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Palaeolithic Occurrences in the Malnad Borderlands, Karnataka: Implications for the Palaeolithic Archaeology of the Western Dharwar Craton, South India

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The paper presents a preliminary analysis of Acheulian to Middle Palaeolithic artefacts documented from eight localities in the Bhadra Reservoir region, contiguous with the Shankaraghatta Kuvempu University campus, Shivamogga District, southwestern Karnataka. The cluster of sites lies in the Upper Tunga and Bhadra Doab (Fig. 1), which has been aptly described by Seshadri (1955, 1956) as ‘Malnad Borderlands’. This is a transition region between the Western Ghats Escarpment and inland semi arid plains (Mysore Plateau) of the larger Dharwar Craton (Fig. 2) characterised by distinctive ecological and climatic zones. The Palaeolithic evidence from this region establishes the early expansion of hominin populations into the transitional biome, between the Western Ghats Escarpment montane moist evergreen forest to the west and semi arid grasslands to the east. The Acheulian phase in the Indian subcontinent has a vast time-span ranging from 1.5 Ma to 140 ka (Pappu *et al.* 2011; Korisettar 2017; Haslam *et al.* 2017; Clarkson *et al.* 2020). Therefore, locating datable stratified contexts is our priority. Many such localities appear to lay submerged in the back waters of the reservoir. The Holocene archaeological record reveals that all sorts of terrestrial biomes were colonised by human populations and that montane and submontane biomes were inhospitable/isolated during the Pleistocene. However, rethinking on the timing of human expansion into these biomes is necessitated by recent discoveries of evidence for Pleistocene adaptations to montane biomes.

In order to delineate the patterns of distribution of

Palaeolithic settlements in the region of Dharwar Craton, the inland sites in particular, away from the channelled water courses, it became necessary for us to lay greater emphasis on the geological, tectonic, geomorphic and climatic aspects of the region and lesser emphasis on the lithic assemblage studies. Inevitably the essay has obtained relevant information from published sources on these aspects to present an environmental background to the study of Palaeolithic archaeology in study area. We realise that prehistory and geology are inseparable disciplines. Typo-technological and morphometric analyses of the assemblage are under preparation.

That Robert Bruce Foote did not leave any stone unturned is amply attested by the fact that he was the first to identify the presence of Early Palaeolithic sites in the interior region of Mysore Plateau and that such sites also occur in the Malnad region (hilly country), away from channelled water courses, as early as 1896, at Lingadahalli (Lat. 13.60° N and Long. 75.83° E) in the Upper Bhadra Basin (Shivamogga/Chikkamagaluru district border) (Foote 1916). A few years earlier similar context findspots were reported by him while he was mapping schist belts (now greenstone belts) in the Chitradurga District and in the Proterozoic Bhima Basin in the present Kalyana Karnataka region (Foote 1876). Recent reinvestigations in the Banasandra Hills of Chitradurga Greenstone Belt, around Kibbanahalli (Srinivas 2014a and b, 2017a, b and c) in Tumakuru District, has compelled us to report similar cluster of sites at Shankaraghatta along the foothills of

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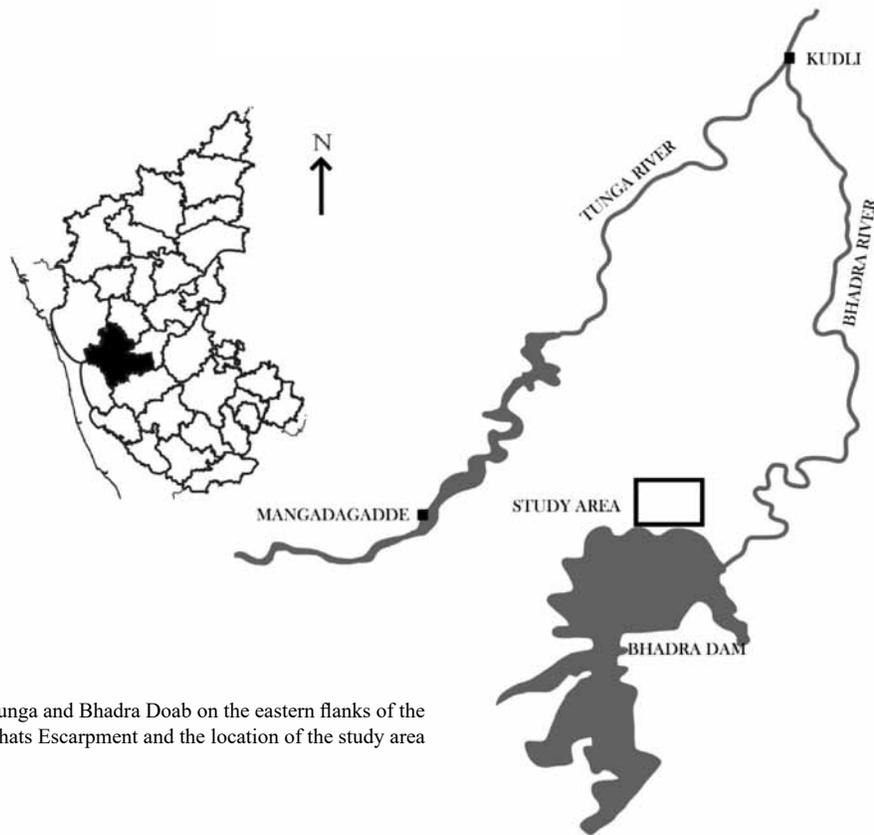


