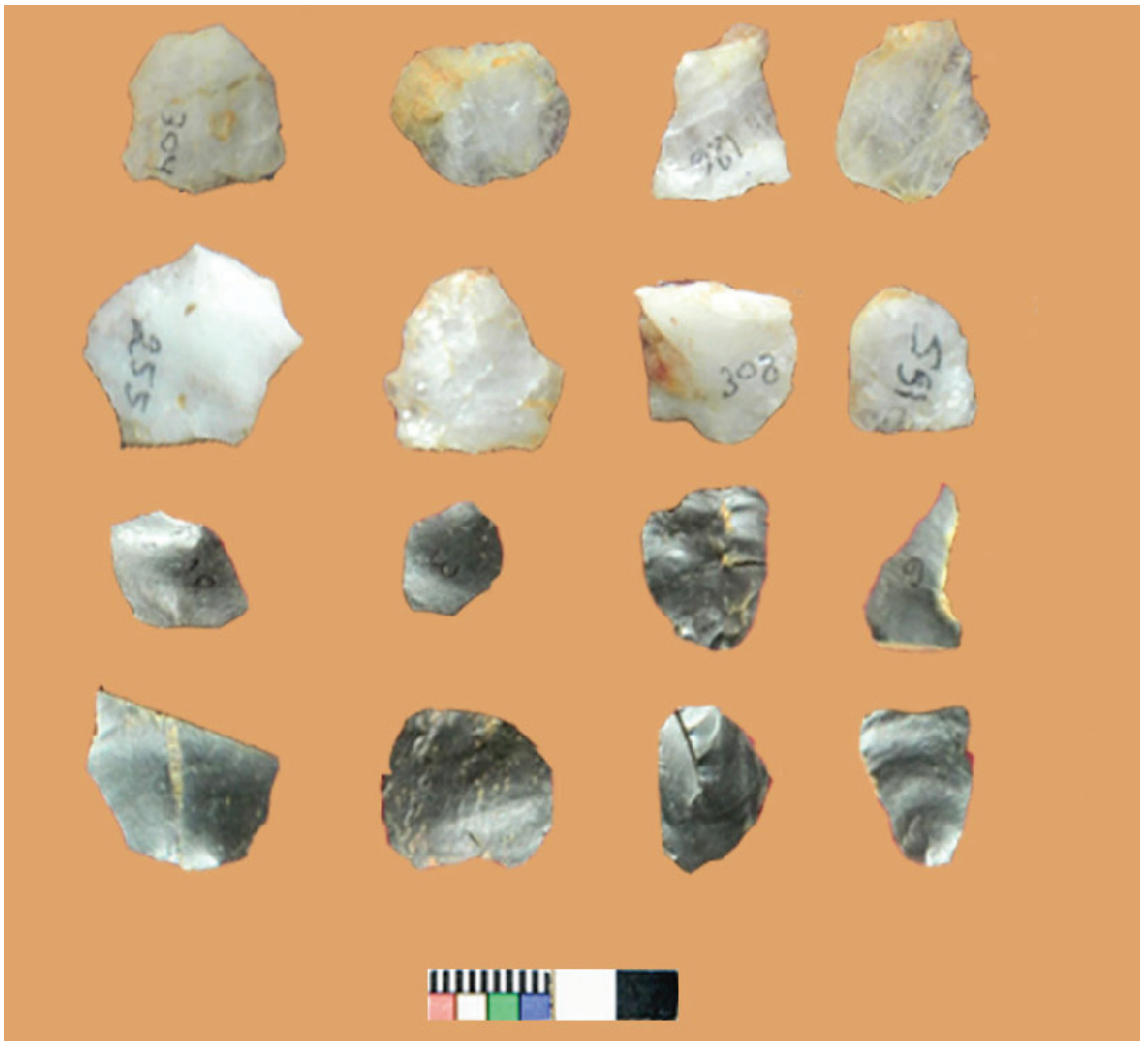

Figure 5: Flakes from Bhalugarh

For the better understanding of classification flake types, we followed the model which is suggested by Toth (1987: 763-87) and the result is: only 3% belong to Type-I (Cortical platform, and dorsal surface), 12 % belong to Type-V (Non cortical platform and partially cortical dorsal surface) and rests of them belong to Type-VI (Non cortical platform and dorsal surface). It indicates that in most of the cases a flake was detached from a prepared platform. The length of flakes ranges between 21- 45mm, in an average of 27.31mm, (Table 3). 1.6% flakes were modified to make different tools. The lower percentage of tool production indicates the non availability of suitable raw material at this site.

Table 3: Dimensions (Length, Width and Thickness) of Flakes in mm

In mm	Maximum	Minimum	Average	Median	St. Dev.
Length	45	21	27.31	27.0	3.786
Width	31	11	17.06	17.0	2.704
Thickness	12	3.0	6.57	7.0	2.137

Different types of flake scars were found on the dorsal surface of the flakes; such as vertical, shallow, deep, step and shallow, step and deep scars. The step fractures on BRS (Blank Removal Surface) indicate that they removed many flakes when they found any suitable raw material; it also indicates their knowledge on the raw material selection. The Flake size, quantity of raw material and completeness of flakes indicate the knapping capabilities of prehistoric people and their intention of tool production.

Blades

Technologically blades were classified as length-width thickness (length**:** width**:** 2**:** 1), with less than 20% dorsal cortex, exhibiting one or more dorsal ridges running roughly parallel to the percussion axis (Movius 1968). In the Microlithic assemblages blade is one of the major tool types, 38 blades were found, making 2.0% of total lithic assemblage (Fig. 6). These are made from quartz 83%, chert 14% and siliceous rock 3%. Metrical analyses of all the blades have been done (Table 4). Only complete blades

