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On the depositional environment of Lower Palaeolithic horizons at the prehistoric site of Attirampakkam, Tamil Nadu

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We present here the depositional environment and discovery of a 7-m-thick argillaceous sedimentary deposit containing Lower Palaeolithic (Acheulian) artefacts at the recently excavated prehistoric site of Attirampakkam, Tamil Nadu. This unique setting occurs at the base of a comprehensive stratigraphic sequence which includes Middle and Upper Palaeolithic and Mesolithic artefacts, and therefore spans a long record of the Pleistocene. Based on micropalaeontological, magnetostratigraphic, geochemical, sedimentological, geomorphological and archaeological evidence, the Argillaceous Formation, when restored within its palaeohydrological context, possibly corresponds to a fluvial backwater of the Kortallayar river. This palaeoenvironment was an attractive resource base for Acheulian hominins, within a dynamic meandering floodplain system, and where the thickness and nature of the deposit has no exact equivalent in the Acheulian record in India.

Keywords: Acheulian, palaeolithic, homonin, prehistoric sites.

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ATTIRAMPAKKAM is located ca. 47 km inland from the East Coast (13°13′50″N and 79°53′20″E; 37.5 m asl) on the banks of the Attirampakkam gully, an ephemeral stream that joins the Kortallayar river < 1 km downstream from the site. Annual rainfall (105–125 cm) currently peaks between September and December, and rain rills dissect the site so that artefacts become exposed as they erode out of an area of 50,000 m^2. The regional topography comprises the NNE–SSW-trending Allikulli (Figure 1) and Satyavedu hills (200–380 m amsl) in the west. These are uplifted and well-preserved palaeodeltas of early Cretaceous age[1,2]. The cobble conglomerate they consist of was sourced by the quartzitic Cuddappah ranges to the west. The lower-lying areas of the piedmont are underlain by shaly marine rocks of the Avadi Formation. Being coeval and intertonguing with the conglomerate beds, these may represent the palaeodelta bottomset beds. The shales are capped by Tertiary laterite. Throughout the region, lateritic gravels (1.5–2.5 m thick) sourced by these outcrops contain Acheulian to Middle Palaeolithic artefacts. Stratigraphically younger ferricrete layers, which also represent eroded gravels sourced by the laterite, contain Middle Palaeolithic artefacts, and microliths occur on the surface[3]. At Attirampakkam, however, Acheulian tools also occur in abundance within an Argillaceous Formation previously assigned to the Avadi Formation.

Attirampakkam has been studied intermittently for over a century[4–6], culminating in recent archaeological excavations under the direction of S. Pappu. Excavations over an area of 220 m^2 led to the identification of six sedimentary units. The stratigraphy[7–9] from the base comprises a laminated argillaceous bed (layer 6: Figure 2), disconformably overlain by a thick sequence of ferruginous gravels (layer 5) capped by argillaceous colluvium (layers 3, 4). These are overlain by finer ferruginous gravels (layer 2) and argillaceous colluvium (layer 1) (see figure 5). Acheulian industries were noted in layers 6 and 5, with Industries possibly transitional to the Middle Palaeolithic in layers 3 and 4 (Figures 3 and 4). Middle Palaeolithic assemblages were noted in layer 2, with a possible early Upper Palaeolithic component. The most significant discovery was the unexpected occurrence of Acheulian tools in layer 6, previously classified as bedrock belonging to the Avadi or Sriperumbudur shale series[2,5,6]. The principal issue to be determined was therefore whether tools were *in situ* or had sunk downprofile into the Cretaceous shales[6]. The stratigraphy being crucial to understanding the archaeological chronology of site occupation, this question was addressed using micropalaeontological, geochemical,

