
Middle Palaeolithic Sites Associated with Youngest Toba Tuff Deposits from the Middle Gundlakamma Valley, Andhra Pradesh, India

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Abstract: Much discussion in recent times has been centred on the 74ka Toba super-eruption and their impacts on hominin behaviour and on regional climate. Based on the current archaeological and genetic evidence from South Asia, there exist two conflicting models (Pre-Toba model of Petraglia et al 2007 and Post-Toba model of Mellars 2006) that explain the initial modern human presence in the region. The aforementioned debates exist due to the restricted nature of the archaeological investigations in the region that focussed upon a limited range of sites, paucity of hominin fossils from South Asia and reliability of Toba ash as a chronological marker. In the light of the above-mentioned issues and debates related to the modern human presence in South Asia, Palaeolithic sites associated with Toba ash has to be approached through multi-disciplinary studies to get more precise and accurate data. As a precursor to this objective, there is a need to shift the focus of investigation from 'site-specific' to 'region-specific' and document more Palaeolithic sites associated with Toba ash to obtain a comprehensive picture of hominin activities in the region around the time of the Toba "super eruption". With this background, the middle reaches of the Gundlakamma river valley was chosen for investigation as it is adjacent to Jwalapuram, where extensive studies have been carried out. Further, the region was also subjected to geological studies in the past, with several localities revealing Toba ash being reported. This paper presents our survey results from Middle Gundlakamma valley which yielded Palaeolithic sites directly associated with Youngest Toba Tuff deposits.

Keywords: Youngest Toba Tuff, Middle Palaeolithic, Lithic Assemblages, Gundlakamma River, Modern Human Dispersals, Andhra Pradesh, South Asia

Introduction

Modern human dispersals from their African origins to other parts of the world have emerged as a significant area of research in the fields of Prehistoric Archaeology and Palaeoanthropology in the recent decades. Changes in lithic technologies and fossil records are two primary sources that are used to explain hominin dispersals. In the recent decades the developments in the field of genetic research such as analysis of mtDNA, non-recombine Y chromosome and Phylogeography have also been used to

understand and date such dispersals. However, the absence of fossil record from the pivotal regions in the dispersal route (such as South Asia) and diverse lithic technologies associated with modern humans in some regions (such as Southeast Asia, Australia, China) constraining us from making any generalizations about the nature of these dispersals.

South Asia is one of the geographically pivotal regions in the modern human dispersal route, situated between the prepared core based lithic technologies in the west and the core-flake based lithic technologies in the east. There currently exists two conflicting models, Post-Toba and Pre-Toba, for the earliest modern human colonization of South Asia (Mellars 2006; Mellars et al 2013; Petraglia et al 2007; Groucutt et al. 2015), which rest on a slender foundation of archaeological evidence and absence of human fossils in the region. The first model states that the modern humans arrived ~50–60ka, from Eastern Africa along the coastlines of South and Southeast Asia, to reach Australia by ~45–50ka (Mellars 2006; Mellars et al 2013). The second proposes the dispersal of modern humans from Africa as early as 120–130ka (Petraglia et al 2007; Groucutt et al. 2015), reaching southern Asia via the Levant or the south Arabian Peninsula, well before the Toba “super-eruption” at 74ka. The Post-Toba model is supported by molecular genetic dating, combined with similarities between Indian microlithic assemblages and Howiesons-Poort-like ones in South and East Africa. Arguments advanced in support of the latter model rest on the evidence unearthed from Jwalapuram where a series of stone tool assemblages have been recovered from locations both underlying and overlying the thick deposits of Toba ash-fall, with a series of associated OSL dates ranging from ~77 to ~38ka (Petraglia et al 2007).

Both the aforementioned models are however characterised by certain drawbacks. DNA analysis often assumes that modern sample populations are an accurate reflection of all past populations, which ignores or rarely considers demographic changes (Petraglia et al 2010). On archaeological grounds, both the models are problematic. The Pre-Toba colonization model suggests that the Indian microlithic technology was an in-situ development from local post-Toba Middle Palaeolithic technologies. However, the earliest Indian microlithic technologies appear similar to those documented over large parts of Old World, with no evidence of technologically transitional industries from 70ka to 45ka to support the in-situ development of microlithic technology in the region. The Post-Toba model on the other hand fails to explain the gaps between the genetically estimated age of the initial modern human colonisation of South Asia (50-60ka) and the earliest directly dated occurrences of typical microlithic industries in South Asia (35-45ka) (Groucutt et al. 2015). Human occupation of Australia by at least 50ka also suggests that earlier sites should be found in South Asia along the route to Australia.

