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Palaeolithic Investigations at the Neemtone Palaeolithic Complex, Central Narmada Basin, Madhya Pradesh*

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Abstract

The Neemtone Palaeolithic Complex, a site complex in the central Narmada Basin, Madhya Pradesh, was discovered during the course of field investigations carried out by the Narmada Basin Palaeoanthropology Project. Located at the interface of the Narmada flood plains and the Vindhyan outcrops, this site complex presents multiple Palaeolithic localities in a regolithic/colluvial context. Raw material is readily available, as natural clasts in the archaeological horizon (regolithic/colluvial deposit) and from the exposed outcrops of the Vindhyan formation. In this paper, field investigations, lithic analyses, and site formation processes of one cluster of the Neemtone Palaeolithic Complex, the Rampura-Samnapur locality, are detailed. Further, the collected and studied lithic assemblages from this locality are juxtaposed with a sample of previous collections collected in 2015 and currently housed at the Department of Archaeology and Ancient History, the M.S. University of Baroda, Vadodara. Lithic analyses indicate that the Neemtone Palaeolithic Complex represents a Mode 2/Acheulean techno-complex with some presence of the Levallois method, represented in the form of large Levallois core elements.

Introduction

The South Asian Lower Palaeolithic (SALP) covers a wide spatial and temporal range (for e.g., Sankalia 1974; Paddayya 1984; Sali 1990; Petraglia and Korisettar 1998; Misra 2001; Pappu 2001; Petraglia 2001, 2006; Mishra 2007; Dennell 2009; Gaillard *et al.* 2010; Pappu *et al.* 2011; Paddayya and Deo 2017; Chauhan 1998, 2009, 2018, 2020; Akhilesh *et al.* 2018). One of the important regions that provide abundant evidence for the SALP is the central Narmada Basin in central India (Madhya Pradesh) (see Singh 2018, and references therein, for a recent review of the Lower Palaeolithic archaeology of the region). In this regard, any exercise to understand the nature and variability of the SALP must investigate the lithic assemblages from this region. During the course of the author's doctoral project (Srinivas 2022), a recently discovered site complex (Neemtone Palaeolithic Complex) was selected and investigated as a proxy for characterising the nature of the lithic techno-complexes of SALP sites located at the margins of the floodplains and pediplains.

Location and Setting of the Neemtone Palaeolithic Complex

The Neemtone Palaeolithic Complex is located in the Sehore District, Madhya Pradesh (Figs. 1-3). It is an open-air Palaeolithic site complex at the interface of the Vindhyan Hills and the floodplain of the River Narmada, on the northern side of the river valley. The site complex was identified as a result of field investigations carried out by Parth R. Chauhan and colleagues (Patnaik *et al*. 2009). The lithic scatter continues all along the northern margin of the river valley, and is considered here as the Neemtone Palaeolithic Complex, with multiple find spots and localities. One of these localities, about 2 km east of the originally identified locality at Neemtone and in-between the present-day villages of Rampura and Samnapur (in Sehore District; not to be mistaken with Samnapur from Narsinghpur District, which is a previously reported Middle Palaeolithic site (Misra *et al*. 1990; Ahsan 1993)), was subjected to intensive field survey and lithic collection as part of the author's doctoral research project (Srinivas 2022) (Fig. 3). In the current study, both 'Neemtone' and the 'Neemtone Palaeolithic Complex' are used interchangeably to refer to the site complex.

History of Research at the Site

The site complex was identified as a result of extensive field investigations carried out by Rajeev Patnaik, Parth R. Chauhan, and colleagues under the purview of the Narmada Basin Palaeoanthropology Project (Patnaik *et al*. 2009). The lithic scatters were originally identified in agricultural fields to the north of the present-day village of Neemtone, in the floodplains at the base of the Vindhyan Hills. Further field investigations evidenced a series of lithic scatters, findspots, and localities all along the northern margin of the Narmada River Valley, at the

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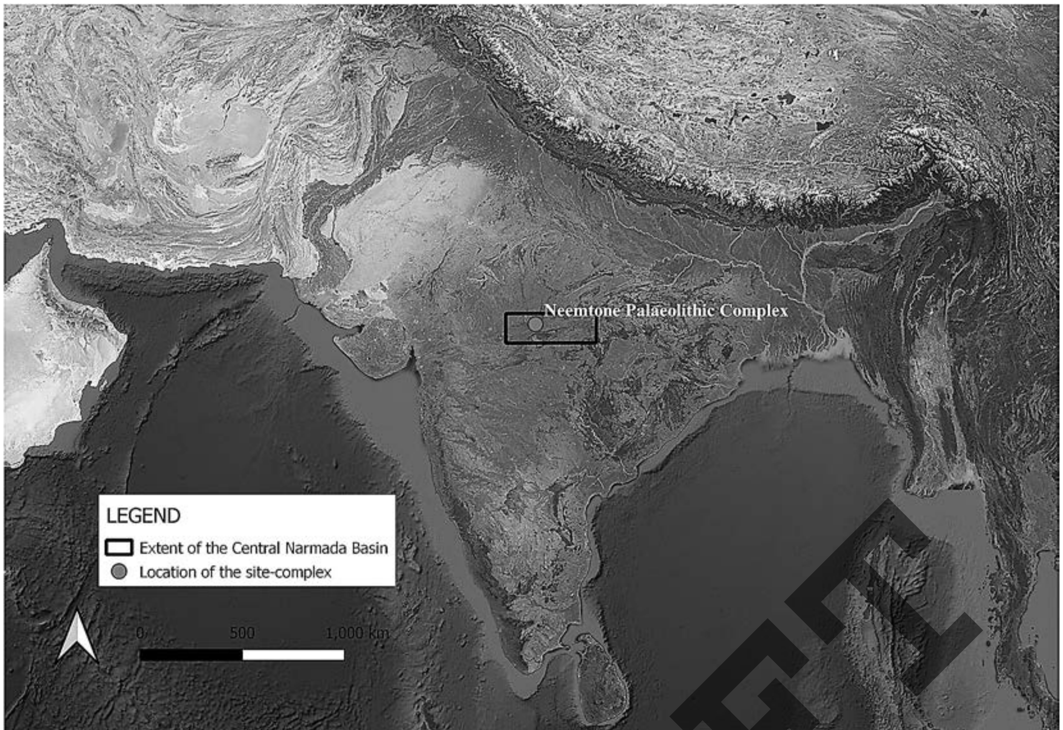

Fig. 1: Location of the Neemtone Palaeolithic Complex

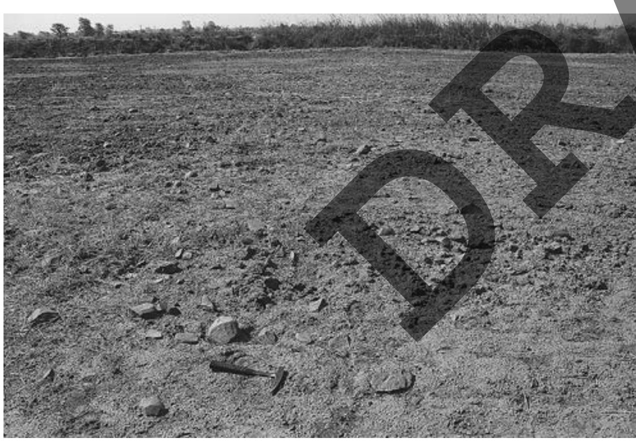

Fig. 2: General view of the exposed lithic elements in the fields of Locality 1 of Neemtone (Rampura-Samnapur locality)

base and interface with the Vindhyan Hills (Singh 2018, 2022). Lithic elements were collected in 2015 from the agricultural fields to the north of Neemtone village, and are currently housed at the Department of Archaeology and Ancient History, the M.S. University of Baroda (MSU), Vadodara (Table 1). Samples from this lithic collection and those from some of the other localities belonging to the Neemtone Palaeolithic Complex were analysed by Vivek Singh as part of his doctoral dissertation (Singh 2022). Microlithic elements have also been reported previously from the vicinity of this region (Chauhan *et al*. 2017).