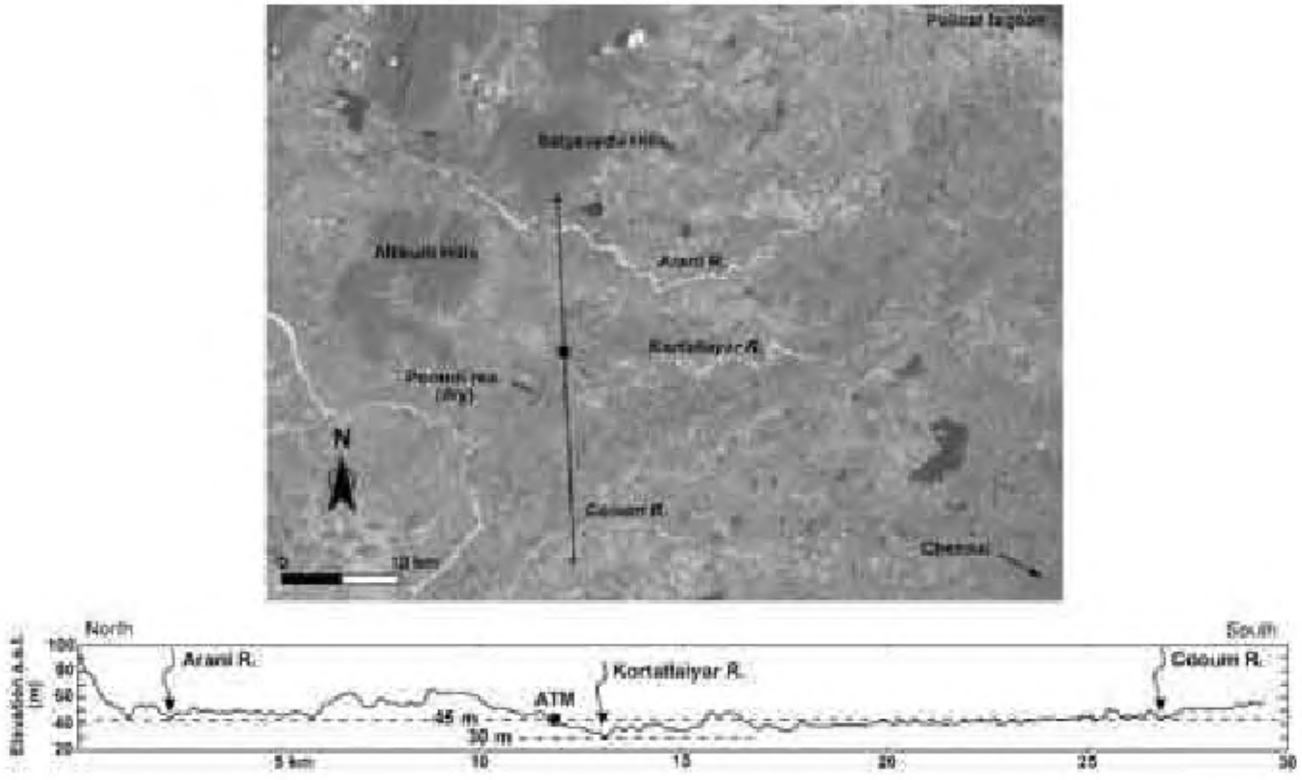

Figure 1. The Kortallayar river basin, showing location of Attirampakkam. Topographic section below shows topographic position with respect to incised drainage in the piedmont (Source: Landsat TM image draped over SRTM elevation model).

Figure 2. General view of the section showing laminated clays of layer 6, trench T8, East wall.

magnetostratigraphic and archaeological evidence[7–9] (Figure 5).

In an attempt at inferring a magnetostratigraphic age for layer 6, and thus for the tools embedded within them, 16 oriented samples were collected in test trench T3 at 50 cm intervals from the surface to –7 m. No Pleistocene magnetic reversals could be identified due to insufficiently clear patterns in magnetic declination, but the consistently low inclination values exclude a Cretaceous age for layer 6. No differences in magnetic directions in layers 1–6 further suggest that the entire stratigraphy is possibly of Pleistocene age[7].