In addition, the modern human presence associated with the Pre-Toba and Post-Toba Middle Palaeolithic assemblages from Jwalapuram were questioned (Haslam et al 2012). Besides, the reliability of redeposited Toba ash beds as a chronological marker

was also questioned (Neudorf et al 2014; Geethanjali et al 2019). In the light of the aforementioned issues and debates related to the modern human presence in South Asia, Palaeolithic sites associated with Toba ash needs to be approached through multi-disciplinary studies to get more precise and accurate data. As a precursor to this objective, it is necessary to shift the focus of investigation from being 'site-specific' to 'region-specific' and document more Palaeolithic sites associated with Toba ash to obtain a comprehensive picture of hominin activities in the region around the time of the Toba "super eruption". With this background, the middle reaches of the Gundlakamma river valley was chosen for investigation as it is adjacent to Jwalapuram, where extensive studies have been carried out (see Petraglia et.al 2012 for a review of studies undertaken). Further, the region was also subjected to geological studies in the past, with several localities revealing Toba ash being reported (Reddy and Shah 2004).

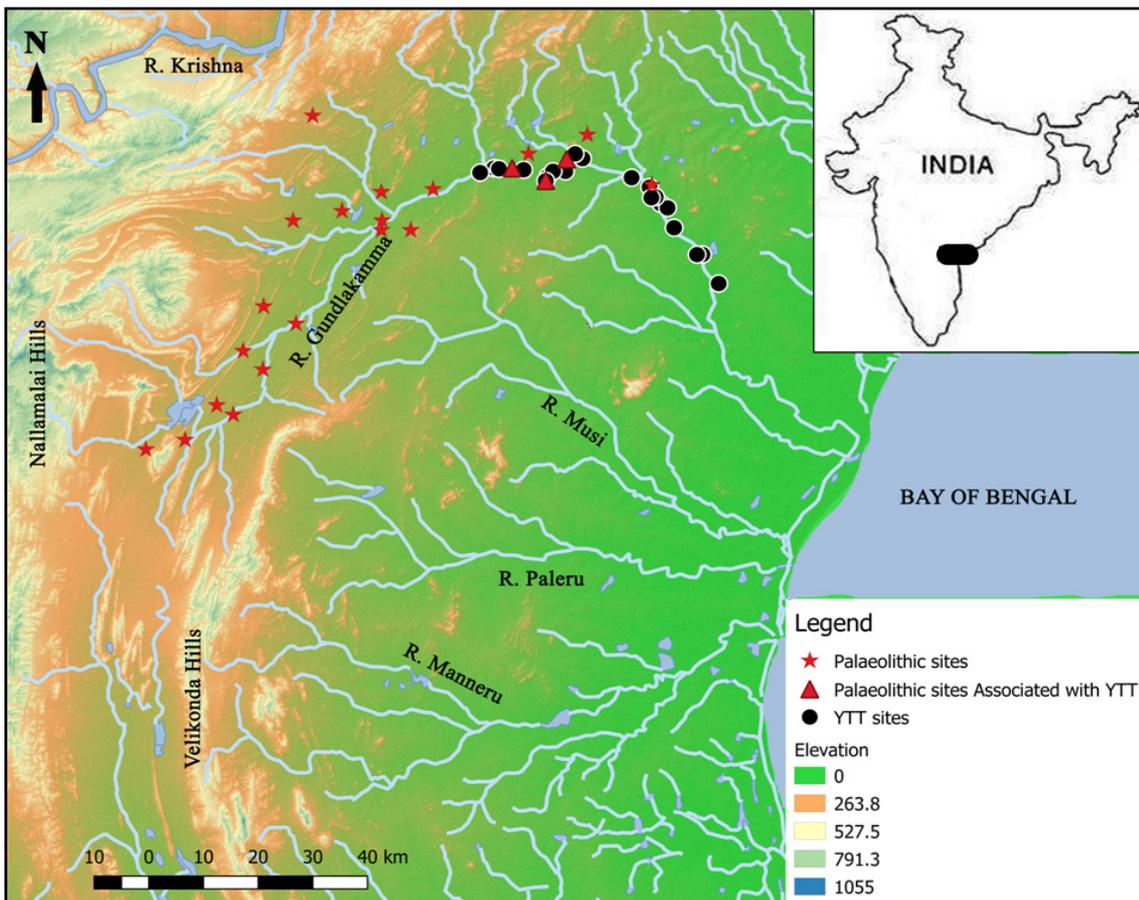


Figure 1: Map showing the study region and the distribution of Palaeolithic sites and Toba Ash sites (Corpus of site information obtained from Issac 1971; Kumari 1987; Reddy and Shah 2004)

The Gundlakamma Basin

The river Gundlakamma rises in the surrounding area of Gundlabrahmeswar, the bordering area between Nandyal and Atmakur *taluka* of Kurnool District at an

elevation of about 800m in the Nallamalai hills (Figure 1). After reaching the plains, it forms two large tanks, one at Cumbum and other at Markapur in Prakasam District and flows in the north-easterly direction and enters Guntur District. Then it changes its direction towards south-east and finally joins the Bay of Bengal near Ulichu village in the Andhra Coast. Chamavagu, Rallavagu, Pogullavagu, Duvvaleru, Jampaleru, Tigaluru, Koneru and Chilakaluru are the tributaries of the river Gundlakamma. The length of the river is about 220km. The drainage network of the Gundlakamma river is controlled by the fracture pattern prevailing in the basal rock formations and the drainage pattern of the Gundlakamma river is of sub-dendritic to sub-parallel in nature (Reddy and Shah 2004). The Gundlakamma river basin is underlain by various rock types of different age groups ranging from Archaean to Recent. The Archaeans