Fig. 1: The Tunga and Bhadra Doab on the eastern flanks of the Western Ghats Escarpment and the location of the study area

Shimoga Greenstone Belt and examine the relationship between the greenstone belts (Archaean volcano sedimentary geo-tectonic provinces) and Palaeolithic occurrences and attempt: (a) an explanation for why the sites are situated where they are, (b) examine the spatial variation in the number and density of sites between Proterozoic Purana Basins of metamorphosed sedimentary rocks and Archaean supracrustal schist belts of volcano sedimentary rocks, and (c) test the validity of the Basin model (Korisettar 2007).

While the Purana Basins contain quartzites, sandstones, limestones, and a variety of crypto-crystalline silica minerals the supracrustal schist belts contain metabasalts, quartz conglomerates, quartzite, phyllite, fuchsite quartzite, minor occurrence of cryptocrystalline silica minerals such as chert, chalcedony, agate, etc., though abundant in precious metals, gemstones and metal ores. The schist belts are a great repository of copper, iron ore and gold. Modern society's economy and polity is controlled by these formations. The well known goldfields are at Kolar (now exhausted), Hutti schist

belts (most productive) and Mangalur (Yadgir District). The vast majority of reported Palaeolithic sites from these belts, by various scholars, during the last 140 years, are surface occurrences associated with proximal outcrops of Archaean quartzites, interstratified in the greenstone belts of Dharwar Supergroup of supracrustals across the Western Dharwar Craton (Fig. 3). The most common source of quartzite is the Bababudan Group and occasionally the Older Peninsular Gneissic Complex. The younger Chitradurga Group also comprises the quartzite, however, association of Palaeolithic artefacts is as yet sporadic. It is interesting to note that all the known Palaeolithic occurrences are on pediment surfaces in the transitional zone between greenstone belts and the surrounding Archaean granite-gneiss formations.

The first report of the discovery of the sites discussed in this paper was presented at WAC-3 (Hegde and Korisettar 1994). Although material from four sites was presented, it revealed the potential of the area for further explorations and scope for reconstructing man-land relationships. Further surveys led to the discovery of four more sites