Micropalaeontology is an important tool in palaeoecology and palaeoenvironmental reconstructions[10]. Foraminifera, which represent one of the most environmentally sensitive groups of marine microfossils (size ranges of 53–212 μm are commonly used for faunal analysis), have been studied extensively[11,12]. They have also been used to discuss problems related to stratigraphic leakages and reworking of sediments[13]. For the analysis discussed here, the samples were collected at close intervals from layer 6 in trench T8, Attirampakkam, and were soaked and washed using H_2O_2. Faunal slides were prepared under a Nikon Stereo Zoom binocular microscope (zoom: × 10). All the foraminiferal specimens were picked from the > 212 μm sediment fraction and compared with taxa already known from the Avadi, Raghavapuram and Vemavaram shales of this region. Foraminifera recovered were exclusively of a

Figure 3. General view of excavated area (trenches GT-02, T8): layer 6.

Figure 4. Close-up of Acheulian handaxe within layer 6.

creamy to dull white arenaceous variety, and in an excellent state of preservation. This rules out transportation over long distances. Faunal assemblages are represented by only three genera, viz. *Ammobaculites*, *Bathysiphon* and *Haplophragmoides* (Figure 6 *a–c*), all common throughout the section and identical to marine assemblages from both the Neocomian to Aptian Avadi Formation[2], and the Lower Cretaceous fauna of the Raghavpuram shale[14]. Almost all the genera present regionally in the shale bedrock therefore also occur in layer 6. The age of the South Asian Lower Palaeolithic is generally bracketed between ca. 150 and > 350 ka[15], with a few dates in excess of this. Given that the palaeomagnetic data rule out a Cretaceous age for layer 6, there is little doubt that the source-rock of layer 6 is the local Avadi shale, and that layer 6 is a Pleistocene deposit. Reconstructions of Pleistocene palaeoshoreline levels in the region based on simulations using a Digital Elevation Model[16] have shown that the shoreline would

have needed to be ≥ + 35 m above current sea level to make Attirampakkam a coastal site. Not only is such a value unrealistic, but there is also no sedimentological or geomorphic fingerprint of a strand line in the area. If remains of a strand line existed at Attirampakkam, significant vertical movements of the crust should have occurred since the site was occupied by hominins in order to account for its current elevation. Tectonically stable continental regions will record magnitudes of late Pleistocene vertical uplift exceeding 20 m if they have been deglaciated – but this is clearly not the case in South India. The occurrence of Lower Cretaceous foraminifera in a good state of preservation implies, instead, transport over limited distances with minimum damage. The archaeological site of Attirampakkam being established < 1 km from a large meander in the Kortallayar river, we suggest that layer 6 is a Pleistocene floodplain deposit consisting of Avadi shale, sourced as suspended matter by an outcrop situated 1–2 km upstream beneath the currently flooded Poondi reservoir area, and inevitably containing some of its original foraminifers. Furthermore, layer 6 aggraded during site occupation and therefore corresponds to Acheulian horizons. In terms of the artefacts being *in situ* rather than having sunk into the sediment, this interpretation is supported by the disproportionate scarcity of vertical conduits in the sediment, the absence of clasts other than Acheulian artefacts within it, the occurrence of conjoinable fragments, and the fact that the deposit is texturally dominated by fine silt (Figure 5). The plasticity of this silty material is not as well suited to gravity-related sinking of foreign objects as would be either wet sand, or clay susceptible to shrinking and swelling. The negligible content in organic matter (< 0.2%) of layer 6 further suggests episodic flooding rather than a perennial swamp with high biological productivity. Sedimentation was never interrupted for sufficiently long periods of time for palaeosols to develop in the profile, although subhorizontal sediment lamination does suggest discrete cycles of sediment influx. We thus infer that Acheulian tools were periodically used at the site and left lying until buried by overwash. This would have been generated by laminar flow overtopping the palaeo-Kortallayar river banks at a time when the river bed had not yet incised its floodplain deposits by 10–15 m. The critical shear stress of palaeoflow depths was insufficient to entrain or disturb the discarded artefacts. As episodic sedimentation proceeded, new tools continued to be discarded onto the fresh depositional surfaces. The observed stratigraphy was thus constructed iteratively through time in this way[7]. The laminations seem typical of sediment settled by low-energy flow in crevasse splays, floodplain ponds or abandoned channels. Few stratified Acheulian sites have been excavated on the scale attempted at Attirampakkam. Multidisciplinary studies in progress from excavated data will throw more light on little known aspects of the Indian Lower Palaeolithic.

