



# Typo-Technological Analysis of Middle Palaeolithic Assemblage in the Upper Baitarani Valley, Keonjhar District, Odisha

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**Abstract:** This paper reports field investigations in the Upper Baitarani Valley, Odisha, from 2019 to 2024, which resulted in the reporting of the Middle Palaeolithic tool assemblage across nine localities, with five sites yielding Middle Palaeolithic tools, associated with microliths. The assemblage is dominated by Levallois and Non-Levallois elements, including cores, flakes, and shaped tools made from quartzite and dolerite sourced from nearby regions as cobbles, pebbles, and nodules. The predominant industry comprises flake tools, with fewer blades and bladelets, all made from locally available stones. Unlike other regions in Odisha, where quartzite dominates, this site also uses medium to fine-grained quartzite along with dolerite, reflecting regional variability. Microliths are made from cryptocrystalline siliceous rocks found in the riverbeds and surrounding hills.

**Keywords:** Middle Palaeolithic, Rock-outcrop, Levallois Technology, Prepared Core, Discoidal Core, Flakes, Cores, Geomorphology, etc.

## Introduction

In South Asia, the Middle Palaeolithic is crucial for understanding the timing and dispersal of modern humans from Africa. Extensive surveys across diverse sites have revealed three main stages: early, middle, and late, with early phases linked to the Late Acheulean industry, featuring small hand axes. Mishra (2011) suggests no distinct Middle Palaeolithic exists in India, viewing it as part of Acheulean traditions, citing technological shifts like smaller bifaces, less heavy-duty tools, and increased use of Levallois techniques with fine siliceous rocks, leading to smaller artefacts often modified from natural spalls. The Indian Middle Palaeolithic is considered vital

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for understanding *hominin* behavioural complexity and serves as a marker for early *Homo sapiens* in the region. Recent studies have extended its timeline to the Middle Pleistocene, suggesting a possible local origin from the earlier Late Acheulian culture. This enduring Middle Palaeolithic tradition in India developed over several glacial and interglacial periods, demonstrating behavioural resilience even during major climatic events such as the ~74 ka Toba super-eruption (Behera & Barik, 2022; Devera *et. al.*, 2024). The Middle Palaeolithic has garnered considerable attention in recent decades, which has not only transformed our understanding but also introduced several new perspectives on hominin behavioural evolution in the region. The Middle Palaeolithic in India was first recognised in 1956 following the discovery of flake tools by H.D. Sankalia at Nevasa on the Pravara riverbank in Maharashtra (Sankalia, 1956: 35-53). During the early stages of Middle Palaeolithic research, these flake-based industries were given various names such as Middle Palaeolithic (Misra, 1962), Middle Stone Age (Mohapatra, 1962), Series II (Sankalia, 1956), Nevasian (Banerji, 1957), and Flake culture (Ghosh, 1972). Numerous sites associated with Middle Palaeolithic culture have been identified across the region after its establishment as a distinct cultural entity (Pal, 1988). The chronology of the early Middle Palaeolithic was initially developed based on its stratigraphic association with the preceding Acheulian culture. The sites at Lakhampur West and East (Petraglia *et al.*, 2003), the Kortallayar basin sites (Pappu, 2001), as well as excavated sequences from Bhimbetka (Misra, 1985), Indola-ki-Dhani, and Singi Talav (Misra, 1982), suggest that Late Acheulian industries were succeeded by the Middle Palaeolithic, with little evidence of occupation hiatus between the two cultural phases. Chronometric ages from 16R dune place the transition from Late Acheulian to Middle Palaeolithic in South Asia between approximately 390–150 ka (Misra, 1995), while the end of the Middle Palaeolithic is estimated to fall between approximately 40–25 ka, based on early Upper Palaeolithic evidence dated to around 25 ka from 16R Dune (Misra, 1995) and Patne (Sali, 1985).

However, from the beginning of the 21<sup>st</sup> century (from 2000 onwards), a fairly good number of chronometric dates have become available for the Middle Palaeolithic culture in India. Jwalapuram in Andhra Pradesh reveals multiple localities with Middle Palaeolithic artefacts dating from 80 to 38 ka (Petraglia *et al.*, 2007). Notably, the association between Middle Palaeolithic artefacts and Youngest Toba Tuff (YTT) deposits is a distinctive feature of Jwalapuram. The Middle Palaeolithic assemblages from Jwalapuram are argued to resemble the African Middle Stone Age assemblages, and it is believed that the former were introduced to the region by incoming *Homo sapiens* from Africa. Furthermore, continuity in Middle Palaeolithic technology

between the sediments below and above YTT suggests little to no impact of the Toba eruption on hominin behaviour in India (Blinkhorn *et al.*, 2013). Aside from Jwalapuram, several other sites have provided chronometric dates for the Middle Palaeolithic period, including Kataoti in Rajasthan (Blinkhorn *et al.*, 2013), Sandhav in Kachchh (Blinkhorn *et al.*, 2019), and Dhaba in Madhya Pradesh (Clarkson *et al.*, 2020). All these dates place the Indian Middle Palaeolithic in the Late Pleistocene epoch and support the pre-Toba model, which proposes that the Middle Palaeolithic in the region resulted from *Homo sapiens* dispersals into *Eurasia* (Petraglia *et al.*, 2007). These studies underscore the importance of the Indian Middle Palaeolithic in global discussions of the dispersal of *Homo sapiens* across *Eurasia* (Blinkhorn *et al.*, 2017). Moreover, the evidence for the youngest Acheulian in India, dated to the beginning of the Late Pleistocene, suggests that archaic hominins persisted in the region until *Homo sapiens* appeared (Haslam *et al.*, 2011). These two sets of evidence present contrasting narratives to the early ideas of a transition from the Late Acheulian to the Middle Palaeolithic in the region, which is dated between 350–150 ka (Misra, 1995). However, recent research from southern India provides both chronological and technological proof of the local development of Middle Palaeolithic technology from the preceding Late Acheulian, placing it within the Middle Pleistocene epoch (Reddy *et al.*, 2004; Blinkhorn *et al.*, 2014). Nonetheless, these new discoveries need further support through more precise dating of Middle Palaeolithic assemblages within the Middle Pleistocene.

In this context, a relative chronology based on techno-typological analysis of Middle Palaeolithic assemblages from the Upper Baitarani Valley in northern Odisha, India, is presented. Consequently, this Middle Palaeolithic assemblage provides a significant data point for Indian Palaeolithic research. The lithic assemblage from the Upper Baitarani Valley is characterised by diverse Levallois reduction techniques, a dominance of scrapers, points, and awls, and the presence of blade components.