Figure 6: Blades from Bhalugarh

Table 4: Dimensions (Length, Width and thickness) of Blades in mm

In mm	Maximum	Minimum	Average	Median	St. Dev.
Length	54.00	24.00	33.76	32.00	6.99
Width	21.00	12.00	14.46	14.00	2.16
Thickness	12.00	1.00	5.76	5.05	2.63

which comprise 92% were considered for length analysis. The maximum lengths of blades are 24-54 mm with an average of 33.76 mm. So, for a better understanding of blade industry of the site in terms of morphometry, measuring the width of a blade is more reliable than the length and the length, width and thickness of blade provide the information about the size, probable function of the blades, and other aspects (Bar-Yosef & Kuhn 1999) i.e. whether large cores were used to produce blades or the oversize blades were broken in order to maneuver them with hafts? Besides, it also provides the basic standard of blade production within a site or specific region.

The data given in figure 7, clearly indicates the length, width and thickness of blades that have been found from the site. It was observed that, different sizes of chunks and nodules were quarried and prepared into desirable size and shape of blades. Differences in size can be interpreted as belonging to different chronologies, but it could also be due to the existence of different groups of people and their regional variance in technology. Blades with irregular edges can be produced by direct or indirect percussion both by using soft and hard hammers but parallel-sided blades can be manufactured only through various pressure techniques (Crabtree 1967).