comprise various types of granites and charnockites occurring as intrusives in the highly folded and metamorphosed sedimentary rocks represented by khondalites, mica-schists etc. Among the Algonkians, there are metamorphosed sedimentary rocks represented by phyllites, slates, shales and quartzites belonging to the Cuddapah system of Precambrian age. Massive, thick bedded, whitish grey or buff coloured and mostly medium to fine grained quartzites are present as the Bareinkonda and the Cumbum formations of the Cuddapah system. These quartzites are exposed as small hill ranges (such as the Velikonda hill ranges) in the basin area and are also available as river pebbles. During the prehistoric times, this quartzite was the most exploited raw material for tool making. The river Gundlakamma has a very narrow flood plain and therefore the development of Quaternary sediments is also limited. However, three distinct terraces are delineated of which T1 and T2 have a regional presence whereas the third T3 terrace has developed locally (Reddy and Shah 2004). T1 is flat, narrow and comprises sand and gravel, T2 is made of gravel, sand, silt and volcanic ash. The volcanic ash is seen at T2 terrace level and sandwiched between flood plain sediments. The T3 terrace is mostly carved out of pediment but at places, it also comprises of sand and silt. The area experiences a sub-tropical climate with temperatures ranging from 15°C in winter to 45°C in summer. The average annual rainfall is 950mm which is spread over eight months. The maximum rainfall is received in October and November months. The area enjoys the benefit of rainfall both from southwest and northeast monsoons. The natural vegetation, now mostly depleted by agricultural activities and over grazing, is dry scrub on skeletal soils and dry mixed deciduous type in more favourable situations.

Prehistoric studies in this region were initiated by Robert Bruce Foote in 1867 who reported a few Lower Palaeolithic tools from the neighbouring Manneru river (c.f. Rao 1979). A small portion of the upper reaches of the Gundlakamma river valley was also explored by Issac in the 1950's (Issac 1960). The Upper Palaeolithic site of Yerragondapalem was located by Thimma Reddy in this basin (c.f. Kumari 1987). The Gundlakamma River was also explored by Aditya Kumari in the late 1980's who reported sites belonging to Lower to Upper Palaeolithic. She also identified occupation floors belonging to Lower and Middle Palaeolithic periods (Kumari 1987). The aforementioned identifications however necessitate reinvestigations. These studies