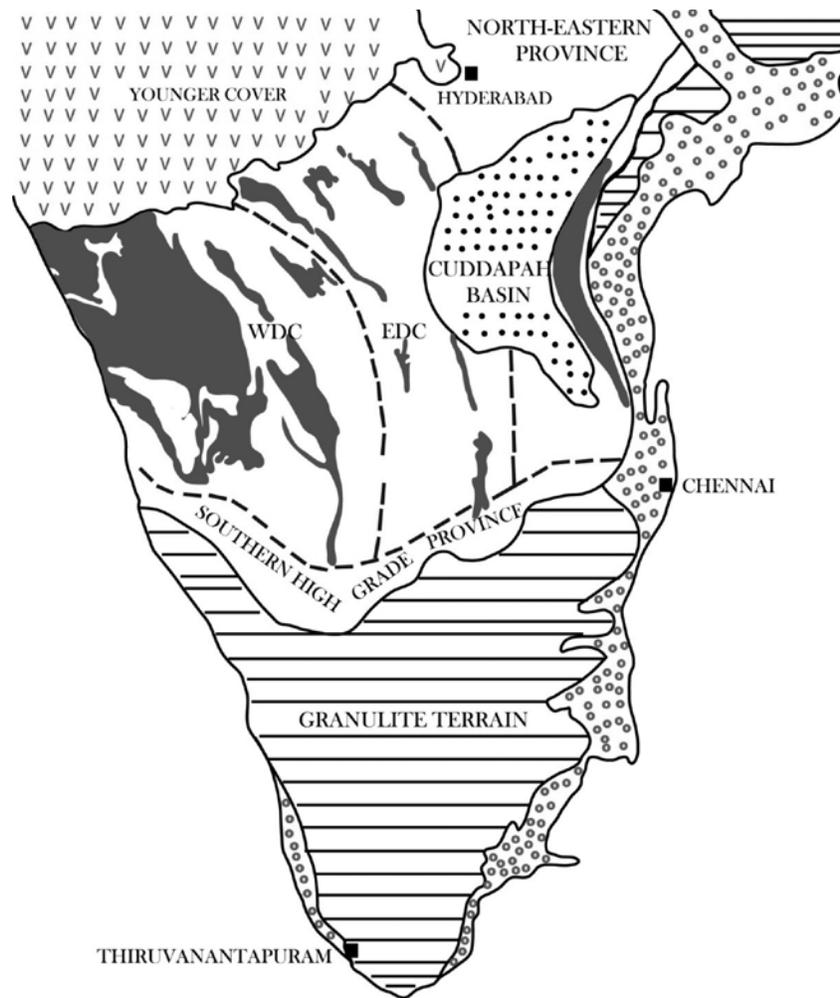


Fig. 2: The Dharwar Craton and its tectonic features including the supracrustal greenstone belts, Mid- Indian Peninsula. Base map from Radhakrishna and Ramakrishnan (1990)

(Hegde 1995, 1997). Rajaram Hegde continued to survey this area till recently and a few localities were identified. We have grouped all the sites under Shankaraghatta Palaeolithic Complex. Artefacts from all these sites are presently stored in the museum of the Department of History and Archaeology, Kuvempu University at Shankaraghatta, Shivamogga District, Karnataka.

The paper is divided into three sections. Section I deals with general features of the Dharwar Craton and Western Dharwar Craton in particular and their geological framework. Section II deals with the study area, the nature and distribution of Palaeolithic sites and general characteristics of the assemblage. Section III, deals with discussion and concluding remarks.

Section I: Dharwar Craton: General Features

The Dharwar Craton (DC) is a mega tectonic landform on the Indian Peninsular shield. The DC lies between Latitudes 11°–19° N and Longitude 72°45′–80° E covers an area of 400,000 sq. km. The DC lies in the middle of the Indian Peninsula. In terms of general geography, the craton occupies Mid- and Southern Deccan Plateau. The DC is bounded by 68-60 Ma Continental Flood Basalts (CFB) to the north and northeast (including Maharashtra and western and southwestern Telangana), a narrow belt of Phanerozoic Gondwana Group to the northeast (the Godavari Rift), Eastern Ghats Mobile Belt (1.6 Ma) to the east and Granulitic-Charnokitic Province to the south and the Arabian Sea to the west. The Palghat-Cauveri