### **Middle Palaeolithic Research in Odisha**

Prior to the late 1950s and 1960s, there was a lack of evidence for a Middle Palaeolithic phase in Odisha in comparison to other regions of the Indian subcontinent. Mohapatra's field investigations between 1959 and 1962 marked the initial report of lithic artefacts from the Middle Stone Age. These artefacts were discovered in the finer gravel, specifically Gravel-II, which overlays the Early Stone Age implementiferous layer. Major findings were discovered in three key river systems – the Brahmani, the Baitarani, and the Subarnarekha – which flow through the districts of Sundargarh, Dhenkanal,

Keonjhar, and Mayurbhanj in the north of Odisha. Initial exploration in the southwest region was conducted by K.C. Tripathy (Tripathy, 1973: 47-59), A.K. Ghosh (Plate Number 1-69: 25), and D.K. Chakrabarti and R.K. Chattopadhyay (Chakrabarty and Chattopadhyay, 1988: 203-208, Chakrabarty, 1990: 13-21) in the Keonjhar and Mayurbhanj districts. Additionally, S.N. Ratha (IAR 1983-84: 64-66) discovered scattered lithic artefacts from secondary contexts dating to the Middle Palaeolithic phase in the Sambalpur district of Odisha. Following these initial findings, interest in further research on this cultural phase in the region waned in the latter part of the 20th century. As a result, until recently, very little was known about the geographical and temporal contexts, as well as the cultural characteristics of the Middle Palaeolithic phase in Odisha. In the last decade, extensive field surveys conducted in the northern region of the Bargarh uplands in western Odisha uncovered a significant number of Late Acheulian-Middle Palaeolithic sites in primary and semi-primary stratified contexts along the upper reaches of the Jira River and its tributary, Danta (Behera *et al.*, 2015; Behera, Thakur, 2019; Behera & Barik 2022). The specified locations are located approximately 20-25 kilometres to the south of the Debrigarh-Lohara massif, which functions as the primary reservoir of unrefined materials, encompassing various forms of quartzite, chert, and vein quartz. These materials were extensively used by the Palaeolithic hominins in the region for making stone tools (Thakur & Behera, 2015). In an effort to understand the spatial distribution of sites in the Keonjhar Uplands, four seasons of intensive field investigations were conducted in the Upper Baitarani Valley starting in 2019, leading to the recovery of a large number of Middle Palaeolithic artefacts. This may shed new light on Middle Palaeolithic research in Odisha as a whole, particularly in the northern part of Odisha.

### **Geology and Geomorphology of the Study Area**

The present study comprises the Upper Baitarani Valley in the Keonjhar district of Odisha, located at the convergence of the Gondwana Formation, Chhotanagpur plateau, and Eastern Ghats. The Baitarani River, originating from the Guptaganga hills near Gonasika village, flows through this region, which includes the Bansapal and Hatadihi blocks and the subdivisions of Champua, Keonjhar Sadar, and Anandapur. Geologically, Keonjhar is rich in Precambrian rocks and various mineral resources, with the Baitarani River Basin featuring alluvial deposits (Figure 1). The geomorphology of the study area includes dense forests and hilly terrain characterized by fertile valleys and diverse soil types (Figure 2). Historically, the Baitarani Valley likely supported ancient settlements due to its strategic geography and abundant raw materials, such

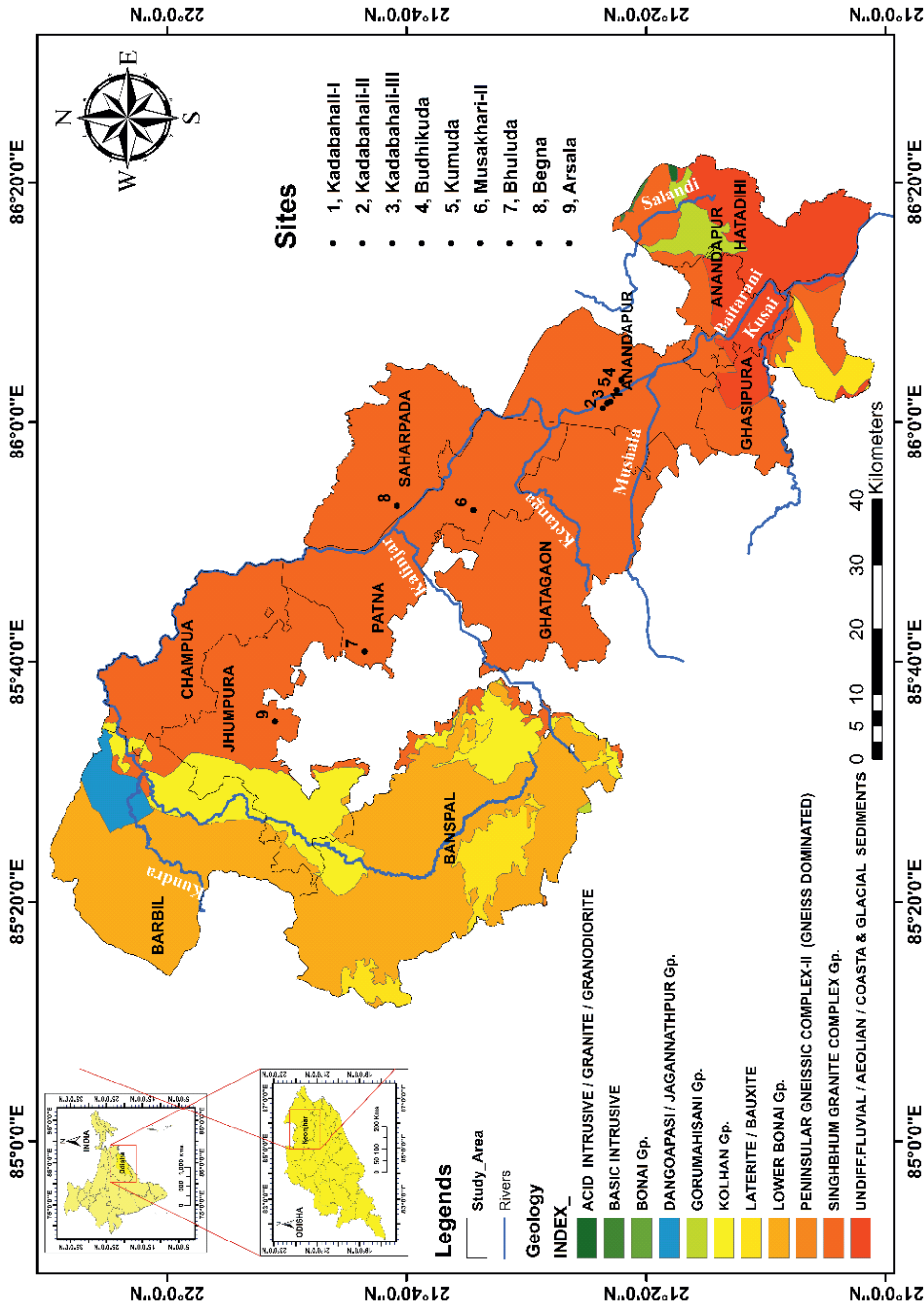


Fig. 1: Map showing the geology of the Upper Baitarani Valley.