have revealed that the prehistoric occupation of the region was prolonged and continuous from Lower Palaeolithic to Mesolithic/Microlithic. The Lower Palaeolithic artefacts made on Cuddapah quartzite comprises Late Acheulian bifaces, choppers, scrapers and other flake implements that have been reported from here and from other river basins in the region (Rao 1979). The Middle Palaeolithic industry of the region was represented by diminutive/miniature handaxes, varieties of scrapers, points, borers, choppers, discoids, flakes and blade-flakes (Kumari 1987). The Upper Palaeolithic industry consisting of blades, scrapers, burins, points, borers, awls, knives, and backed pieces etc is comparable with the well-known Upper Palaeolithic site of the region, Yerragondapalem. Issac (1960) has mentioned of microlithic industries made on quartz from the Gundlakamma river basin. These studies demonstrate the immense potential the region holds for understanding the Palaeolithic and later cultural developments in terms of human adaptation to environmental conditions.

In addition to the immense potential for Palaeolithic studies, recent surveys carried out by geologists from Geological Survey of India in the Gundlakamma river valley have yielded animal fossils and Toba ash deposits (Reddy and Shah 2004). Their surveys here resulted in the documentation of Toba ash at 23 localities along the upper and middle reaches of the Gundlakamma River, associated with T2 terrace (Figure 1). In a few instances these ash beds were found sandwiched between flood plain materials and at times rest directly over the phyllites. The ash bed occurring at Kothapalem, perhaps the longest one is traced along the river for a length of 500m and has a width of 100 – 150m with an average thickness of one metre. The ash beds usually display sharp lower contact and diffused upper contact with the calcareous nodules of various sizes. Extensive chemical analyses on volcanic ash along different river valleys across Andhra Pradesh have revealed that it is co-relatable with the Youngest Toba Tuff (YTT) (Acharyya and Basu, 1993; Westgate et al 1998,) which was deposited due to the eruption of Toba on the north-western part of Sumatra Island of Indonesian Archipelago around 74,000 years ago. Further, chemical analyses of the Toba ash from the Gundlakamma river by Reddy and Shah (2004), reveals that it is co-relatable with the Youngest Toba Tuff. Further, Reddy and Shah (2004) observed fracture patterns within the ash beds at Kothapalem which suggests manifestation of the neo-tectonic activity, which requires further investigations.

Palaeolithic Sites Associated with Toba Ash

The authors conducted extensive explorations in the middle reaches of the Gundlakamma river valley which yielded Toba ash sites in association with lithic assemblages. Among these three sites namely Ainavolu, Timmayyapalem and Kothapalem are of particular interest as they have a direct association with the lithic assemblages. These three sites are located in an area of 20km radius along the Gundlakamma river (Figure 2).

In the vicinity of Ainavolu and Kothapalem, Palaeolithic implements were previously reported by Issac (1960) and Kumari (1987) respectively. There is however no mention

of Toba ash in their reports as the knowledge regarding the nature of ash was limited at that time. Later during 1998-99, geological surveys by geologists from the Southern Circle, Geological Survey of India have reported Toba ash from Ainavolu and Kothapalem (Reddy and Shah 2004), although there was no mention of the lithic assemblages from these sites. The site of Timmayyapalem has been reported by the team for the first time.



Figure 2: Map showing the locations of the sites of Ainavolu, Timmayyapalem and Kothapalem (Source: Google Earth)