As a part of the doctoral research project, field investigations and lithic collections were carried out by the author in 2019 at another locality related to the Neemtone Palaeolithic Complex, about 2 km east of Neemtone village, between the present-day villages of Rampura and Samnapur villages. This locality is referred to as Neemtone (Rampura-Samnapur Locality) (site code: NRS) in all associated literature.

Material and Method

The studied lithic assemblage of Neemtone that is included here is the result of the study and analysis of two lithic collections from the site complex. The first collection is the result of surface explorations and systematic sampling

Table 1: Distribution of the lithic assemblage of Neemtone resulting from the 2015 field collections, and currently housed at the M.S. University of Baroda, Vadodara

Category	Count*	% of total assemblage
Core elements	673	25.59%
Flake elements	1828	69.51%
Bifaces	87	3.31%
Angular fragments	42	1.59%
Total	**2630**	**100%**

* *This distribution is preliminary and awaits further analysis.*

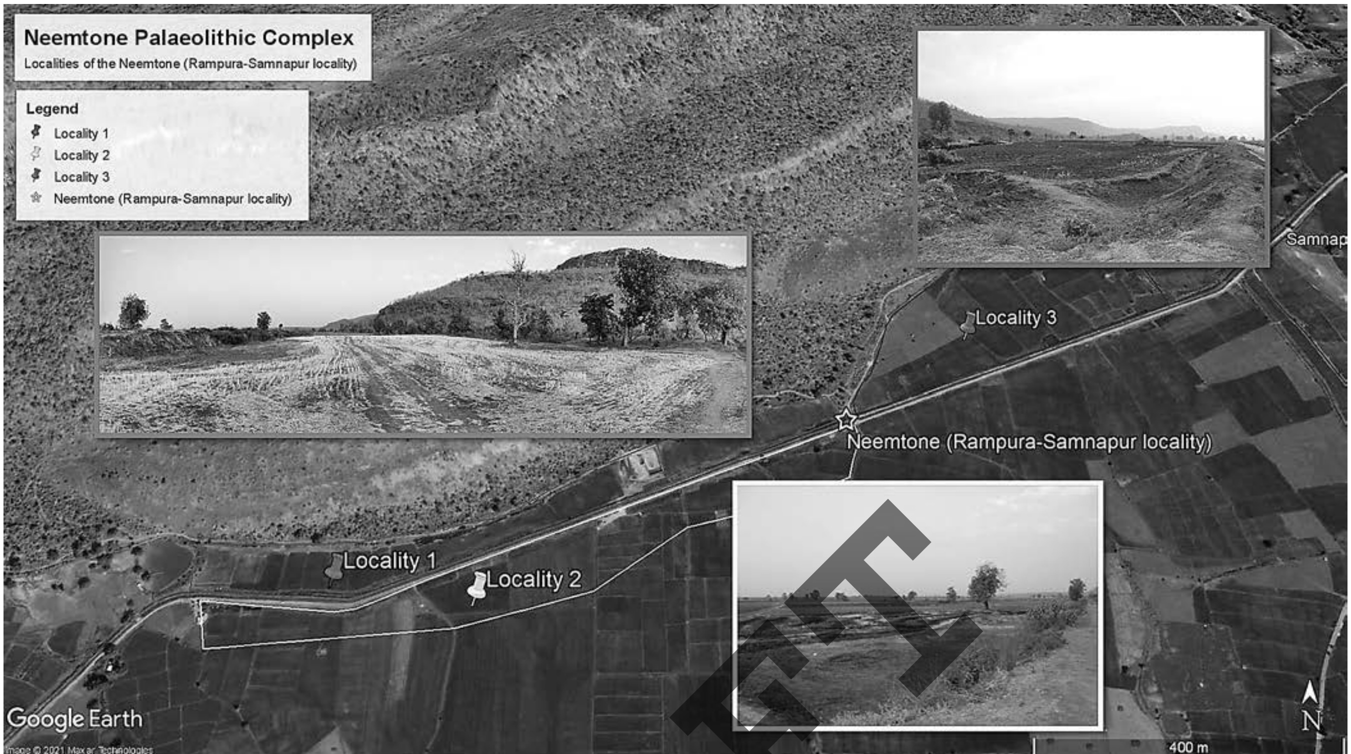

Fig. 3: Localities of Neemtone (Rampura-Samnapur locality) [insets provide a general view of the specific localities]

undertaken by the author between March and May 2019. Fieldwork and lithic sampling were facilitated through a permit granted by the Archaeological Survey of India (ASI) to Parth R. Chauhan. A total of 473 lithic elements (Table 2) were collected and analysed under the purview of the current study. This number accounts for all lithic elements collected during fieldwork. The field collections were collected from three sub-localities (Locality 1, Locality 2, and Locality 3) of the Neemtone Palaeolithic Complex, near the vicinity of Rampura and Samnapur villages (Fig. 3; Table 2).

The three sub-localities are situated in agricultural fields and ploughed lands. They are demarcated by means of a canal (between Locality 1 and Locality 2) and an unmetalled road (between Locality 1 and Locality 3). Each sub-locality is identified and differentiated on the basis of its recent anthropogenic land-use patterns. Locality 1, at the base of the Vindhyan outcrops and north of the canal channel, has only recently been transformed into cultivated fields (within the last 10 years). Locality 2, located south of the canal channel, has been subject to agricultural cultivation, including the use of heavy machinery, for many years (more than 30 years). Locality 3, located east of the unmetalled road and north of the canal channel, has both agricultural fields and some forest lands, with variable land-use patterns. Some portions of Locality 3 have been under cultivation in the recent past (within the last 30 years), while other portions have only recently been subject to cultivation. The constant change from forest land to agricultural fields is witnessed in this locality. Information regarding the nature and history of anthropogenic land-use in these localities was gathered from primary interviews with the landowners and the agricultural workers currently working in the fields. Future work will situate these observations and interviews within long-term anthropogenic land-use patterns, such as those detailed elsewhere (Srinivas 2023), to corroborate claims from the interviews and better contextualise site formation processes at the site complex. The lithic collection resulting from the primary field collections is currently housed at the Palaeo-Arch Lab, IISER Mohali.