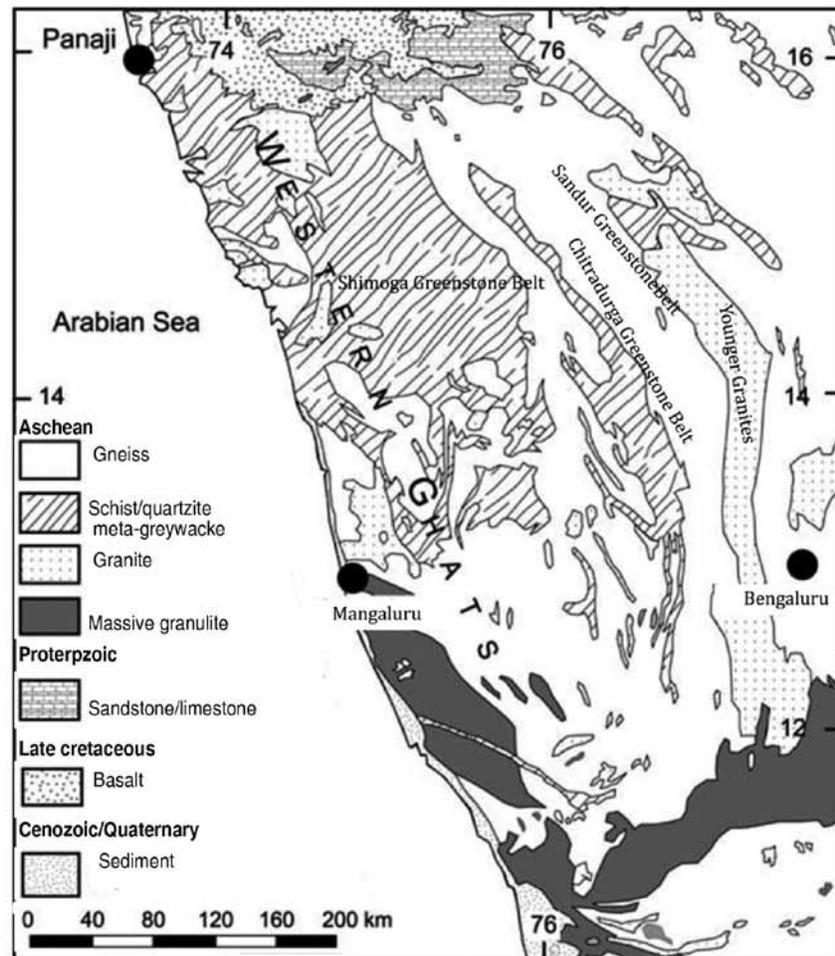


Fig. 3: The Western Dharwar Craton showing the Shimoga and Chitradurga Greenstone Belts and planation surfaces on Peninsular Gneissic Complex and lineament controlled drainage pattern in the upper reaches. Base map from Radhakrishna and Ramakrishnan (1990)

Shear Zone (the Pandyan Rift, 0.75 – 0.55 Ma) separates the DC from the rest of Indian Peninsula, i.e. Tamil Nadu and Kerala (Fig. 2).

The present physiographic manifestation of the DC is governed by lithology, tectonic history, climate and denudation. Prominent topographic features include coastal lowlands, Western and Eastern Ghats, and the inland plateau. Enclaves of a series of sub-parallel supracrustal greenstone belts and Older and Younger Peninsular Gneissic Complexes constitute the major geological provinces. Although granite greenstone landforms are considered a low relief landform feature some of the greenstone belts (e.g. Chitradurga and Shimoga belts) have high relief. The Hutti, Gurmakal and

Mangaluru Greenstone Belts, traversing the Raichur and Shorapur Doabs are relief-less landforms (Tenginkai and Ugarkar 1987; Sangurmath 2015). The DC is a tectonically stable landmass since its formation between 3 and 2.5 Ga. Following the stabilisation of the craton, during Mid- to Late Proterozoic (1.8 Ga - 560 Ma) intracratonic sedimentation took place in the Cuddapah (45,000 sq. km), Bhima (8000 sq. km) and Kaladgi Basins (15,000 sq. km). The Pranhita-Godavari Gondwana Basin is dated to around 290–208 Ma. In the northern and eastern parts the DC is covered by Mid- to Late Proterozoic basins, such as Kaladgi, Bhima and Cuddapah basins, also referred to as Purana Basins by Holland in 1907 (Radhakrishna and Ramakrishnan 1990). These basins have been identified as core areas or refugia of Stone Age communities and later

settlements in the subcontinent (Korisettar 2007). These have revealed evidence for continuity and intensity of human occupation ever since their first colonisation in the Pleistocene. The mosaic landforms on the DC are a product of prolonged denudation under the influence of fluctuating long and short term climatic cycles, especially during the Neogene and Quaternary period.

Western Dharwar Craton and Palaeolithic Occurrences along the Greenstone Belts

The DC is broadly divided into Eastern Dharwar Craton (EDC) and Western Dharwar Craton (WDC). The 400km long meridional Younger Granite (2.5 Ga) range of hills together with Chitradurga Shear Zone marks the dividing line (Figs. 2 and 3). The Western Dharwar Craton (WDC) consists of three generations of volcano-sedimentary greenstone-granite sequences: (a) the 3.1–3.3 Ga Sargur Group, (b) the 2.6–2.9 Ga Dharwar Supergroup and (c) the 2.5–2.6 Ga calc-alkaline to high potassic granitoids (Tandon *et al.* 2014). In the WDC, the schist belts of Sargur Group are deformed with Peninsular Gneisses and are unconformably overlain by the younger moderately deformed schist belts of Dharwar Supergroup. The Dharwar Supergroup unconformably overlies Peninsular Gneiss and Sargur Group of rocks, and is divided into lower Bababudhan Group and upper Chitradurga Group (Swami Nath and Ramakrishnan 1981; Bongale and Kshirsagar 2015). Denudational processes associated with these formations have given rise to the geomorphic diversity, including Block Mountains, plateaus, cuestas, escarpments and valleys. The granite-gneiss inselbergs, bornhardts and koppies are surrounded by mantled or bare pediments, dominate many areas underlain by granite and gneisses.