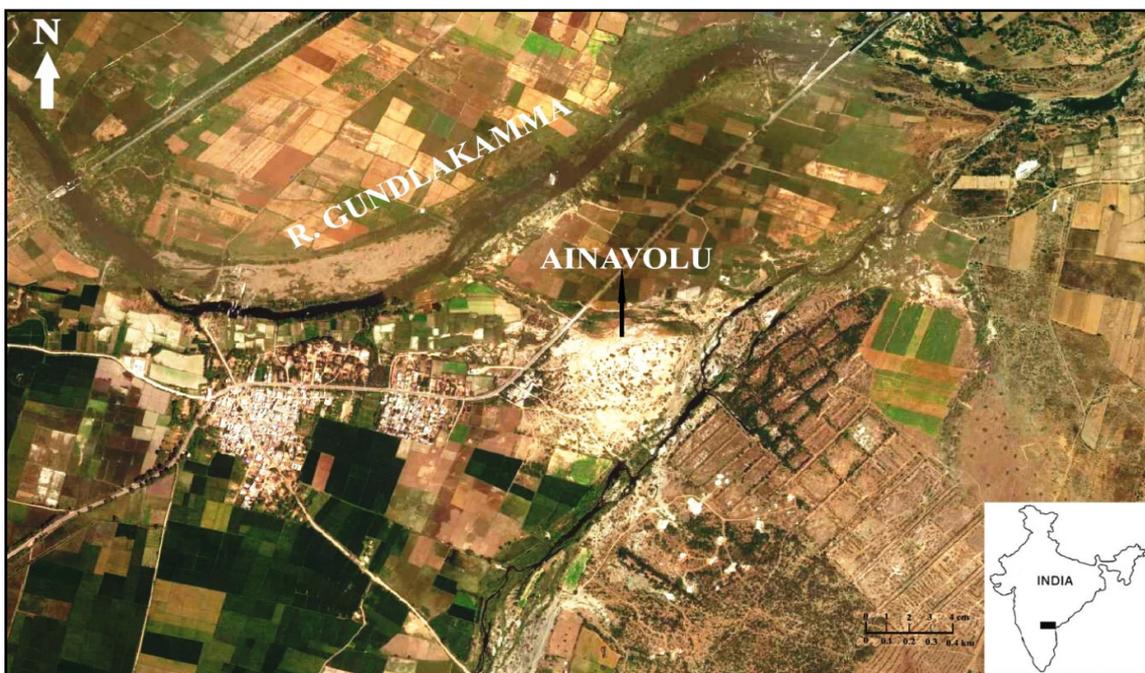


Figure 3: Location of the site of Ainavolu (Source: Google Earth)



Figure 4: Ash beds exposed due to mining activity at Ainavolu



Figure 5: Location of the site of Timmayyapalem (Source: Google Earth)

The site of Ainavolu ($15^{\circ}59' 39''$ N, $79^{\circ}40' 42''$ E) is located northeast of the village Ainavolu which is 10km from the Vinukonda town in Guntur District. The extent of exposed ash beds is around 200m in length and is situated on the right bank of the river Gundlakamma (Figure 3). The ash beds were exposed due to sheet erosion which eventually removed the overlying layers by fluvial action and the ash beds have a thickness of 0.6-0.7m (Figure 4). Several pockets of small gravels ranging from 5 to 10mm were observed at the site, where lithic artefacts and fossils were found.

Geethanjali et al (2019) provide OSL ages of an exposed section at Ainavolu and these dates brackets the ash deposits between the range of 57 ± 5 ka for below ash sediment and 22 ± 3 ka for above ash sediment.

The site of Timmayyapalem ($16^{\circ}1'23''$ N, $79^{\circ}42'51''$ E) is located 6km north of the site of Ainavolu and has similar geological context of Ainavolu, where sheet erosion has exposed the Toba ash beds by eventually removing the subsequent layers (Figure 5). This site is located on the right bank of the stream Pasupuleru, which is a tributary of the Gundlakamma.