The second collection is part of the Narmada Basin Palaeoanthropology Project, under the direction of Parth R. Chauhan. This collection contributes 171 lithic elements (Table 2) to the studied assemblage of Neemtone included in the present study. These collections are part of the current Narmada Basin Palaeoanthropology Project, and were collected in 2015 from the agricultural fields near the vicinity of Neemtone village. A total of 2630 lithic elements from the 2015 collections at Neemtone are currently housed at the Department of Archaeology and Ancient History, M.S. University of Badoda, Vadodara (Table 1). Their analysis is currently underway, and only a sample of it is included in this study. More lithic elements originating from this collection are still available for study, and can form part of a future research project. Thus, the

Table 2: Distribution of the total studied lithic assemblage of the Neemtone Palaeolithic Complex

Category	**Locality 1 (% of total)**	**Locality 2 (% of total)**	**Locality 3 (% of total)**	**Total (Field collections)**	**MSU**	**Total**	**% of total assemblage**
Core	7 (5.83%)	5 (4.20%)	19 (8.12%)	**31 (6.55%)**	33 (19.30%)	**64**	9.94%
Core fragment	15 (12.50%)	10 (8.40%)	21 (8.97%)	**46 (9.73%)**	10 (5.85%)	**56**	8.70%
Flake	4 (3.33%)	3 (2.52%)	20 (8.55%)	**27 (5.71%)**	4 (2.34%)	**31**	4.81%
Incomplete flake*	19 (15.83%)	13 (10.92%)	32 (13.68%)	**64 (13.53%)**	1 (0.58%)	**65**	10.09%
Flake fragment	29 (23.33%)	43 (36.13%)	79 (33.76%)	**150 (31.71%)**	8 (4.68%)	**158**	24.53%
Retouched flake	23 (19.17%)	3 (2.52%)	25 (10.68%)	**51 (10.78%)**	10 (5.85%)	**61**	9.47%
Percussion element	-	1 (0.84%)	1 (0.43%)	**2 (0.42%)**	-	**2**	0.31%
Flaked element	10 (8.33%)	7 (5.88%)	6 (2.56%)	**23 (4.86%)**	66 (38.60%)	**89**	13.82%
Bifacially flaked element	3 (2.50%)	3 (2.52%)	-	**6 (1.27%)**	13 (7.60%)	**19 (21.35%)**	2.95%
Debris	6 (5%)	15 (12.61%)	21 (8.97%)	**42 (8.88%)**	2 (1.17%)	**44**	6.83%
Modified/Utilised clast	3 (2.50%)	4 (3.36)	-	**7 (1.48%)**	3 (1.75%)	**10**	1.55%
Natural clast	5 (4.17%)	15 (12.61%)	10 (4.27%)	**30 (6.34%)**	34 (19.88%)	**64**	9.94%
Total	**120**	**119**	**234**	**473**	**171**	**644**	**100%**

* *Incomplete flakes refer to flake elements which are damaged, but the breakage does not compromise the dimensional integrity of the flake element, i.e., measurements along the technological axis are not affected.*

total studied assemblage from the two lithic collections (i.e., the recent field collections carried out by the author and the collections housed in MSU) of the Neemtone Palaeolithic Complex number 644 lithic elements (Table 2).

The following methods were used for data collection from the lithic assemblages of the selected archaeological sites: Primary lithic analysis along the lines of the technological approach (Inizan *et al*. 1999) and the reduction sequence and *chaîne opératoire* perspective (Leroi-Gourhan 1971; Roche and Texier 1991; Soressi and Geneste 2011; Tostevin 2011) form the crux of the study. Primary data collection entailed the preparation of multiple lithic analysis spreadsheets, including data from flakes, cores, and debris (see further, Srinivas 2021). Select pieces were subjected to photographic documentation. The various parameters and attributes recorded were categorised following Andrefsky (1998, 2005), Inizan *et al*. (1999), Soressi and Geneste (2011), Tostevin (2011) and Gallotti and Peretto (2015), and are detailed by Srinivas (2016, 2022).

Criteria for technological attribution are derived from the currently applied schemas of western Europe (Barsky *et al*. 2013; Mosquera *et al*. 2013; Gallotti and Peretto 2015), eastern Africa (Kleindienst 1962; Clark and Kleindienst 1974), and western Asia (Shea 2013). Further, other datasets from eastern Africa (Sánchez-Yustos *et al*. 2018) and eastern Asia (Yang *et al*. 2014, 2016) are also incorporated to broaden the analytical framework of the study. This geographically varied selection is to ensure that regionally categorised perspectives do not bias the study, and the generated dataset can be integrated more easily into discussions at a global level. The non-regional bias would also make the research methodology more robust. While technological attribution for the South Asian Middle Palaeolithic is published (Akhilesh *et al*. 2018: supplementary material), a similar criterion was unavailable for the SALP prior to the doctoral research project (Srinivas 2022) and thus, could not be incorporated. The resulting technological attribution for the SALP will be presented elsewhere, as it is beyond the scope of the current paper.

Results

The entire total of the lithic collections (n = 644; Table 2) is studied as a whole, as no feature, such as context, surface preservation and patination, degree of rolling, or others, could differentiate them, such as to warrant their segregation into different assemblages, collections, or the result of different episodes of knapping or accumulation. Future fieldwork at the site, including excavations, may suggest criteria for differentiation, which, if necessary, shall be considered then. It is presently not known whether all specimens at the site complex are broadly contemporary, either ranging from a few years to a few hundred or thousand years, and represent local activity areas, or if it is a mixture of discrete time-dispersed technological activities, depending on the age of the associated strata and rate(s) of deposition and accumulation of the regolith/colluvial deposit, and the impact of modern-day anthropogenic activities (see Srinivas 2023). At present, the best interpretation of the archaeological horizon is that it is a slow-accumulating palimpsest (Binford 1981; Malinsky-Buller *et al*. 2011).

The lithic assemblage derived from the field collections (n = 473, 73.45% of the studied lithic assemblage) is studied as three distinct collections from three different sub-localities (Table 2). Locality 1 accounts for 120 lithic elements (18.63% of the studied lithic assemblage and 25.37% of the lithic assemblage resulting from fieldwork), Locality 2 accounts for 119 lithic elements (18.48% of the studied lithic assemblage and 25.16% of the lithic assemblage resulting from fieldwork), and Locality 3 accounts for 234 lithic elements (36.34% of the studied lithic assemblage and 49.47% of the lithic assemblage resulting from fieldwork).

Raw material and surface modification

The dominant raw material in the studied assemblage is coarse-grained quartzite (Table 3). This is locally available as angular and tabular clasts derived from the regolithic/colluvial deposit, which is the archaeological horizon, and from the bedrock outcrops of the Vindhyan Formation noted at all the Neemtone localities. Rarely, fluvial-rounded clasts are also used, which are possibly collected from the Narmada River channel and its environs, located about 10 km south of the site complex. Quartzite clasts account for 99.38% (n = 640) of the studied lithic assemblage. Sandstone (possibly ortho-quartzite or quartz/quartzose sandstone?) elements account for four elements (n = 4, 0.62%; four flake elements). All the lithic elements are patinated. A significant proportion of lithic elements evidence signs of abrasion or weathering (n = 603, 93.63%), while a few elements indicate traces of calcrete encrustations (n = 12, 1.86%). The high number of lithic elements that indicate signs of abrasion or weathering suggests that most of the lithic elements were subject to a prolonged period(s) of exposure, either before their burial, after their burial and prior to their collection, or a combination of both of these processes. This is very plausible considering the nature of the archaeological deposit, which is in a regolith/colluvial context that allows for prolonged and/or repeated periods and cycles of burial and exposure, in line with colluvial processes (for example, Goldberg and Macphail 2006).