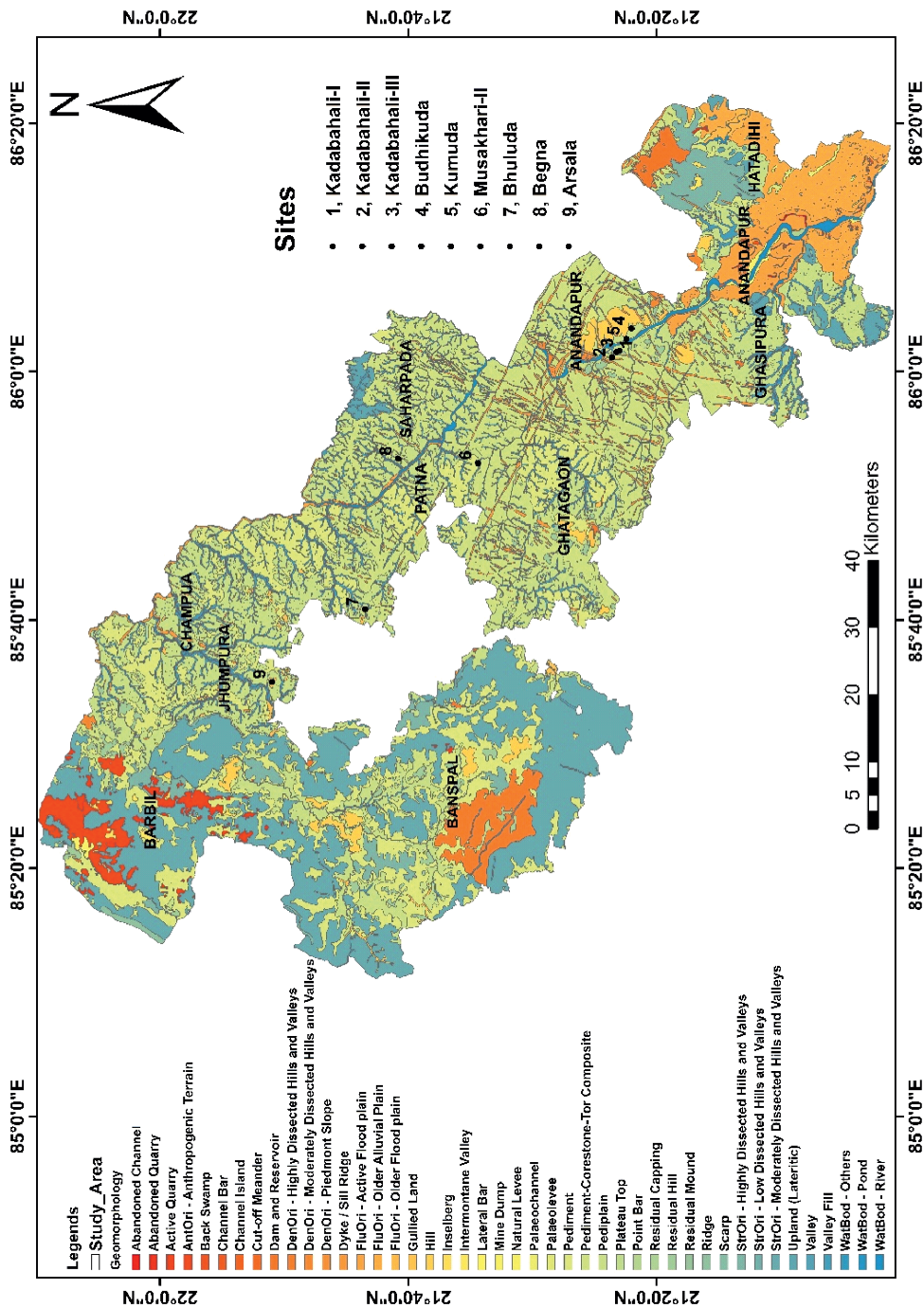


Fig. 2: Map showing the geomorphology of the Upper Baitarani Valley.

as quartzite and dolerite, found in the forms of dykes, river pebbles, cobbles, and hill slopes, which would have facilitated prehistoric habitation during the Pleistocene period. A significant portion of the area is covered by forests featuring tree species such as *Sal*, *Piasal*, *Kendu*, and *Palas*. The Baitarani River system features a distinctive drainage pattern, enhanced by its numerous significant tributaries, including the Matai, Deo, Indrani, Aradei, Salandi, Kusei, Sita Nadi, Kani, Musala, Kukurkuta, Tel, Kanjhari, and Remala. These tributaries play a crucial role in contributing to the river's flow. The overall drainage configuration of the region follows a dendritic pattern.

### **The Nature of Sites and Lithic Assemblage Composition**

Intensive archaeological investigations in the Upper Baitarani River valley have yielded Middle Palaeolithic artefacts from nine sites, of which five sites yield microliths found associated with Middle Palaeolithic tools (Table 1). A total of 87 Middle Palaeolithic artefacts were collected from different localities, i.e. Musakhari-II (n=25), Bhuluda (n=3), Begna (n=1), Arsala (n=21), Kadabahali-I (n=10), Kadabahali-II (n=8), Kadabahali-III (n=10), Budhikuda (n=1) and Kumuda (n=8) (Table 2). The sites were situated on both the right and left banks of the Baitarani River and its tributaries (Figure 3). The Middle Palaeolithic sites were discovered in various geomorphological settings, including foothills, eroded surfaces on the riverbanks, and highly elevated granitic rock outcrops. Here, rather than giving a detailed description of the newly discovered site, the emphasis is on analysing the lithic assemblages. The artefacts collected are categorized into three main groups: Core (n=16), accounting for 18.39%; Unretouched Debitage (n=24), representing 27.58%; and Retouched Pieces/Shaped Tools (n=47), making up 54.02%. The assemblage's overall composition indicates that flakes comprise not only the majority of thedebitage group but also the larger portion of the shaped tool category. Artefacts collected from the hill-slope and foothill areas, apart from the hilltop context, consistently exhibit thin patina and moderate abrasion. These artefacts frequently display patches of ferruginous stain and/or encrustation on their surface, reflecting their depositional context. Despite the hill's slope and recent human activity, the majority of the retrieved artefacts remain in good physical condition (Plates 1 & 2).

**Table 1: List of Recently Explored Middle Palaeolithic Sites in the Upper Baitarani Valley, Keonjhar District, Odisha**

<i>SL NO</i>	<i>SITE NAME</i>	<i>BLOCK</i>	<i>CONTEXT</i>	<i>River Bank</i>	<i>Location</i>
1	Kadabahali-I (KDBL-I)	Anandapur	Foothill	Right bank of Baitarani River	Lat:21.38722222 Long:86.02638889
2	Kadabahali-II (KDBL-II)	Anandapur	Foothill	Right bank of Baitarani River	Lat:21.39333333 Long:86.01916667
3	Kadabahali-III (KDBL-III)	Anandapur	Foothill	Right bank of Baitarani River	Lat:21.38305556 Long:86.02833333
4	Budhikuda (BKD)	Anandapur	Foothill	Left bank of Baitarani River	Lat:21.36722222 Long:86.05805556
5	Kumuda (KMD)	Anandapur	Foothill	Right bank of Baitarani River	Lat:21.37416667 Long:86.04416667
6	Musakhari-II (MKR-II)	Patana	Erosional Surface on the Rocky Outcrop	Left bank of Kasia Nala	Lat:21.57305556 Long:85.87722222
7	Bhuluda (BLD)	Patana	Erosional Surface in the Piedmont area	Left Bank of a Perennial Streamlet	Lat:21.72455278 Long:85.68098333
8	Begna (BGN)	Saharapada	Erosional Surface on Rocky Outcrop	Left bank of Baitarani River	Lat:21.68008333 Long:85.88320556
9	Arsala (ASL)	Jhumpura	Erosional surface along the riverbank	Right Bank of Aradei River	Lat:21.84965833 Long:85.58327778