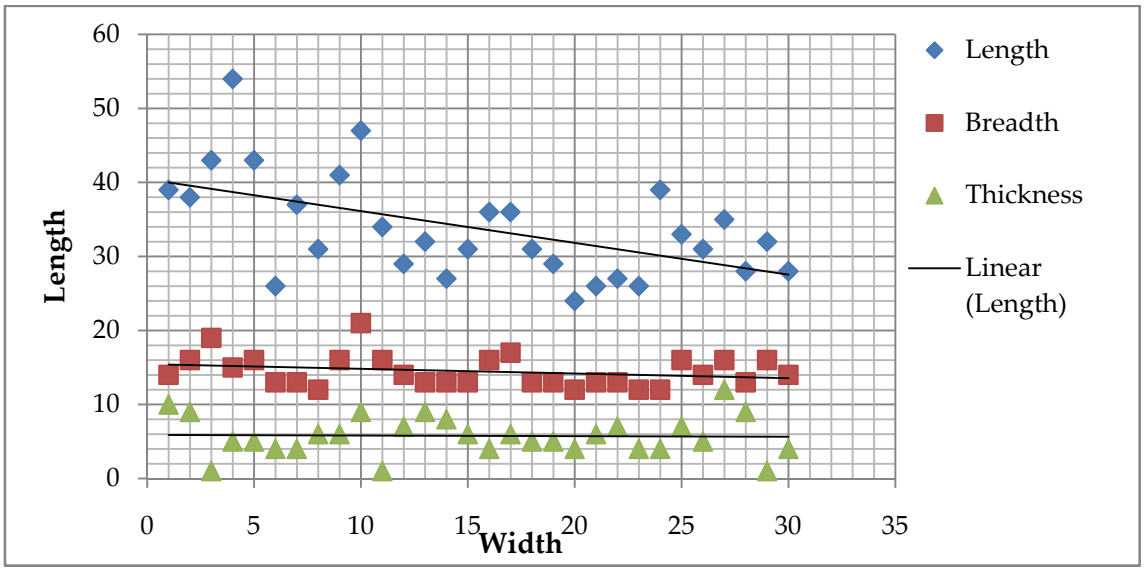

Figure 7: Length /Width/Thickness Scatter gram of Blades from Bhalugarh

Bladelets

Bladelets are defined as having length/width ratios of equal to or greater than 2:1, maximum width of 12mm, and maximum length of 50mm (Texier 1963). Width is the most important criterion for defining the bladelets, those less than 1cmwidth will be

identified as bladelets (Seong 1998: 245-278) (Table 5). A total number of 64 (4%) specimens belong to bladelets, out of which chert is 8%, milky quartz is 78% and crystal quartz is 14% (Fig. 8). In consideration of blank form, chunks and nodules are used to detach bladelets. The presence of backed tool is very low in proportion covering only 12/64 (19%), most of the backed tool are made from crystal quartz and chert.

Table 5: Dimensions (Length, Width and Thickness) of Bladelets in mm

In mm	Maximum	Minimum	Average	Median	St . Dev.
Length	31.00	14.00	21.88	22.00	3.93
Width	12.00	2.10	7.85	9.0	3.31
Thickness	7.0	2.0	4.40	4.0	1.33

Figure 8: Bladelets from Bhalugarh

The above shown data indicates the size of raw material used by prehistoric people during the process detachment. It also indicates that good quality of raw material produces large amount of bladelets, but when the raw material quality is not good then the production ratio also decreases (Odell 1994: 102-20). The function of bladelets depends upon the context, shape, size and wear of the individual specimen. Keeping in view our limitation we cannot go for microscopic analysis to determine the function of bladelets, because of that we do not have any idea, whether they were used for cutting, drilling, shaving , graving or used as projectile points (Clark 1932, 1969).

Retouched tools

Only 1% of retouched material is (Fig. 9) available in Bhalugarh microlihic site and it may be due to non-availability of good quality of raw material or they might have taken their material to other region after giving them finishing touch. The maximum percentage of backed tool was produced from crystal quartz as compare to milky quartz (Fig. 10).