Concerning the original blank morphology of the various lithic elements, most of the specimens in the assemblage are struck-off angular or tabular clasts. From among the 644 elements, the original blank morphology could be identified for only 252 lithic elements (39.13% of the total lithic assemblage). For 392 lithic elements (60.87% of the total lithic assemblage), the original blank morphology could not be identified or is indeterminate. Angular and tabular clasts account for 212 elements (32.92% of the total assemblage; 84.13% of elements whose original blank morphology can be identified). Fluvial-rounded clasts account for 14 elements (2.17% of the entire lithic assemblage and 5.55% of the elements whose blank morphology can be identified). Flakes are noted as the blanks for 26 lithic elements (4.04% of the total assemblage; 10.32% of elements whose original blank

Table 3: Distribution of raw material and their original blank morphology for the different collections of the Neemtone Palaeolithic Complex assemblage studied.

Locality*	Angular/Tabular clasts	Fluvial clasts	Flake blanks	Indeterminate	Total
Locality 1	47	2	1	70	**120**
Quartzite	44	2	1	69	**116**
Sandstone	3	-	-	1	**4**
Locality 2	43	2	5	69	**119**
Locality 3	91	-	3	140	**234**
Field collections	181	4	9	279	**473**
MSU	31	10	17	113	**171**
Total	**212**	**14**	**26**	**392**	**644**

* *Raw material recovered from all collections is on coarse-grained quartzite. Only Locality 1 evidences the use of sandstone (quartzitic-sandstone?).*

morphology can be identified; three core elements, three flake elements, one retouched flake element, and 19 flaked elements). This indicates the secondary use of flakes as both core elements and as supports for flaked elements, albeit in a minor capacity.

It is noted that sandstone is evidenced in the lithic collections from only Locality 1 of the field collections (all four sandstone lithic elements). A possible reason for this could be the recent introduction of anthropogenic agency within this locality, which has not yet invisibilized the sandstone lithic elements, which are relatively more susceptible to weathering and breakage, when compared with the quartzite elements. Another possibility could be its closer proximity to the raw material outcrops, where such elements may have been opportunistically utilised (all four elements are flake elements) and discarded. Further fieldwork and spatial analysis at the site and localities may help clarify this enigma.

Lithic elements

From the 473 elements resulting from the field collections, 77 elements (16.28% of the lithic elements collected from the field) are classified as cores and core fragments (Table 2). Among the 77, 31 are complete core elements, while 46 are core fragments. Amongst the cores, two techniques of flake detachment are noted: the direct hand-held stone hammer percussion technique and the bipolar-on-anvil percussion technique. Further, five methods of flake detachment are seen: opportunistic (SSDA: *système par surface de débitage alterné*, Forestier 1993), centripetal (Mourre 2003), discoidal (Boëda 1993), Levallois (Boëda 1994), and Kombewa (Inizan *et al*. 1999; Owen 1938). The typological classification of the core elements is detailed in Table 4.

The opportunistic method is the most common (n = 64, 83.12% of all core and core fragment elements; complete core elements: 25 out of 31, 80.64%; core fragment elements: 39 out of 46, 84.78%). The centripetal method accounts for four core elements (5.19% of all core and core fragment elements; complete core elements: 4 out of 31, 12.90%). The discoidal and Kombewa methods account for one complete core element each (1.30% of all core and core fragment elements; complete core elements: 1 out of 31, 3.23%). The Levallois method is attested to by the presence of three core fragment elements (3.90% of all core and core fragment elements; core fragment elements: 3 out of 46, 6.52%). Almost all of the core elements indicate flake detachment using the direct hand-held stone hammer percussion technique (n = 75, 97.40% of all core and core fragment elements). Only two complete opportunistic core elements evidence the use of the bipolar-on-anvil percussion technique (n = 2, 2.60% of all core and core fragment elements).

From the 171 elements that were studied from the archaeological repository of MSU, 43 elements (25.15% of the lithic assemblage analysed from the MSU collections) are classified as cores and core fragments (Table 2). Among the 43 core elements, 33 are complete core elements, while 10 are core fragments. Amongst the cores, only one technique of flake detachment is noted, the direct hand-held stone hammer percussion technique. Further, five methods of flake detachment are seen: opportunistic (SSDA, Forestier 1993), discoidal (Boëda 1993), centripetal (Mourre 2003), Kombewa (Owen 1938; Inizan *et al*. 1999), and Levallois (Boëda 1994). The typological classification of the core elements is detailed in Table 5.

The discoidal method is the most abundant (n = 20, 46.51% of all core and core fragment elements;

Table 4: Typological classification of the core elements from the field collections of Neemtone (Ramnagar-Samnapur)

Category*	Locality 1	Locality 2	Locality 3	Total
Unidirectional core	9 (4/5)	9 (2/7)	10 (9/1)	**28** (15/13)
Bidirectional core	5 (1/4)	-	11 (2/9)	**16** (3/13)
Orthogonal core	-	-	1 (0/1)	**1** (0/1)
Multidirectional core	1 (1/0)	-	5 (1/4)	**6** (2/4)
Unifacial centripetal core	1 (0/1)	2 (1/1)	3 (2/1)	**6** (3/3)
Bipolar-on-anvil core	-	-	2 (2/0)	**2** (2/0)
Opportunistic cores	**16** (6/10)	**11** (3/8)	**32** (16/16)	**59** (25/34)
Discoidal core	-	-	1 (1/0)	**1** (1/0)
Kombewa core	-	1 (1/0)	-	**1** (1/0)
Centripetal core	1 (1/0)	1 (1/0)	2 (2/0)	**4** (4/0)
Preferential Levallois core	-	-	1 (0/1)	**1** (0/1)
Radial recurrent Levallois core	2 (0/2)	-	-	**2** (0/2)
Unclear	3 (0/3)	2 (0/2)	4 (0/4)	**9** (0/9)
Total	**22** (7/15)	**15** (5/10)	**40** (19/21)	**77** (31/46)

* *Counts are Total (complete core elements/core fragment elements)*

Table 5: Typological classification of the core elements from the Neemtone collections housed at the repository at the MS University of Baroda, Vadodara

Category	**Complete core**	**Core fragment**	**Total**
Unidirectional core	4	2	**6**
Bidirectional core	3	2	**5**
Orthogonal core	1	1	**2**
Multidirectional core	4	1	**5**
Unifacial centripetal core	-	1	**1**
Opportunistic cores	**12**	**7**	**19**
Discoidal core	18	2	**20**
Kombewa core	-	1	**1**
Centripetal core	2	-	**2**
Recurrent Levallois core	1	-	**1**
Total	**33**	**10**	**43**

Table 6: Typological classification of the core elements from the total studied collections of the Neemtone Palaeolithic Complex

Category	**Complete core**	**Core fragment**	**Total**
Unidirectional core	19	15	**34**
Bidirectional core	6	15	**21**
Orthogonal core	1	2	**3**
Multidirectional core	6	5	**11**
Unifacial centripetal core	3	4	**7**
Bipolar-on-anvil core	2	-	**2**
Opportunistic cores	**37**	**41**	**78**
Discoidal core	19	2	**21**
Kombewa core	1	1	**2**
Centripetal core	6	-	**6**
Preferential Levallois core	-	1	**1**
Radial recurrent Levallois core	-	2	**2**
Recurrent Levallois core	1	-	**1**
Unclear	-	9	**9**
Total	**64**	**56**	**120**

complete core elements: 18 out of 33, 54.55%; core fragment elements: 2 out of 10, 20%). The opportunistic method is equally common (n = 19, 44.18% of all core and core fragment elements; complete core elements: 12 out of 33, 36.36%; core fragment elements: 7 out of 10, 70%). The centripetal method accounts for two complete core elements (4.65% of all core and core fragment elements; complete core elements: 2 out of 33, 6.06%). The Kombewa method accounts for one core fragment element (2.33% of all core and core fragment elements; core fragment elements: 1 out of 10, 10%). The Levallois method is attested to by the presence of one complete core element (2.33% of all core and core fragment elements; complete core elements: 1 out of 33, 3.03%).