**Table 2: Site-wise distribution of Middle Palaeolithic artefacts in the Upper Baitarani Valley.**

<i>Tool Type</i>	<i>MKR-II</i>	<i>BLD</i>	<i>BGN</i>	<i>ASL</i>	<i>KDBL-I</i>	<i>KDBL-II</i>	<i>KDBL-III</i>	<i>BKD</i>	<i>KMD</i>	<i>Total</i>
Core			1	2	1	2			1	7
Flake	1	2		14		1	6			24
Levallois Core	1				5	1		1	1	9
Single-sided Scraper				3	4	1	1		3	12
Point							2			2
Round Scraper				1					1	2
Borer-cum-Awl	1									1
Levallois Point	7					2				9
Concave Scraper	3									3
Double-sided Scraper	5	1		1		1			2	10
Scraper-cum-Borer	1									1
Notch	3									3
End Scraper	3						1			4
Total	25	3	1	21	10	8	10	1	8	87

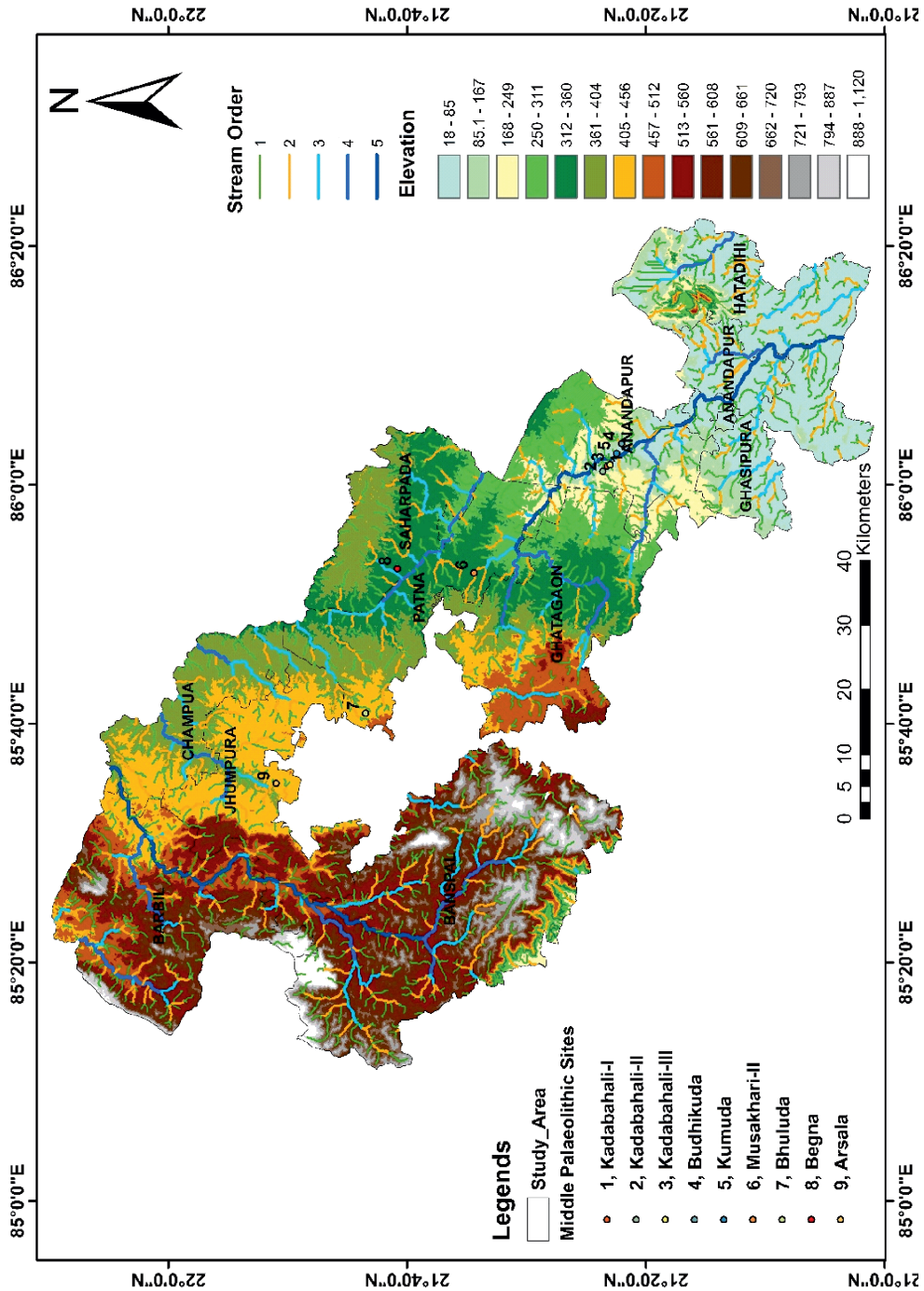


Fig. 3: The Digital Elevation Model of the Location of Middle Palaeolithic Sites in Upper Baitarani Valley.



**Plate 1: General view of the artefacts scattered at the Bhuluda site, Patana Block, Keonjhar district.**



**Plate 2: General view of the artefacts scattered on the rock outcrop in Musakhari-II site.**

## Analysis of Lithic Assemblages

To understand the various techniques used for utilizing blanks at the site, morphometric analysis was conducted on the available cores and debitage, considering their blank forms, scar patterns, and employed removal techniques. This analysis led to the identification of three broad core types: discoidal core, multidirectional core, and Levallois core (Plates 3, 4, and 5). Therefore, the focus here lies in the description of the cores and their respective types.

### Core Analysis

The discoidal core is distinguished from a Levallois core by specific features (Boëda, 1995). In the case of a discoidal core, the two surfaces are not hierarchically related, as both surfaces can be inverted within a single operational scheme, with one acting as a platform surface and the other as a debitage surface. Additionally, the plane of intersection of the two surfaces is always situated at an angle (secant position), and discoidal flaking involves the exploitation/flaking of a volume rather than just the surface (Figure 4). Two discoidal cores were recovered from the Kumuda and Kadabahali-I sites. The dimensions of the cores measured 9.2 cm (length), 7.4 cm (breadth), and 3.3 cm (thickness). A total of 8 flakes were detached from each core, with the resulting scars distributed around the entire circumference. The maximum dimension of the scars varied between 2.5 cm and 4.5 cm. Only one surface of the core was utilized, and no inversion was observed. Cores exhibit removals from three or more surfaces, lacking well-developed striking platforms or defined removal surfaces. These cores typically possess a polyhedral form and display considerable variability in the degree of reduction (Conard & Moreau, 2004). Three multidirectional cores were collected from the sites of Begana (n=1), Arsala (n=2) and Kadabahali-II (n=2). The mean dimensions of the core are 9.3 cm, 5.5 cm, and 3.8 cm, respectively, according to length, breadth, and thickness. A total of 4 negative scars were noted in the core. The removed flakes were not less than 3.5 cm in their maximum length. The posterior surface of Levallois cores mostly has flat features with remains of the initial blank form and displays signs of prepared platforms across it. In contrast, the dorsal surface maintains its usual convex shape with centripetal negative scars. The majority of cores in this assemblage exhibit a broad to oval shape and are relatively thin compared to their maximum width, possibly indicating an intensive core reduction strategy. Although the cores vary widely in size, the width/length ratio of Levallois cores demonstrates noticeable symmetry compared to others. A total number of 9 Levallois cores were found from Musakhari-II (n=1) (Plate 3), Kadabahali-I (n=5), Kadabahali-II (n=1),



Plate 3: Close-up view of a Levallois Core from the Mushakhari-II site, Patana, Keonjhar.