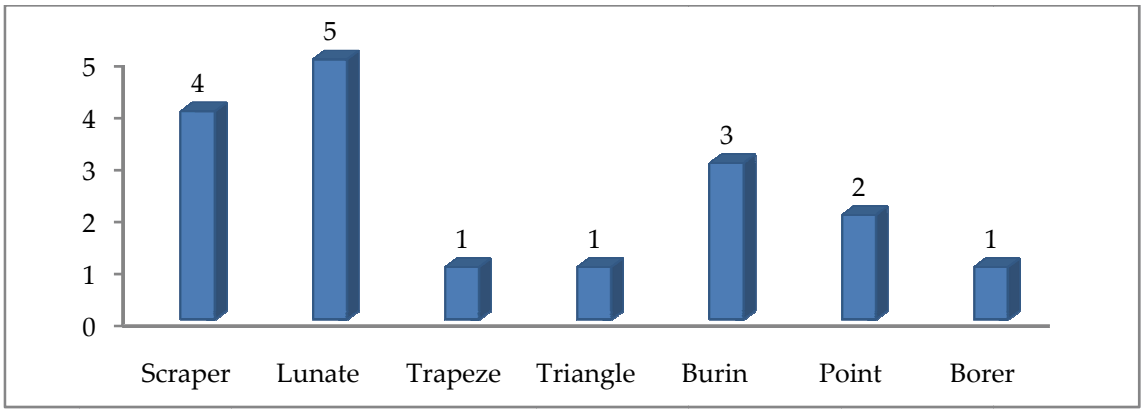

Figure 9: Details of Retouched tools from Bhaulgarh

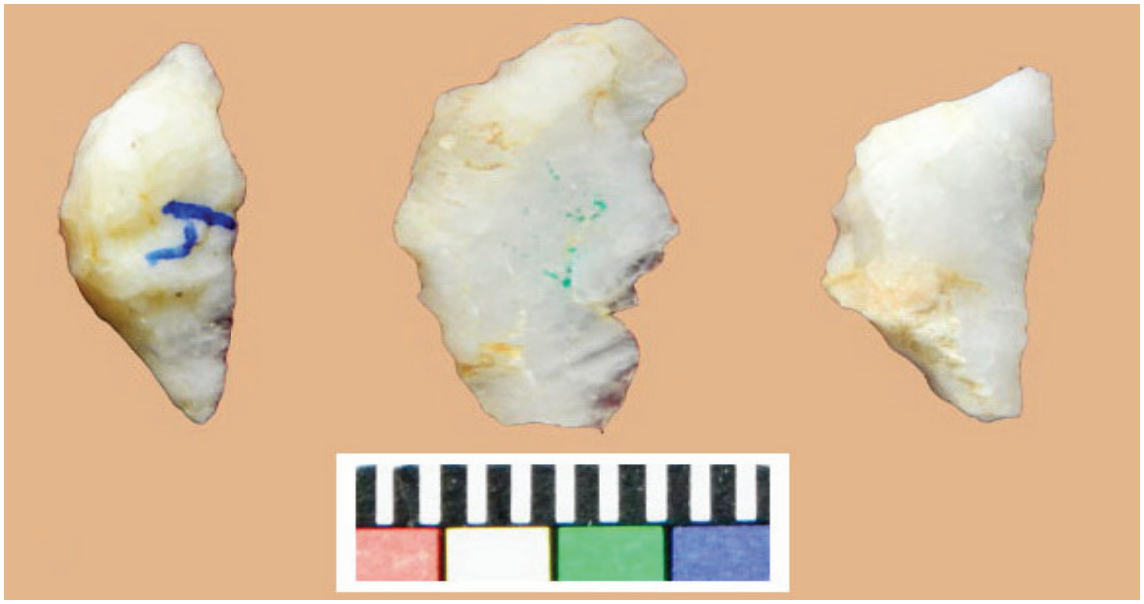

Figure 10: Backed tools from Bhalugarh

Hammer stone

Only one hammer stone (Fig. 11) was found from this site. The battering marks over the hammer stone indicates that it was used. However, the length : width : thickness - 9:7:5 and weight 380 gm suggest that, it cannot be used to produce any kind of tool; rather it may have been used to detach sizable proportion of chunk from boulder for tool production.

Figure 11: Hammer Stone from Bhalugarh

Chips/Chunks

When any detached piece is discarded or not used as a tool or not modified into a tool, they are called debitage (Anderfsky 1998). A total number of 231 chips/chunks consisting of 15% of the total were collected from the site. Chip production is seen as a process of material modification with the intention to form a particular object. During the course of production of the tool, debitages were left at the site of production, which is a good indicator of a manufacturing center (Crabtree 1967). Debitage analysis is a basic technique used in the reconstruction of a lithic production system.