When the total assemblage of 644 elements is considered as a whole, 120 elements (18.63% of the total lithic assemblage) are classified as cores and core fragments (Table 2). Among the 120, 64 are complete core elements, while 56 are core fragments. Amongst the cores, two techniques of flake detachment are noted – the direct hand-held stone hammer percussion technique and the bipolar-on-anvil percussion technique. Five methods of flake detachment are seen: opportunistic (SSDA, Forestier 1993), discoidal (Boëda 1993), centripetal (Mourre 2003), Kombewa (Inizan *et al*. 1999; Owen 1938), and Levallois (Boëda 1994). The typological classification of the core elements is detailed in Table 6.

As a whole, the opportunistic method is the most common (n = 83, 69.17% of all core and core fragment elements; complete core elements: 37 out of 64, 57.81%; core fragment elements: 46 out of 56, 82.14%). The discoidal method accounts for 21 core elements (17.50% of all core and core fragment elements; complete core elements: 19 out of 64, 29.69%; core fragment elements: 2 out of 56, 3.57%). The centripetal method accounts for six complete core elements (5% of all core and core fragment elements; complete core elements: 6 out of 64, 9.38%). The Kombewa method is attested to by the presence of two core elements (1.67% of all core and core fragment elements; complete core elements: 1 out of 64, 1.56%; core fragment elements: 1 out of 56, 1.79%). The Levallois method is attested to by the presence of four core elements (3.33% of all core and core fragment elements; complete core elements: 1 out of 64, 1.56%; core fragment elements: 3 out of 56, 5.36%). Almost all of the core elements indicate flake detachment using direct hand-held stone hammer percussion (n = 118, 98.33% of all core and core fragment elements). Two complete core elements indicate the use of the bipolar-on-anvil percussion technique (n = 2, 1.67% of all core and core fragment elements).

Flakes account for 48.91% (n = 315) of the total studied lithic assemblage of Neemtone. They are further classified into complete flakes, incomplete flakes, flake fragments, and retouched flakes (Table 7). Complete flakes account for 31 elements (4.81% of the total lithic assemblage and 9.84% of the flake elements). Incomplete flakes account for 65 elements in the assemblage (10.10% of the total lithic assemblage, and 20.63% of the flake elements). Flake fragments number 158 elements (24.53% of the total lithic assemblage, and 50.16% of the flake elements). Retouched flake elements in the lithic assemblage are 61 in number (9.47% of the total lithic assemblage and 19.37% of the flake elements).

Among the flake elements, two techniques of flake detachment are noted: direct hand-held stone hammer percussion and bipolar-on-anvil percussion. Further,

Table 7: Distribution of the flake elements from the different collections of the Neemtone Palaeolithic Complex assemblage

Locality*	**Complete flakes**	**Incomplete flakes****	**Flake fragments**	**Retouched flakes**	**Total**
Locality 1	4	19	28	23	**74**
Quartzite	4	16	27	23	**70**
Sandstone	-	3	1	-	**4**
Locality 2	3	13	43	3	**62**
Locality 3	20	32	79	25	**156**
Field collections	27	64	150	51	**292**
MS University	4	1	8	10	**23**
Total	**31**	**65**	**158**	**61**	**315**

* *Raw material recovered from all collections is coarse-grained quartzite. Only Locality 1 evidences the use of sandstone (quartzitic-sandstone?).*

** *Incomplete flakes refer to flake fragments which are broken, but the breakage does not affect their dimensional integrity.*

four flaking methods are noticed: opportunistic (SSDA, Forestier 1993), discoidal (Boëda 1993), centripetal (Mourre 2003), and Kombewa (Owen 1938; Inizan *et al*. 1999), although in differing proportions. The opportunistic method accounts for 308 flake elements (97.78% of the total flake elements). This is the most common method of debitage noted. The discoidal method accounts for two flake elements (0.63% of the total flake elements; one flake element each from Locality 1 and the MSU collections); the centripetal method accounts for one flake element (0.32% of the total flake elements; from Locality 3); and the Kombewa accounts for four flake elements (1.27% of the total flake elements; one element from Locality 2 and three elements from Locality 3).

Most of the flake elements indicate the use of the direct hand-held stone hammer percussion technique (n = 314, 99.68% of the total flake elements). Evidence for the bipolar-on-anvil percussion technique is present on one flake element (one opportunistic flake element from Locality 3), and accounts for 0.32% of the total flake element assemblage. One of the possible reasons for the lower representation of discoidal, centripetal, Kombewa and Levallois flake elements, despite their representation amongst the core elements, could be the equifinality of morphologies of flakes (for e.g., Bordes 1968; Li *et al*. 2017; Radinović 2015; Shen and Wang 2000; Srinivas 2016, 2022; Srinivas and Singh 2023). Discoidal, centripetal, Kombewa and Levallois flake morphologies sometimes overlap with opportunistic flake morphologies (Srinivas 2016), and in such instances, they may be underrepresented. However, until detailed field studies, including sub-surface explorations, are undertaken, we cannot discount hominin lithic behaviours as a reason for this discrepancy and distribution of these flake elements. The same can be suggested for the bipolar-on-anvil core elements and flake elements (Radinović 2015; Srinivas 2016, 2022; Srinivas and Singh 2023).

Natural edge damage is noted on 274 flake elements. This high proportion of edge damage, amounting to 86.98% of the total flake elements, can be attributed to their archaeological context: a regolithic/colluvial deposit with a shallow surface cover of sediments, which may have led to multiple episodes of burial and exposure, and their susceptibility to site formation processes such as trampling, intensive agriculture, and other anthropogenic actions. Further, 117 flake elements feature edge damage that could possibly be the result of anthropogenic agency (based on preliminary macroscopic investigations). A total of 94 flake elements evidence secondary working/flaking. Retouch is noticed on 61 flake elements (Locality 1: 23 out of 74 flake elements, 31.08%; Locality 2: 3 out of 62 flake elements, 4.84%; Locality 3: 25 out of 156 flake elements, 16.03%; Total field collections: 51 out of 292 flake elements, 17.47%; MSU collections: 10 out of 23 flake elements, 43.48%). Retouch is mostly alternating or bifacial (n = 30, 49.18% of the retouched flake elements). The other elements indicate direct retouch (n = 15, 24.59% of the retouched flake elements), inverse retouch (n = 11, 18.03% of the retouched flake elements), and alternate retouch (n = 5, 8.20% of the retouched flake elements). The localization of retouch is varied. A total of 25 elements evidence retouching on their distal ends-,; while flakes with lateral edges retouched include 20 elements that indicate retouching on their right lateral edges and 22 elements that indicate retouching on their left lateral edges. Two elements indicate basal retouch, while seven elements indicate the total retouch of their edges. Retouch is generally continuous (n = 48, 78.69% of the retouched flake elements); semi-abrupt (n = 54, 88.52% of the retouched flake elements); short (n = 54, 88.52% of the retouched flake elements); and scalar (n = 61, 100% of the retouched flake elements). Denticulate morpho-types account for 59 retouched flake elements (96.72% of the retouched flake elements), while 'classical' retouched scrapers account for the other two flake elements (3.28% of the retouched flake elements). The classical forms are convex (n = 1) and rectilinear (n = 1).