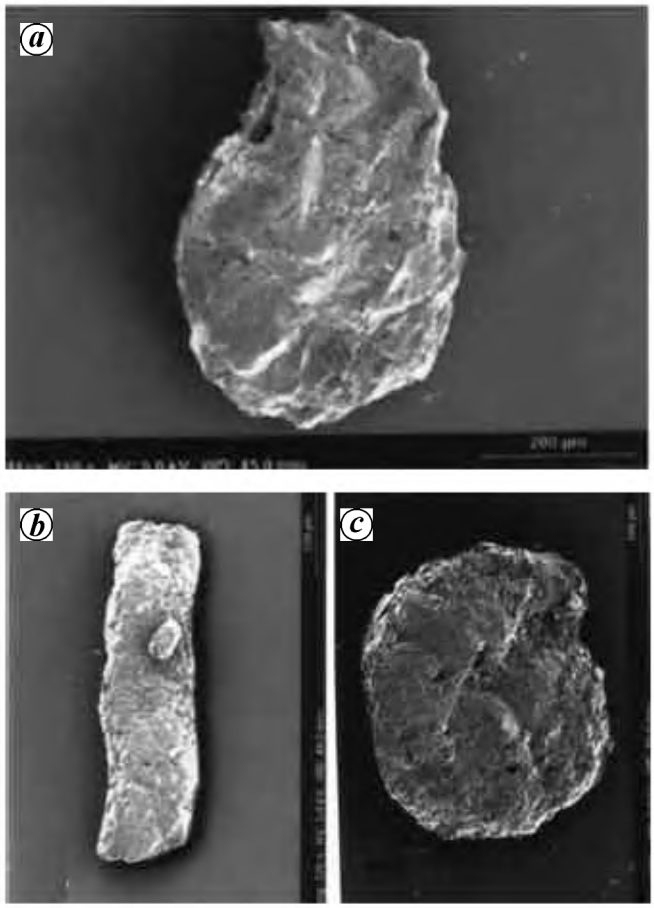

Figure 6 *a–c*. Foraminifera: ***a***, *Ammobaculites* sp.; ***b***, *Bathysiphon* sp., ***c***, *Haplophragmoides* sp.

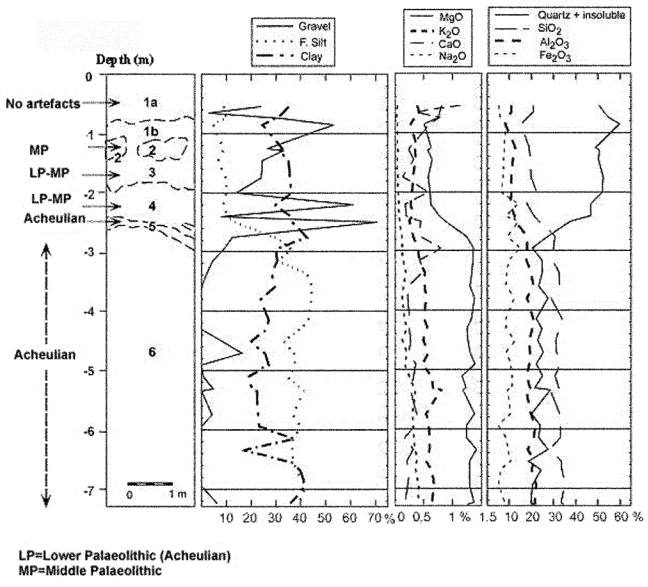

Figure 5. Stratigraphy and geochemistry of the prehistoric site (Test-pit T3).

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