The basis of distinction between chips and flakes is that the chips should be 2 cm or less in length, without an apparent working on the surface (Elston & Kuhn 2002). Flakes, of course, are longer than 2 cm. The finding of large quantity of chips also reflects the manufacturing activities conducted at the site. The quartz dominating at Bhalugarh microlithic site has a larger number of chips because of the nature of fracture of the raw materials. Chunk is the predominating blank form in this site, and in the lithic assemblage the thick and sub-angular and angular flakes comes under this category. Maximum size of the chunk varies between <3cm->1cm. The large quantity of chunks present at the site also denotes manufacturing activities. The initial preparation of raw material nodules to make them into a core produces a large number of chunks.

Discussion

Stratigraphically these assemblages have been found associated with erosional surfaces, composed of loose silty-sandy-clay of reddish-brown colour associated with lateritic pellets (Fig. 12). The Bhalugarh site is characteristically a factory site, which is observed by the occurrence of finished and semi-finished tools, cores, flakes, blades, bladelets, core dressing flakes, numerous waste products, lumps of raw material, and hammer stones showing percussion marks on their surfaces.

The preliminary observation on the microlithic assemblages of Bhalugarh demonstrates that flakes are predominant part of the assemblage. However, the maximum number of available cores belongs to the category of flake-bladelet cores. This indicates that majority of the available flakes might have been detached during the process of core dressing. Equally remarkable is the very rare occurrence of blade-core in lithic assemblages. Availability of sizeable proportion of blades indicates that the core reduction process was in use at this site. This means that a nodule or a pebble was first utilized to detach flakes from it and then, when it was reduced in size; blades were taken off from it after preparing one or more platforms at suitable places. Thereafter, when the core was further reduced in size it was utilized for detaching bladelets after necessary preparations.

Concluding Remarks

The foregoing discussion on the lithic assemblages from the Sapai river may be broadly considered as belonging to the Microlithic cultural phase in view of the general presence of microblades and typical microlithic forms, viz. blades, blade-lets and cores in various types such as flake core, blade-bladelet core and different types of backed tools in varying proportions. Quartz is the principal raw materials used by the knappers for tool production.

Microlithic industry of the Sapai River exhibits a tool tradition, which certainly adds to the significance of the region. It is true that this industry have come from surface, by comparative analysis they can be easily correlated with the stratified finds of the region. The only Microlithic site excavated in Odisha is Kuchai in the Mayurbhanj district (IAR 1961-62: 36), except that no one has reported any Microlithic sites in

stratified context in the state so far. Stratified deposits generally provide a relative chronology, but the problem of chronology is not peculiar to our region. Most of the microlithic industries of the Indian subcontinent cannot be fixed in an absolute chronological frame work (Jayaswal and Pant 1980, Jayaswal 1998: 29-41).