Two percussion elements are noted; one each from Locality 2 and Locality 3. They are both broken, and could possibly be active percussion elements, as evidenced by marginal flaking. Such marginal flaking could probably be the result of incidental removals derived during percussion activities (Titton *et al*. 2018). A detailed analysis of these elements is necessary and may form part of a future research project.

Flaked elements are 89 in number (13.82% of the total lithic assemblage), of which 19 are bifacially-modified (2.95% of the entire lithic assemblage; and 21.35% of the flaked elements). Where possible, they evidence the use of various blank-forms, such as those worked on coarse-grained quartzite angular and tabular clasts (n = 13, 14.61% of the flaked elements), on fluvial-rounded clasts (n = 2, 2.25% of the flaked elements), or off flakes (n = 19, 21.35% of the flaked elements). The original blank morphology for 55 elements was indeterminate or could not be identifiable beyond reasonable doubt. All bifacially flaked elements whose original blank morphology was identified were recognised as flake blanks (8 out of 19 bifacial-flaked elements, 42.11%). Among the 19 bifacially flaked elements, two can be classified as handaxes and three as bifacial scrapers. The rest cannot be classified into any of the acknowledged typological forms (n = 14; 13 lithic elements occupy the gradation between handaxes and bifacial scrapers, and one lithic element can be either a bifacial or a unifacial scraper). Amongst the flaked elements, 10 elements (three bifacial-flaked elements) are from Locality 1, seven elements (three bifacially flaked elements) are from Locality 2, and six elements (no bifacial-flaked elements) are from Locality 3. This totals the flaked elements recovered from the field to 23 elements, including six bifacially flaked elements. The MSU collections account for 66 flaked elements, and include 13 bifacially flaked elements. The bifacially flaked elements are distributed as follows: Locality 1: two handaxes and one bifacial scraper; Locality 2: two bifacial scrapers and one handaxe or bifacial scraper; and MSU collections: 12 handaxes or bifacial scrapers and one bifacial or unifacial scraper. This discrepancy in the counts of flaked elements could be due to the collection strategies employed in both cases: the field collections were the result of systematic collection, while the MSU collection results from pedestrian surveys and random sample collections, which leads to a biased collection of more ‘diagnostic’ elements.

The nature of the lithic assemblage

The composition of the studied collections from Neemtone includes cores and core fragments, flakes and flake fragments, retouched flakes, flaked elements, percussion elements, debris, and natural clasts (Table 2). The raw material employed is coarse-grained quartzite. Raw material is locally available, in the form of angular and tabular clasts in the regolith/colluvial deposit and as outcrops in the landscape. The secondary use of flake blanks as cores and as supports for flaked elements is noted, especially for bifacially flaked elements. All the lithic elements are patinated, with many evidencing the effects of abrasion and weathering. Two techniques of flake removal are noted: direct hand-held stone hammer percussion and bipolar-on-anvil percussion, which are represented on both core elements and flake elements. However, due to their low occurrence, the low number of bipolar-on-anvil core elements (two), and the possibility of morphological equifinality between the debitage products of the two flaking techniques (Radinović 2015; Srinivas 2016, 2022; Srinivas and Singh 2023), further work and collections from the site complex are needed before the presence and/or absence of the bipolar-on-anvil percussion technique can be ascertained beyond reasonable doubt.

Five methods of flake detachment are the opportunistic, discoidal, centripetal, Kombewa and Levallois. However, the overlap between the morphologies of the discoidal, centripetal, Kombewa and Levallois flakes and the opportunistic flakes results in their underrepresentation amongst the flake elements. However, future work at the site may elaborate on possible lithic behaviours or site formation processes that may have possibly led to the observed lithic distribution, if any.

Evidence for shaping is present. Bifacially flaked elements are noted, and these elements display both bifacial and bilateral symmetry, albeit sometimes in a nominal sense. Some of the bifacial elements recovered can be classified as ‘bifaces’ or ‘handaxes’. Cleavers are not noted in these collections.

Lithic reduction sequence

The reconstructed lithic reduction sequence of Neemtone is outlined in Fig. 4. At the site, locally available angular and tabular clasts, as well as exposed outcrops of coarse-grained quartzite, are selected and exploited as the raw material for stone tool production. A component of sandstone (quartzose sandstone?) was also exploited.

Cores are primarily utilised opportunistically, with minimal core preparation. Some of the core blanks indicate no attempt at decortication or platform preparation (n = 90, 44% of the core elements). Core preparation, when present, involves decortication (n = 6; 48% of the core elements) or the preparation of the striking platform by a series of small or shallow flake removals (n = 16; 8% of the core elements). Hierarchical organisation, with flake removals maintaining the peripheral striking platform and decorticating the striking platform, is also noted on five elements (8% of the core elements). There is one core element with both its debitage surface and striking

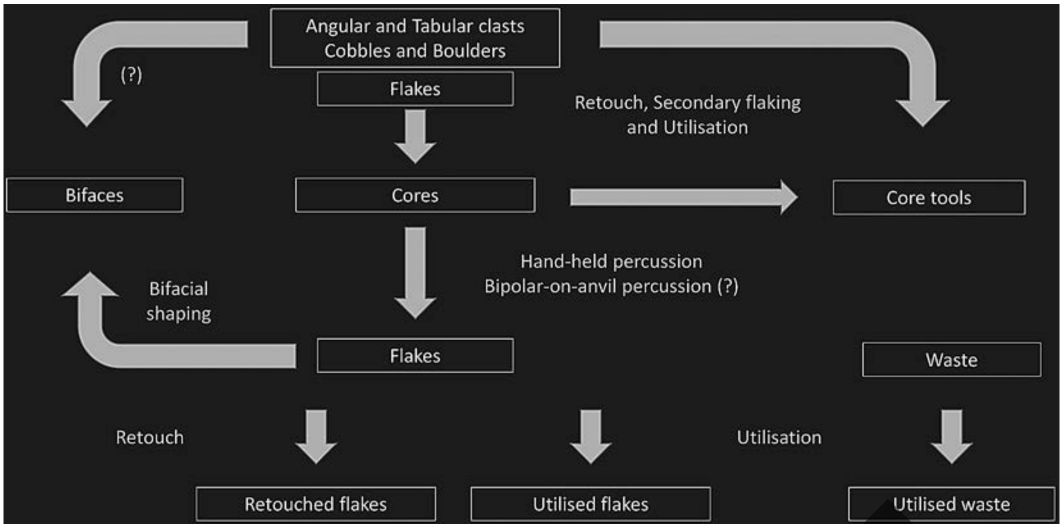

Fig. 4: Lithic reduction sequence at the Neemtone Palaeolithic Complex

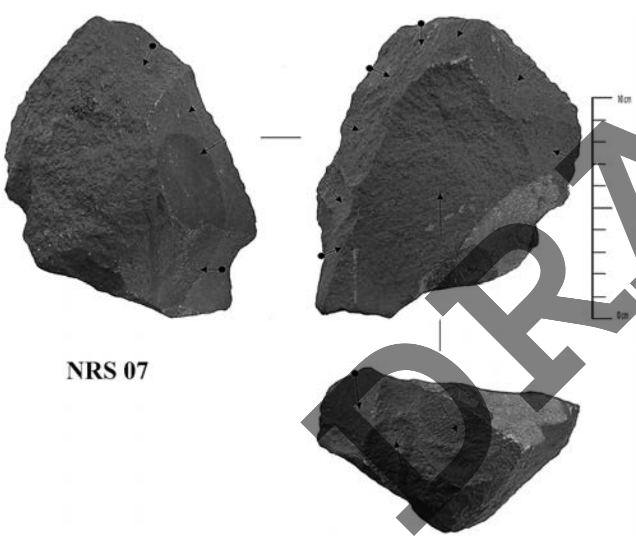

Fig. 5: NRS 07, a Preferential Levallois core (Neemtone Rampura-Samnapur locality)