Plate 4: Close-up view of a Levallois Core from the Kumuda site, Anandapur block, Keonjhar district.

Budhikuda (n=1) and Kumuda (n=1) (Plate 4). The mean dimensions of the type are 11.28 cm, 9.42 cm, and 5.04 cm in length, breadth, and thickness. A total of 8 flakes were detached from the core. The scar was distributed over its whole circumference. The maximum dimension of the scar ranges between 2cm and 5cm. In the core, only one surface was exploited and not inverted.



Plate 5: Prepared Core and Discoidal cores found from the sites of Upper Baitarani Valley

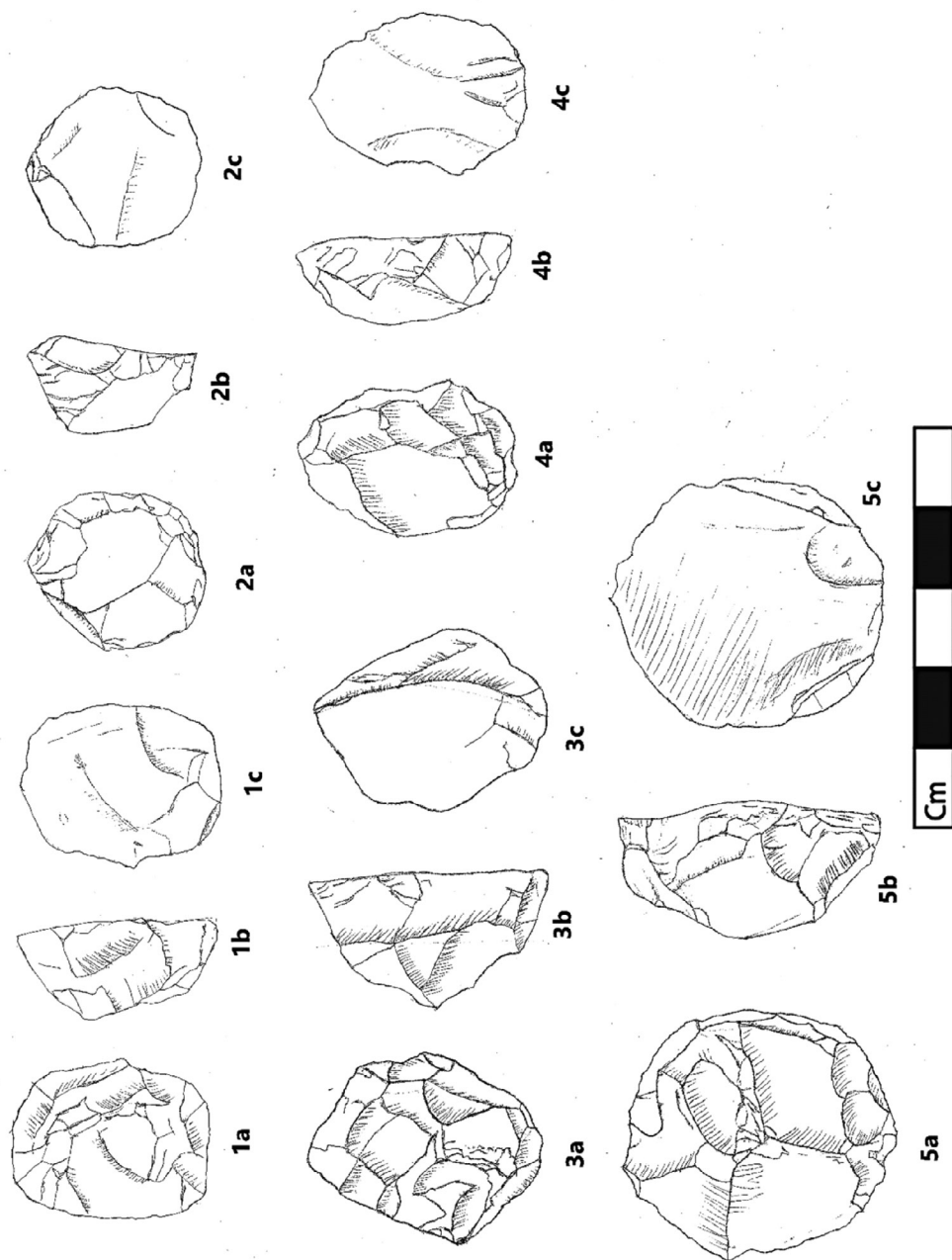


Fig. 4: Middle Palaeolithic (N. 1 & 3) multidirectional flake core and (N. 2, 4 and 5) Levallois cores.

## Debitage Product Analysis

The term “debitage” conventionally refers to the deliberate shaping of raw material blocks to produce products that may undergo further refinement or be used in their current state. Additionally, it encompasses the physical remnants (debitage products) resulting from this process (Inizan et al. 1999: 62-64). The debitage product category includes three subtypes: Simple Flake (n=15), Debordant Flake (n=6), and Redirecting Flake (n=3). As shown below, attributes such as blank morphology, platform morphology, termination morphology, and dorsal scar directionality were briefly observed in the debitage products (Plates 6 & 7). Debitage or flake blanks have been categorized into three types (Table 3) based on their morphological characteristics, following the classification proposed by Isaac: Side-Struck, End-Struck, and Special Side-Struck (Issac, 1960). The collected assemblage primarily consists of End-Struck (n=15) specimens, followed by Special Side-Struck flakes (n=3) and Side-Struck flakes (n=6). The analysis of debitage requires consideration of the platform or butt, which is a crucial attribute. Existing literature has identified ten types of platform morphology (Inizan et.al. 1999: 71-72), of which this study focuses on three types found in the assemblage: plain (n=15), faceted (n=4), and cortical (n=3), as shown in Table 4. The most commonly observed platform type is plain, followed by faceted and cortical.



Plate 6: Varieties of Flakes found from the sites of Upper Baitarani Valley



Plate 7: Debitage products found from the sites of Upper Baitarani Valley

**Table 3: Showing Blank Morphology of Debitage Products**

<i>Debitage Type</i>	<i>Side-Struck</i>	<i>End-Struck</i>	<i>Special-Struck</i>	<i>Retouch Absent</i>	<i>Retouch Present</i>
Simple Flake (15)	5	8	2	11	4
Debordant Flake (6)	1	4	1	4	2
Redirecting Flake (3)		3		2	1
Total	6	15	3	17	7

**Table 4: Showing Platform Morphology of Debitage Products**

<i>Debitage Type</i>	<i>Cortical</i>	<i>Plain/Flat</i>	<i>Facetted</i>	<i>Unidentified</i>
Simple Flake (15)	3	9	2	1
Debordant Flake (6)		4	1	1
Redirecting Flake (3)		2	1	
Total	3	15	4	2

It is positioned across from the platform's end or distal end and is usually classified into four types: feather, step, out-repass, and hinge. These types are also observed in the current collection, with feather terminations being the most prevalent (n=13), followed by step terminations (n=8). Additionally, two out-repass terminations and one hinge termination are present. The production of debitage was evident throughout every phase of the core reduction sequence, and the dorsal surface exhibits distinct characteristics from these various preceding stages. This feature is instrumental in comprehending the preparation of the core surface prior to the final strike. In this study, a diverse array of scar patterns was observed and classified based on the work of Shimelmitz and Kuhn (Shimelmitz & Kuhn, 2013: 1-27). A predominant presence of bidirectional scar patterns was noted in the assemblage, followed by straight and perpendicular scars. Additionally, both unidirectional and bidirectional flake scars were found in considerable numbers, and a centripetal and convergent scar pattern was identified in one specimen each (Table 5).