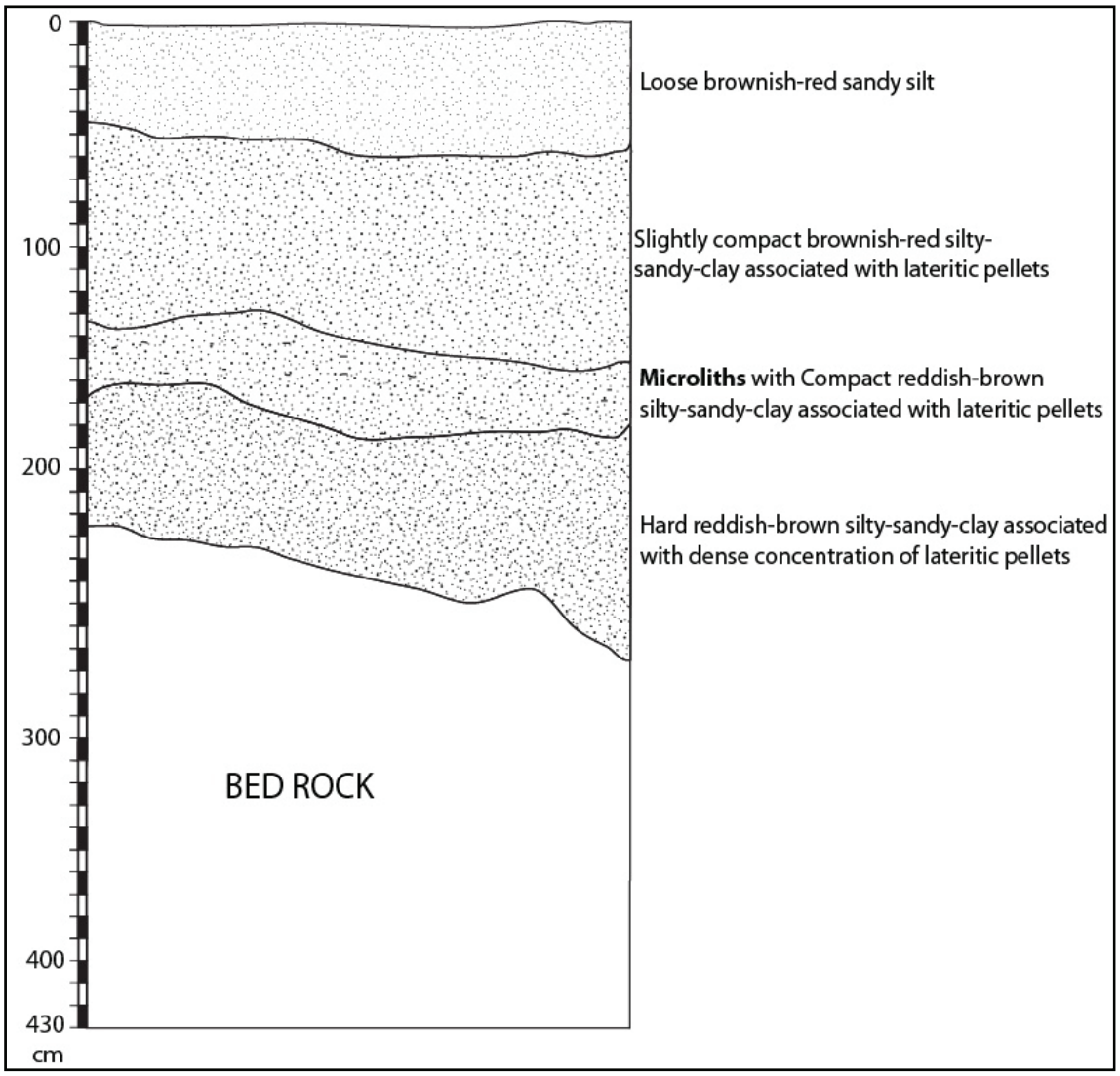

Figure 12: Stratigraphic profile of right bank of the Sapai River near Bhalugarh

Last two-three decades of our knowledge pertaining to the Microlithic industry of Odisha has increased substantially. However, it needs to be pointed out that most of the evidence has come down to us from surface studies carried out in different parts of Odisha. Similarly, no firm conclusion regarding the environmental condition prevailing in the region during the late Pleistocene to early Holocene phase is available.

Further intensive systematic and scientific survey with multidisciplinary aspects in the region will provide valuable insights into the human adaptive strategies i.e. their

cultural system, functional and/or seasonal grouping, the prehistoric lifestyle and the relative roles played by the prehistoric hunters-gatherers and their hunting and gathering activities in the food economy of the contemporary foragers and site distribution pattern of the Microlithic using community. In view of the above, we may succeed at least partly, in tracing the continuity of the Microlithic culture of the Ib river basin in general and the Sapai stream in particular.

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