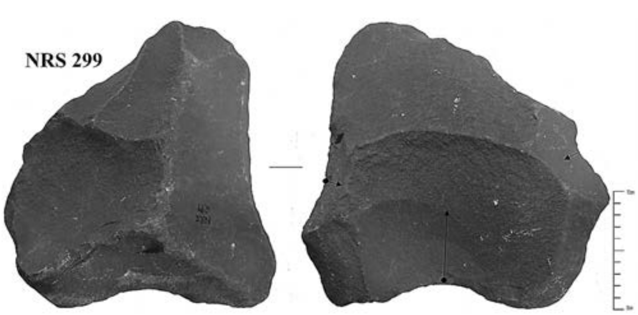

Fig. 6: NRS 299, a Kombewa *sensu stricto* core (Neemtone Rampura-Samnapur locality)

platform showing preparation by flake removals (Fig. 5: NRS 07, a core element from Locality 3, classified as a preferred Levallois core). There is one core element that can be considered a Kombewa *sensu stricto* core, with the ventral surface of the large flake blank exploited as the debitage surface (Fig. 6: NRS 299, a core element from Locality 2, classified as a Kombewa core). This attests to the secondary use of flake blanks as cores.

Many of the core elements indicate plain, striking platforms (n = 63, 92% of core elements). Moreover, evidence for core management schemes is present, due to the presence of discoidal, centripetal, and Levallois cores. Cores are minimally exploited, with only a few flakes detached before core abandonment. In most cases, the reasons for core abandonment are unclear. The reduction sequence is geared towards the production of small and medium-sized flake blanks (113 out of the 120 core elements). A few core elements also evidence large flake removals (4 out of the 120 core elements).

At the Neemtone site complex, flake elements are detached using multiple parallel strategies, employing at least two techniques and five methods of flaking. Further, there is evidence for the secondary working of flakes as supports for flaked elements (61 retouched flake elements and eight bifacially flaked elements). Shaping is present, with flake elements indicating secondary flaking, as well as bifacial flaking employed in the making of bifacially flaked elements. Flaked elements are also retouched (41 of the 94 flake elements that have secondary flake removal evidence are retouched; 61.40% of the flake elements have secondary flake removals; and 25 of the flake elements are retouched). This indicates some intention to curate the lithic elements and to probably extend their useful life. However, the opportunistic nature of the lithic assemblage, coupled with the opportunistic use of the angular and tabular clasts from the regolith/colluvial deposit, also suggests that some of the lithic behaviours at the site were also of an expedient nature.

Technological Attribution

Based on criteria elaborated for western Europe for all three of the checklists (Barsky *et al*. 2013; Gallotti and Peretto 2015; Mosquera *et al*. 2013), the lithic assemblage of Neemtone can be ascribed to a Mode 2 technological stage (Tables 8-10). The same Mode 2 technological attribution is evident when comparing it to the eastern African checklist (Clark and Kleindienst 1974, Table 11) or the checklist derived from the Levantine assemblages (Shea 2013, Table 12). Thus, irrespective of the regional database to which the lithic assemblage of Neemtone is compared to, by employing a holistic technological and *chaîne opératoire* analysis of its lithic assemblage, Neemtone has elements of a Mode 2/Acheulean techno-complex. The presence and exploitation of large flake blanks, the secondary use of flakes as core blanks and supports for flaked elements, and the presence of shaping in the lithic assemblage are some of the varied reasons for a Mode 2/Acheulean technological ascription to this assemblage.

An interesting point of note regards the application of the criteria established by Mosquera *et al*. (2013) and Clark and Kleindienst (1974) (Tables 9 and 11). In the criteria established by Mosquera *et al*. (2013) (Table 9), the lithic assemblage of Neemtone generally exhibits Model B of flake debitage (diversification of production methods: centripetal, unipolar, orthogonal, multidirectional, bipolar - Mosquera *et al*. 2013:131), but also includes the discoidal and Levallois methods, which are included in Model D (Centripetal method and development of preferential flakes' methods), but the assemblage cannot be ascribed to Model D as there is no '*dominance of the centripetal method*' (Mosquera *et al*. 2013: 131), and as such, it is considered here as a Model B with the addition of the discoidal and Levallois methods.

Table 8: Evaluation of the lithic assemblage from the Neemtone Palaeolithic Complex against the criteria of technological attribution of Barsky *et al*. (2013)

Criteria	Presence at Neemtone
Innovative technology to deal with region-specific external impact factors	Yes
Large-flake production/transformation	Yes
Presence of LCTs	Yes
Multifacial knapping schemes	Yes
Bifacial knapping schemes	Yes
Discoidal knapping schemes	Yes
Secondary use of flakes as cores	Yes
Secondary use of flakes as support for retouched tools	Yes
Higher mobility	Up to 10 km at least
Standardisation of the toolkit	Indeterminate

Table 9: Evaluation of the lithic assemblage from the Neemtone Palaeolithic Complex against the criteria of technological attribution of Mosquera *et al*. (2013)

Criteria	Presence at Neemtone
Model of flake debitage	Model B + Discoidal and Levallois
Small retouched flakes	Yes (few)
Standardisation of the toolkit	Indeterminate
Choppers/Chopping tools	Yes (few)
Presence of LCTs	Yes

Table 10: Evaluation of the lithic assemblage from the Neemtone Palaeolithic Complex against the criteria of technological attribution of Gallotti and Peretto (2015)

Criteria	Presence at Neemtone
Centripetal/Discoidal exploitation	Yes
Transformation of the original blank matrix	Yes (few)
Prepared striking platforms	Yes (few)
Nature of *chaîne opératoire*	Long
Larger retouched flakes	Yes
Dominant technique of percussion	Direct hand-held

Regarding the criteria laid out by Clark and Kleindienst (1974) (Table 11), while all the features of the assemblage are in line with what can be considered Mode 2, the section related to the 'cores' is more attributable to what is considered 'Component A of the Middle Stone Age', rather to those of the 'Early Stone Age' (Clark and Kleindienst 1974: 79). However, due to the other features of the lithic assemblage, despite these discrepancies, the lithic assemblage of Neemtone is ascribed to Mode 2. The reason for this discrepancy could be the result of '*innovative technology to deal with region-specific external impact factors*' (Barsky *et al*. 2013: 142) or the result of site formation processes related to the nature of the archaeological horizon (i.e., slow-accumulating palimpsest). Future work and analysis can help tackle these observed discrepancies.