**Table 5: Showing Dorsal Scar Directionality of Debitage Products**

<i>Debitage Type</i>	<i>Unidirectional</i>	<i>Bidirectional</i>	<i>Perpendicular</i>	<i>Convergent</i>	<i>Centripetal</i>	<i>Straight &amp; Perpendicular</i>
Simple Flake (15)	3	3	1	1	1	6
Debordant Flake (6)		4	2			
Redirecting Flake (3)		2	1			
Total	3	9	4	1	1	6

Flakes are produced without any special prior preparation of the core (Inizan *et al.*, 1999). A total of 15 simple flakes were collected from the sites of Arsala (n=9), Kadabahali-III (n=4), and Bhuluda (n=2). The mean dimensions of the flake are 5.2 cm, 3.3 cm, and 1.5 cm, respectively, in terms of length, breadth, and thickness. Except for 2 broken parts, all the specimens were complete. A total of 8 flakes are characterized by end-struck morphology, and 5 are side-struck morphology; the remaining 2 pieces are categorized as special side-struck morphology. The dorsal surface was full of cortex, as noted on 2 pieces, and 13 pieces were devoid of any cortex. Varied types of dorsal

scar patterns were observed, such as straight perpendicular (n=1), double perpendicular (n=6), unidirectional (n=3), Bidirectional (n=3), Convergent (n=1) and Centripetal (n=1). Platform or butt type comprised cortical (n=3), faceted (n=2), plain (n=9), and one is unidentified. Feather termination was noted on nine specimens, step termination on four specimens, and Outrepass and Hinge terminations were found on one specimen in each.

Flakes or blades are intentionally struck along the edge of the core in order to reshape the flaking surface. Preserving a substantial part of the worked edge of a core on the dorsal surface, away from the point where the fracture starts, is part of this process. This includes the distal or lateral edges, along with the central area of the dorsal surface. This practice is associated with reshaping, rejuvenating, or otherwise maintaining a flake-release surface (Shimelmitz & Kuhn, 2013). A total of 6 flakes were assigned as Debordant flakes, collected from the site of Arsala (n=4), Musakhari-II (n=1), and Kadabahali-II (n=1). All of them are complete. The mean dimensions of the flakes are 5.4 cm, 3.2 cm, and 1.3 cm by their length, breadth, and thickness. Two types of dorsal scar patterns were noted on the specimen: straight perpendicular (n=2) and bi-directional (n=4). Different kinds of platforms are found on the surface, such as faceted (n=1), plain (n=4), and unidentified (n=1). With the exception of one step and one out-repass termination flake, all instances are linked to feather termination. This type is classified as a naturally backed knife due to its sharp cutting edge, which is opposite a thick edge.

Flakes that are redirected typically eliminate the previous platform edge of the core. Redirected flakes are the result of redirecting the core reduction process to a new platform (McCarthy, 1976)<sup>1</sup>. A total of 3 flakes were categorized as redirecting flakes, retrieved from the sites of Arsala (n=1) and Kadabahali-III (n=2). The mean dimensions are 5.1 cm, 3.1 cm, and 1.2 cm in length, breadth, and thickness, respectively. Two types of dorsal scar patterns were noted on the specimen: straight perpendicular (n=1) and bi-directional (n=2). Different kinds of platforms are found on the surface, such as faceted (n=1) and plain (n=2). All are associated with feather terminational flakes.

### **Retouched & Shaped Tools**

The tool category consists of a diverse range of artefacts displaying secondary alterations of debitage (Table 6). Out of 47 shaped tools in total, the vast majority are made from non-Levallois flakes, and the assemblage includes a significant variety

of scrapers, such as single-side scrapers, round scrapers, concave scrapers, double-side scrapers, end scrapers, notch tools, and a combined scraper cum borer (Plates 8 & 9). A small number of parallel-sided, elongated blade tools are also found associated with the Middle Palaeolithic tool assemblage (Plate 10). The study reveals that there was no specific size preference for blanks to be modified into different types of tools. Instead, it seems that blanks were likely chosen randomly for tool modification based on their suitability and specific requirements. Additionally, in the non-Levallois category, secondary modifications on flakes with unidirectional scars on the dorsal surface are evident. Additionally, a considerable number of Levallois points, Awls, and non-Levallois points were discovered at various sites within the study area (Figure 5). The retouch marks on the scrapers predominantly exhibit semi-invasive characteristics and are prevalent on the dorsal surface of the blanks. Notched tools primarily display retouched individual notches meticulously, with a few instances of Clactonian-type notches.



Plate 8: Single and double-sided scrapers from the Upper Baitarani Valley



Plate 9: Levallois Points found from the Kadabahali-II site, Anandapur, Keonjhar.

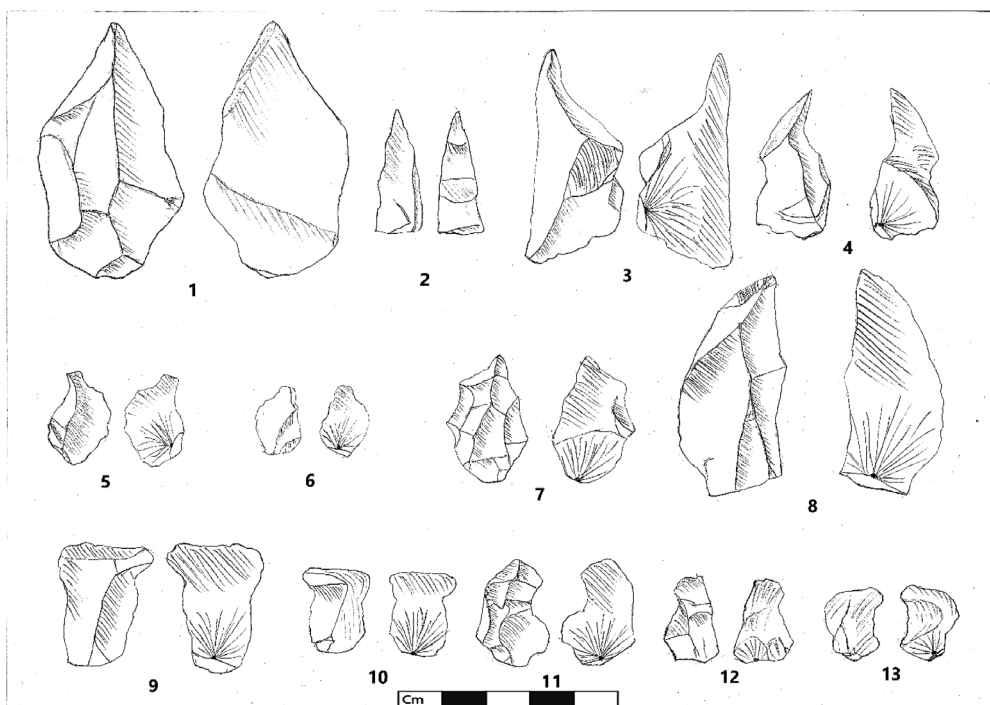


Fig. 5: Middle Palaeolithic tools Awl (1), Notch (10, 11 & 13), Scrapers (5, 6, 9 & 12), Borers (7) and Points (no. 2, 4 & 8) recovered from the Upper Baitarani Valley.