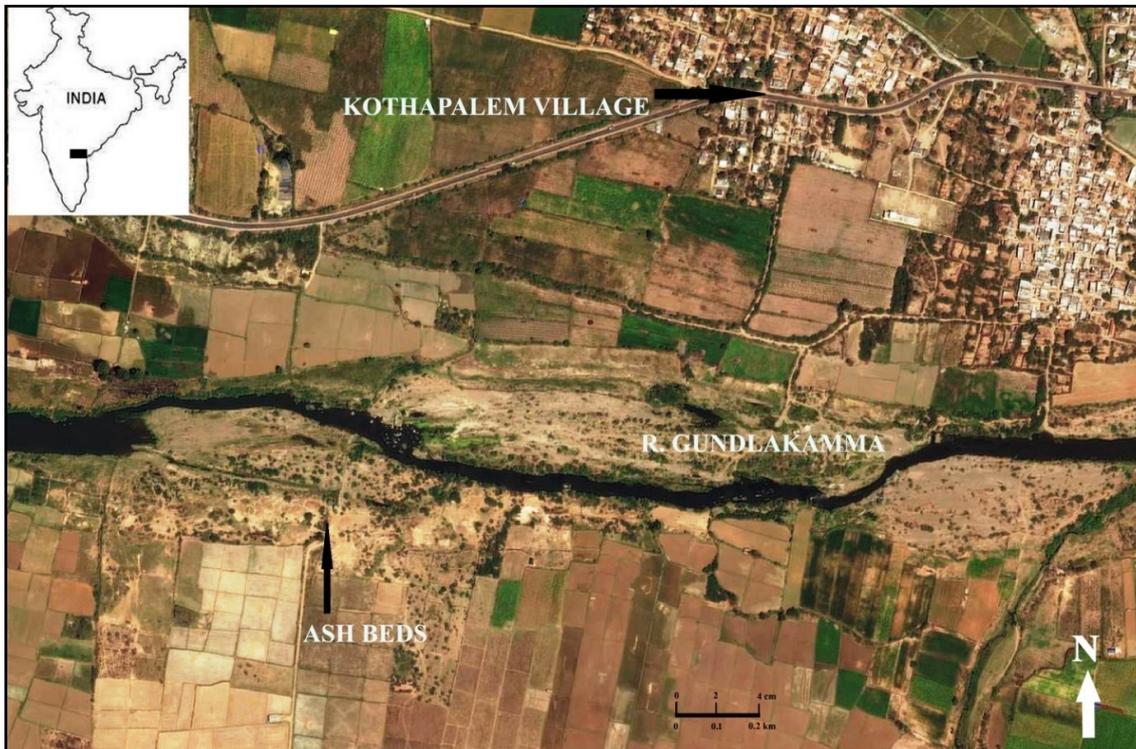


Figure 6: Map showing the location of the site of Kothapalem (Source: Google Earth)

Unlike the above mentioned two sites, the ash beds at the site Kothapalem ($16^{\circ}0'25.92''$ N, $79^{\circ}35'58.94''$ E) is found right on the riverbank, which reveals the stratigraphic position of the ash bed within the river section (Figure 6). Kothapalem is located 15km southwest to the site of Ainavolu on the right bank of the river Gundlakamma and the extent of the ash beds was seen to be around 500m and with a thickness of ~1m. Lithic artefacts such as flakes, scrapers and micro-blade cores were found above and below the ash beds in disturbed context and rolled bifacial tools were recovered from the river gravel.

Toba ash deposits have been found in terrestrial settings across India, but only a few stratigraphic sections have adequately revealed convincing associations between the ash, palaeoenvironments and archaeological remains (for instance Jwalapuram, middle Son valley). However, Williams et al (2009) raise potential methodological problems

associated with the Jwalapuram OSL ages and the context of the lithic assemblages. Although the YTT deposits were first reported on the sites in the Middle Son valley, these YTT occurrences were found to be unreliable as chronostratigraphic markers for millennial scale palaeoenvironmental reconstruction (Gatti et al 2011; Neudorf et al 2014). The Toba ash deposits from the Gundlakamma river are significant as they were found from a number of localities (24 locations for now and expected find more), their association with Palaeolithic artefacts and their divergent geological context. Hence, these ash beds along with their lithic associations can provide more accurate and precise data to get a better understanding of the relation between ash fall and environments and lithic assemblages.

Table 1: Techno-typological composition of the assemblages from Ainavolu (ANV), Timmayyapalem (TMP) and Kothapalem (KPM)

Type	ANV	TMP	KPM	% of ANV	% of TMP	% of KPM	Total
Core types							
Radial Core	3	4	2	2.9	4.5	2.2	9
Unidirectional Core	1	1	0	0.9	1.1	0	2
Multiplatform core	0	2	0	0	2.2	0	2
Discoidal core	0	0	1	0	0	1.1	1
Micro-blade core	0	0	4	0	0	4.4	4
Core fragment	0	4	7	0	4.5	7.7	11
Flakes							
Flake	52	45	48	50.9	50.1	52.3	145
Flaked piece	5	15	13	4.9	16.9	14.3	33
Flake Types							
Blade	5	6	11	4.9	6.7	12.1	22
Levallois Flake	1	0	0	0.9	0	0	1
Retouched							
Scrapers	24	9	2	23.5	10.1	2.2	35
Bifacial point	1	1	3	0.9	1.1	3.3	5
Borer	2	0	0	1.9	0	0	2
Burin	1	0	0	0.9	0	0	1
Denticulate	1	0	0	0.9	0	0	1
Notched flake	1	0	0	0.9	0	0	1
Retouched fragments	5	2	0	4.9	2.2	0	7
Total	102	89	91	-	-	-	282