Discussion and Conclusion

The composition of the studied collections from Neemtone includes cores and core fragments, flakes and flake fragments, retouched flakes, flaked elements, percussion elements, debris, and natural clasts (Table 2). The

Table 11: Evaluation of the lithic assemblage from the Neemtone Palaeolithic Complex against the criteria of technological attribution of Clark and Kleindienst (1974)

Criteria	Presence at Neemtone
Flakes	Mostly irregular, with plain striking platforms
Cores	Unidirectional, Bidirectional, Multidirectional, Unifacial centripetal, Centripetal, Discoidal, Kombewa and Levallois
Utilised/modified	Flakes, cores, fragments and chunks
Shaped tools	Large cutting tools and large scrapers
Heavy duty	Picks, round-ended bifaces, core-scrapers and choppers
Light duty	Small scrapers, *becs* and denticulated scrapers

reconstructed lithic reduction sequence from Neemtone is outlined in Fig. 4. Raw material is locally available, in the form of angular and tabular clasts in the regolith/colluvial deposit and as outcrops in the landscape. At this site complex, this locally available raw material is selected and exploited as the raw material for stone tool production. A component of sandstone (quartzose sandstone?) is also exploited. Further, all the lithic elements are patinated, with many evidencing the effects of abrasion and weathering.

Cores are primarily utilised opportunistically, with minimal core preparation. Some of the core blanks indicate no attempt at decortication or platform preparation. Core preparation, when present, involves the decortication or preparation of the striking platform, by a series of small or shallow flake removals. Hierarchical organisation, with flake removals maintaining the peripheral striking platform and decorticating the striking platform, is also noted, including core elements that can be classified as 'Preferential Levallois' (Fig. 5). There is one core element that can be considered a Kombewa *sensu stricto* core, with the ventral surface of the large flake blank exploited as the debitage surface (Fig. 6). This attests to the secondary use of flakes as cores. Thus, evidence for core management schemes is present, due to the presence of discoidal, centripetal, and Levallois cores. Cores are minimally exploited, with only a few flakes detached before core abandonment. In most cases, the reasons for core abandonment are unclear. Most of the core elements indicate plain, striking platforms. The reduction sequence is generally geared towards the production of small and medium-sized flake blanks, while a few core elements also evidence large flake removals.

At the site complex, flake elements are detached using multiple parallel strategies, employing at least two techniques and five methods of flaking. Further, there is evidence for the secondary working of flakes as supports for flaked elements. Shaping is present, with flake elements indicating secondary flaking, as well as bifacial flaking employed in the making of bifacially flaked elements. Flaked elements are also retouched and secondarily flaked, indicating some intention to curate lithic elements and probably extend their useful life. However, the opportunistic nature of the lithic assemblage, coupled with the opportunistic use of the angular and tabular clasts from the regolith/colluvial deposit, suggests that some of the lithic behaviours at the site complex were of an expedient nature.

Five methods of flake detachment are noted. These are the opportunistic, discoidal, centripetal, Kombewa and Levallois, as evidenced from both the core elements

Table 12: Evaluation of the lithic assemblage from the Neemtone Palaeolithic Complex against the criteria of technological attribution of Shea (2013)

Criteria	Presence at Neemtone
Mode A: Stone percussors	Yes (inferred)
Mode B: Bipolar cores	Yes
Mode C: Pebble cores/non-hierarchical cores	Yes
Mode D: Retouched flakes	Yes
Mode D1: Retouched flake tools	Yes
Mode D2: Backed/truncated flakes	Yes
Mode D3: Burins	No
Mode D4: Retouched microliths	No
Mode E: Elongated core tools	Yes
Mode E1: Large cutting tools	Yes
Mode E2: Thinned bifaces	No
Mode E3: Bifacial core tools with retouched proximal concavities	No
Mode E4: Celts	No
Mode F: Bifacial hierarchical cores	Yes
Mode F1: Bifacial hierarchical cores – Preferential	Yes
Mode F2: Bifacial hierarchical cores – Recurrent	Yes
Mode G: Unifacial hierarchical cores	Yes
Mode G1: Platform cores	Yes
Mode G2: Blade cores	No
Mode H: Edge abrasion	No
Mode I: Groundstone tools	No

and flake elements. However, the overlap between the morphologies of the discoidal, centripetal, Kombewa and Levallois flake elements with the morphologies of the opportunistic flakes, results in the underrepresentation of the other flaking methods and their flake elements (for e.g., Bordes 1968; Shen and Wang 2000; Radinović 2015; Srinivas 2016, 2022; Li *et al*. 2017; Srinivas and Singh 2023). Two techniques of flake removal are noted: direct hand-held stone hammer percussion and bipolar-on-anvil percussion, which are represented on both core elements and flake elements. However, due to their low occurrence, the lack of bipolar-on-anvil core elements, and the possibility of morphological equifinality between the debitage products of the two flaking techniques (for e.g., Radinović 2015; Srinivas 2016, 2022; Srinivas and Singh 2023), further work and collections from the site complex are needed before the presence and/or absence of the bipolar-on-anvil percussion technique can be ascertained beyond reasonable doubt and help elaborate on possible lithic behaviours or site formation processes that may have resulted in the observed distribution(s) of the lithic assemblage.

The secondary use of flake blanks as cores and as supports for flaked elements is noted, especially for bifacially flaked elements. Evidence for shaping is present. Bifacially flaked elements are noted, and these elements display both bifacial and bilateral symmetry, albeit sometimes in a nominal sense. Some of the bifacially flaked elements recovered can be classified as 'bifaces' or 'handaxes'. However, cleavers are not noted in these collections. The reasons for this could be many, including, but not limited, their rare or non-presence in the lithic toolkits of the prehistoric hominin populations, a possible functional overlap with some of the large, unretouched and utilised flake elements, the possible absence of large core blanks to afford multiple sequences of preparation and core blank configuration for cleaver blank production, the absence for a functional or technological need for making and using cleavers at the site complex, or even their undetectable presence from the archaeological record (either due to site formation processes or their non-identification and recovery from the surface lithic scatters, or their active displacement away from the site complex by prehistoric populations). Future fieldwork and lithic collections, as well as constant lithic analyses, may address this issue.

Technological ascription on the basis of the checklists employed (Clark and Kleindienst 1974; Barsky *et al*. 2013; Mosquera *et al*. 2013; Shea 2013; Gallotti and Peretto 2015; Tables 8-12) ascribes a Mode 2/Acheulean technological characterization for the lithic assemblage of the Neemtone Palaeolithic Complex. The presence and exploitation of large flake blanks, the secondary use of flakes as core blanks and supports for flaked elements, and the presence of shaping in the lithic assemblage are some of the reasons for this technological ascription. Despite possible minor discrepancies noted with regards to the ascription while employing the criteria laid out by Clack and Kleindienst (1974) and Mosquera *et al*. (2013), due to the holistic nature of the other features of the lithic collections, the studied lithic assemblage of Neemtone can be ascribed to the Mode 2/Acheulean.

The possible reason for the noted discrepancies between the published regional checklists and the recovered lithic assemblage from the Neemtone Palaeolithic Complex could be the result of either '*innovative technology to deal with region-specific external impact factors*' (Barsky *et al*. 2013: 142), the result of site formation processes related to the nature of the archaeological horizon (i.e., slow-accumulating palimpsest), or due to the inherent variability of the South Asian lithic assemblages when compared with those used for generating the checklists in question (Srinivas and Singh 2023). Future work and analysis, along with sub-surface surveys and chronometric exercises, may help tackle this issue. Further, these results are proof of the necessity to employ a more comprehensive and holistic lithic analysis of the entire lithic assemblage at any site (including its core elements and flake elements) and to move beyond simple index-type-based classifications, resulting in a more secure technological attribution of a lithic assemblage. Further, these results also suggest the need for an indigenously developed checklist of technological and behavioural features for the technological ascription of the lithic assemblages of the South Asian Palaeolithic Complex. This would better help to characterise the nuances of the South Asian Palaeolithic Complex and contribute towards a better reconstruction of past behaviours and lifeways.

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