Plate 10: Blade-tool components recovered from the Upper Baitarani Valley.

Table 6: Metrics of Middle Palaeolithic Assemblage Compositions in Upper Baitarani Valley

Measurements	Core	Flake	Single side Scraper	Point	Round Scraper	Borer	Levallois Point	Concave scraper	Double side Scraper	Scraper-cum-Borer	Notch	End Scraper	Levallois Core
LENGTH (in CM)													
MAXIMUM	7.40	2.80	3.30	11.00	5.50	11.50	4.60	4.60	6.00	5.00	4.50	3.50	8.50
MINIIMUM	10.50	9.70	15.00	17.00	8.00	11.50	7.50	6.40	15.00	5.00	6.00	7.50	16.50
STDEV	1.18	1.97	2.65	4.24	1.77		0.82	1.04	3.51		0.75	1.73	2.59
MEAN	8.80	5.26	8.88	14.00	6.75	11.50	5.77	5.20	9.77	5.00	5.30	5.40	11.28
WIDTH (in CM)													
MAXIMUM	4.50	1.40	4.10	5.00	6.00	9.00	3.00	2.50	2.30	3.20	3.10	4.50	7.50
MINIIMUM	8.90	9.10	10.00	5.40	6.10	9.00	4.50	4.30	99.00	3.20	5.00	10.00	13.00
STDEV	1.45	1.74	1.79	0.28	0.07		0.52	0.91	29.70		0.98	2.65	2.17
MEAN	7.49	3.70	7.21	5.20	6.05	9.00	3.66	3.33	14.75	3.20	4.20	6.60	9.42
THICKNESS (in CM)													
MAXIMUM	3.20	.30	.90	2.50	1.50	2.80	.80	1.00	1.00	.80	.80	1.00	3.10
MINIIMUM	7.50	2.60	5.50	2.80	2.20	2.80	1.30	1.40	99.00	.80	1.80	3.50	6.70
STDEV	1.49	0.71	1.22	0.21	0.49		0.15	0.23	30.65		0.50	1.08	1.14
MEAN	4.26	1.27	2.95	2.65	1.85	2.80	1.02	1.13	11.80	0.80	1.27	2.00	5.04
TOTAL NO OF SAMPLES	7	24	12	2	2	1	9	3	10	1	3	4	9
PERCENTAGE	8.00	27.59	13.79	2.30	2.30	1.15	10.34	3.45	11.49	1.15	3.45	4.60	10.34

### Raw materials used

The quality, forms, size, and availability of raw materials play a very crucial role in the organisation of lithic technology. Andrefsky discussed that the availability of lithic raw materials might be the most important factor in the organization of technology that influenced the settlement configurations (Andrefsky, 1998). Understanding the organization of Palaeolithic adaptive strategies often relies on analyzing the types of raw materials present in an assemblage. In the Upper Baitarani Valley, Middle Palaeolithic stone tool knappers commonly used two types of raw materials: quartzite and Dolerite. Quartzite (62.07%) is the dominant raw material used for the production of tools. Dolerite (37.93%) is also used in the manufacture of a significant number of tools (Figure 6). The peak of the inselberg exhibits rock formations of silicified dolerite dykes and quartzite stone blocks, with some showing evidence of quarrying activities carried out on-site. The slope of the Inselberg is rich in angular and sub-angular cobbles of this stone, which have been widely utilized for tool production at the site, in addition to quarrying activities. It is possible that the Middle Palaeolithic hominins were attracted to temporarily or seasonally inhabit this area due to the availability, quality, and cost-effective acquisition of this raw material. The closest source of quartzite is the gravel bed of the river Baitarani, located around 5-6 kilometres away from the sites. In some cases, multiple sites are located very close to each other, resulting in the presence of extensive dolerite dykes stretching 1 to 2 kilometres. The raw materials used in the Upper Baitarani Valley sites were obtained from the lithic landscape within a range of approximately 15-25 kilometres. The prevalent practice involved utilizing on-site primary sources, particularly silicified rock, rather than importing raw materials from distant locations. This localized approach to raw material acquisition was a distinctive characteristic of the site (Gould and Saggars 1985: 117-136).

### Microlithic Tools

The relatively wider distribution of microlithic sites in the Baitarani River valley possibly reflects better preservation due to patterns of stratigraphic exposure. Population density during the microlithic period might also have been greater. Microlithic people led a wandering lifestyle, moving across landscapes in search of resources, from raw material procurement to hunting, gathering, and food collection. The microlithic assemblages in the Study area are completely devoid of ceramics but are associated with Neolithic-type ground stone tools, ringstones, and other heavy-duty tools. This indicates that the sites discovered were inhabited before the beginning of agriculture and were exclusively occupied by microlith-producing hunter-gatherers.

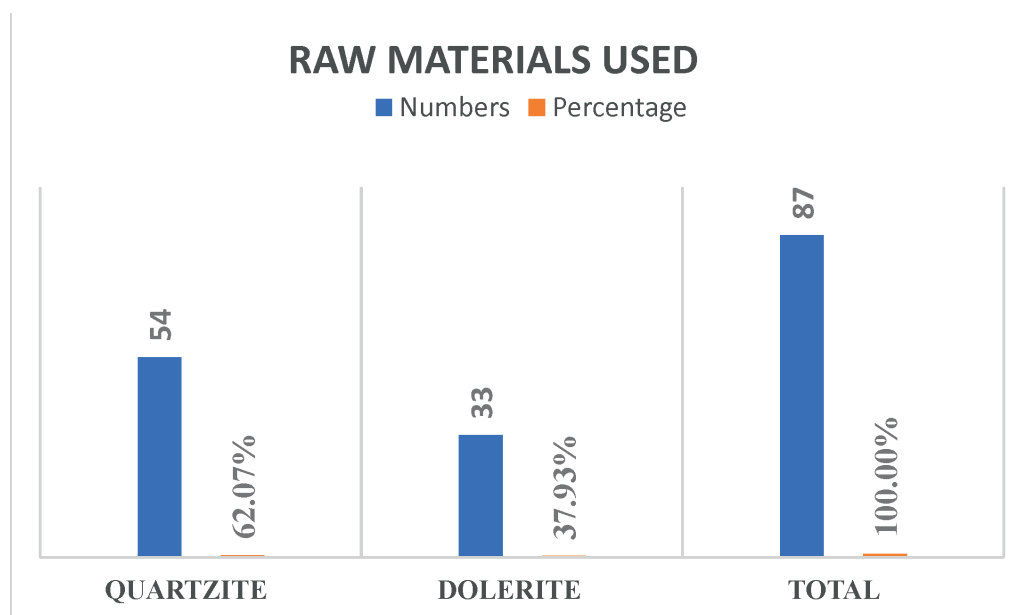


Fig. 6: The number and percentage of raw materials of the Middle Palaeolithic tools.