Techno-typological Analysis of Lithic Assemblages

A total number of 282 stone artefacts were collected from the surface at three sites: Ainavolu (102 artefacts), Timmayyapalem (89 artefacts) and Kothapalem (91 artefacts). The compositions of the assemblages from the three sites are shown in Table 1, presenting a breakdown into standard technological classes as well as more formal typological elements where appropriate. All three assemblages were dominated by

unretouched flakes, comprising 50-52 per cent of the assemblage. Flaked pieces, which are clearly derived from the conchoidal fracture but lack diagnostic features required to determine technological category, also make up a large portion of the assemblages (5-17 per cent). The variety of cores collected from the sites indicates that multiple core-reduction strategies were in use and consist of radial, unidirectional, multiplatform and discoidal core reduction present in the assemblage (Figure 7). Only a single Levallois flake was recovered from Ainavolu, although no cores were found. Four microblade cores are also recovered from the site of Kothapalem. Radial cores are easily the most common form at all the sites and it is not surprising that most of the flakes were of that type. The large range of flake types found at the sites is consistent with the range of core forms found at the site; radial cores and radial flakes both indicate that radial flaking from faceted platforms was practiced at the sites. Blades or Blade-flakes are present and constitute 5-12 per cent in the assemblages, which needs a detailed examination to know whether these are struck intentionally and therefore represent a technological adaptation. Retouched implements and fragments mostly consist of various kinds of scrapers, making up 3-23 per cent of the assemblages. Furtherer, burins, points (bifacial), borer and denticulate are also present in the assemblages.



Figure 7: Representative Lithic artefacts from Ainavolu. 1: Unidirectional core, 2: Radial core, 3: Utilised flake, 4: Denticulate, 5: Broken point, 6: End scraper, 7, 10, 12: Utilised blade-flake, 8: Notched flake, 9: Side scraper on blade-flake, 11: Burin, 13: Blade blank, 14 and 15: Borer, 16: Ventrally retouched side scraper, 17: Side-scraper



Figure 8: Animal Fossils collected from Middle Gundlakamma valley. Top Row: Animal Fossil teeth from the site Ainavolu (1: tooth of *Bos sp.*; 2&3: teeth of *Equus sp.*; 4: tooth of unidentified animal); Middle Row: Animal Fossil remains from Khambhampadu (5: tooth of *Bos sp.*; 6: limb bone fragment of unidentified animal; 7: Phalanx of *Bos sp.*; 8: Proximal part of Metacarpal of *Bos sp.*); Bottom: (9: Fossilized Metatarsal of *Bos sp.*) from the site Gokanakonda

Discussion

The three sites discussed above presents a stratigraphic association between the YTT deposits and Palaeolithic material. Sheet erosion along with ash mining activities here has exposed the ash beds and artefacts. However, sediments underlying the ash which were not exposed at the sites investigated suggesting that the artefacts recorded may belong to above ash sediments. Unlike the adjoining regions such as Jwalapuram and Sagileru where the thickness of the ash ranges between a few meters, the thickness of the ash deposits at the sites investigated here measure less than a metre. Notably the ash deposits in the Middle Gundlakamma valley were found associated with different geomorphic units such as floodplain deposits, directly over the basal rock formations, shallow topographic depressions, river cliff sections etc. Further studies on these geomorphic units will be helpful in understanding the depositional histories of the ash within the river basin. Optically stimulated Luminescence dating of the sediments associated with YTT deposits in Son valley has indicated re-deposition of the ash and therefore cannot be used as a reliable chronological marker. In this context, more chronometric dates are needed to confirm about the depositional nature of the YTT deposits in South Asia. The artefacts collected from the surfaces at the three sites discussed earlier reveal close similarities with Jwalapuram localities 3 and 22, which are Middle Palaeolithic in nature, even though the raw material varies between the sites. The artefacts seem to be in secondary contexts as small sized gravels were associated with the artefacts. Few animal fossil remains were also found in association with artefacts from Ainavolu (Figure 8).

Further investigations of these sites combined with chronometric dating and sedimentological analyses will throw more insights into the nature of YTT deposits and the associated Middle Palaeolithic assemblages.

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