The sites with Middle Palaeolithic tools found alongside microlithic artefacts are situated at five different locations: Musakhari-II (n=141), Bhuluda (n=39), Begna (n=10), Kadabahali-I (n=1), and Kadabahali-II (n=27). A total of 218 microlithic artefacts have been collected. The microlithic assemblage includes Flake Core n=11 (5.05%), Blade Core n=20 (9.17%), Flake-Blade Core n=21 (9.63%), Blade-Bladelet Core n=17 (7.80%), Blade n=18 (8.26%), Burin n=12 (5.50%), Bladelets n=18 (8.26%), Borer n=5 (2.29%), Backed Blade n=11 (5.05%), Micro Blade n=11 (5.05%), Single side scraper n=3 (1.38%), Point n=5 (2.29%), Double side scraper n=4 (1.83%), Notch n=2 (0.92%), Broken Blade n=3 (1.38%), Micro Scraper n=3 (1.38%), Point cum Borer n=5 (2.29%), Tringle n=2 (0.92%), Crescent n=5 (2.29%), Flake n=18 (8.26%), and Chips and Chunks n=24 (11.01%). Chert (96.34%) and quartz (3.66%), in various forms, were used as the primary raw materials to produce microliths at these sites. In the overall microlithic assemblage, black chert (64.67%) is the predominant type of raw material used for the manufacturing of tools (Figure 7). The greater number of cores, flakes, and chunks across various types in the overall microlithic assemblage suggests that these sites may have been areas of microlithic manufacturing. Different types of microlithic technologies were observed in assemblages from various sites, including hard-hammer, indirect percussion, and pressure-flaking techniques for core reduction (Plate 11). A large number of non-

geometric and geometric types of microliths were produced. Some of the blade cores observed produced only a few blades, along with blade cores found, which showed numerous blade scars and appeared more reduced or exhausted. Both large and small blades, as well as backed blades, were observed in the microlithic assemblage (Plate 12).

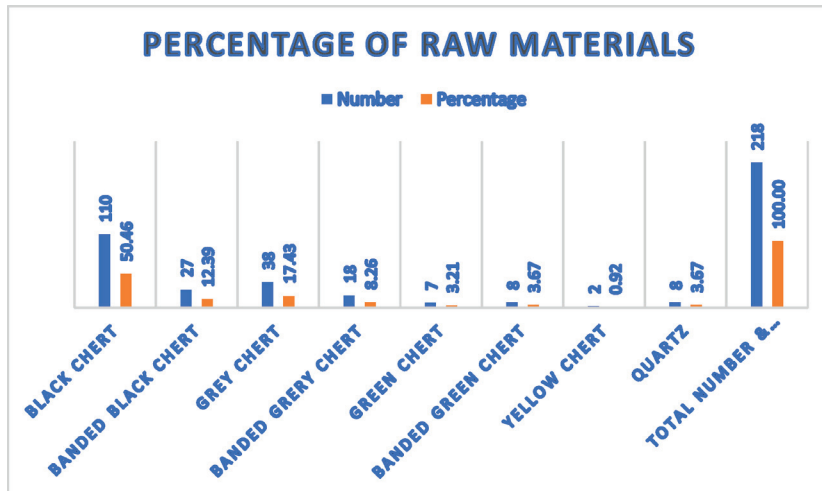


Fig. 7: Number and percentage of recovered microlithic tools from Upper Baitarani Valley.



Plate 11: Flake cores, Blade cores and Bladelet Cores found from the study area.



Plate 12: Different types of blades, bladelets, points and crescents from the Upper Baitarani Valley.

### Discussion & Conclusion

The Middle Palaeolithic assemblage of the Upper Baitarani Valley exhibits several unique features distinct from those of other river valleys in Odisha, including the absence of small to medium-sized handaxes and cleavers, as well as picks, polyhedrons, but the presence of a well-organised blade core technology. However, it shares a unique characteristic in the northern highlands of Keonjhar district, in general, and in the Baitarani river basin in particular. The region also shares some similarities in material culture with other regions, such as the Jira Valley and Bargarh uplands in Western

Odisha, the Singhbhum region in Jharkhand, and Mayurbhanj in northern Odisha, especially in the Subarnarekha and Budhabalanga river valleys. The lithic assemblages exhibit a widespread utilization of both preferential and recurrent Levallois techniques, discoids, and a prevalence of scrapers, notched tools, and denticulates, which are commonly encountered in the majority of the Middle Palaeolithic industries within the Indian sub-continent. The remarkable presence of chopper-chopping tools is evident in numerous Indian Middle Palaeolithic sites, including those in the Soan valley (Late Sohan-A), the Dang-Deokhuri valleys in Nepal, the Budha Pushkar area in Rajasthan, several sites in southern Uttar Pradesh, Patpara-II in the Son valley, Adamgarh in central India, Jamalpur in Bihar, Kortallayar basin in Tamilnadu, Ramayogi Agraharam in Andhra Pradesh, Giddalur area in Kurnool district of Andhra Pradesh and Sagileru basin in the Cuddapah district in Andhra Pradesh (Petraglia et.al 2007; Corvinus, 1994; Allchin et.al 1972; Blumenschine et. al 1983; Pant, 1982; Joshi, Badam and Pandey 1978; Reddy, 1978; Reddy and Sudarsen 1978: 32-40; Jayaswal, 1978; Pappu, 1996; Rath, 1997).

Notably, despite the prevalence of pebbles and cobbles of varying sizes in the channel beds of both major and minor rivers and their tributaries within the region, the Middle Palaeolithic industries of the Upper Baitarani Valley do not exhibit chopper-chopping tools. The presence of a few large blades of the late/upper Palaeolithic type, made from quartzite and dolerite, along with the large number of microlithic tools made from silicious rocks found at sites such as Musakhari-II and Kadabahali-II, indicates advancement in stone tool production in this region. In the Indian context, some scholars have attempted to categorise the Middle Palaeolithic industries into three developmental stages: an early phase characterized by the continuity of Acheulian elements, a middle phase dominated by prepared core and discoidal core technology, and a late phase marked by increasing use of blade technology (Pal 2002: 79). The interpretation of the Middle Palaeolithic and its assignment to a specific phase in the archaeological record seems theoretically sound, although it lacks support from stratigraphic sequences and mainly depends on techno-typological variations. The lithic assemblage, characterised by the dominance of prepared-core and discoidal-core technologies, along with a smaller number of blade tools and the presence of microlithic tools at some sites in the Upper Baitarani Valley, suggests a probable affiliation with the middle to late phase of the Middle Palaeolithic period, based on techno-typological aspects. However, establishing a specific chronological position is currently not possible. Nevertheless, our study unequivocally illustrates variations in the utilization of raw materials and the composition of assemblages in the Upper Baitarani Valley; primarily,

they used locally available stones, such as dolerite and quartzite, for tool manufacture in the region. Because dolerite is locally available in the form of dyke of hockey stick shape.

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