Western Dharwar Craton: Drainage Network and Denudation

For the purpose of this study we would like to focus our attention on the southern part of the Western Dharwar Craton, the Mysore Plateau and Malnad Borderlands in particular. This plateau is a distinctive elevated peneplain formed on charnokite, which is resistant to weathering and erosion in relation to northern gneissic plains. This is

clearly attested by the northeasterly direction of flow of the Tungabhadra River, which also marks the boundary between Mid- Deccan and Southern Deccan peneplains. The Mysore Plateau merges with the Nilgiri Hills in the south and precipitation regimes vary between 80 inches in the south to 28 inches in the north. The plateau is largely a rain shadow semi arid region, lying to the east of Malnad Borderlands.

The Middle Krishna and Upper Kaveri river basins drain the region. The trunk streams are allochthonous with their source in the Western Ghats Escarpment. The dendritic pattern of stream network is maintained by tributary streams arising from east-west running secondary divides or inter-basinal interfluves across the craton and by the basement structure. All these are broad and shallow bedrock rivers with low gradients. In the middle reaches the trunk streams maintain a braided channel pattern. They are presently in an incision phase and water flow is confined to the channel network. In many river valleys the alluvial sediments are associated with Youngest Toba Tuff (YTT) of 74 ka indicating their Late Quaternary age. Early Palaeolithic assemblages associated with relict geomorphic units are exposed by the incision phase. Despite scientific assertion that biotite composition is unique to each of the volcanic eruptions and that it has been demonstrated for OTT, MTT and YTT some scholars adhere to the argument that geochemical composition is not true indicator of individual eruptive events and continue to subscribe to anomalous dates (Westgate and Pearce 2017; Korisettar 2021).

The present physiography and topography of the WDC are the result of prolonged denudational (fluvial erosion) processes since the Late Archaean times. Quaternary depositional features are exposed along the trunk streams of the drainage basins. The topography is made up of a mosaic of planation surfaces and hill ranges. Major parts of the Archaean plains were carved by sheetwash processes. The planation surfaces are traversed by a number of sub-parallel supracrustal belts. They are rich in rocks, minerals and metals of economic importance to man, through the ages, not seen in any other part of the subcontinent. High ground water table spring activity in the granite-gneiss hills and in the geological junction between supracrustal

belts and intruding granitoids facilitated formation of perennial water bodies, associated with pediment troughs, in the inland plains of the craton. Though the inland part of the craton lies in the rain shadow of the WGE and experiences semi arid monsoon climate it was well watered during the Pleistocene and was subject to low to very low demographic pressure until the onset of Holocene. Subsequent population explosion and intensive exploitation of natural resources have modified the relict landform features.

The regional topography of the DC, according to Gunnell (2014: 201) “essentially alternates between (i) N–S parallel ribs of rugged and untrafficable porphyritic granite, which is fragmented by joint patterns into boulder-strewn monoliths and mostly covered by patchy dry deciduous woodland and scrub; and (ii) by more deeply weathered TTG corridors that benefit from groundwater recharge provided by runoff from the neighbouring granite hills. Human settlements and ingenious indigenous forms of water harvesting for agriculture known as tank systems... cluster in those areas. Landform patterns among the porphyritic, K-rich granites remain characteristically dominated by joint density. In conjunction with weathering-limited bedrock alteration controlled by climate, the stripping of weathering fronts is spatially controlled by contrasting depths of incision by drainage systems encroaching headward into the peninsula”. Human exploitation of granite, gneiss, copper, iron and gold is largely seen in the archaeological record from the Neolithic period onwards, with increasing intensity during historical and modern times. On the present showing the Archaean granite-greenstone plateau of the WDC is considered a water deficit region (Sudheer *et al.* 2019). Archaeological record of the Pleistocene from this region also attests to this situation that this was an area of relative isolation. The surface runoff was limited to monsoon months and fluvial processes were characterised by perimetral flow of water in the region of supracrustal belts and tor-inselberg landscapes. Despite Quaternary long and short term climate changes semi arid conditions appeared to have prevailed in the region. However, inland regions reveal the presence of surface water bodies in the form of pools and ponds, evidenced by black clay rich soils on the pediment lows.

The ground water resources are also uneven across the WDC. Aquifers are restricted to weathering zones and

fractures, especially in the regions of gneisses intruded by younger granites and pegmatites. However, the yield is low. In the Purana Basins the aquifer yield is relatively higher. This situation would have been very different during the Pleistocene and not surprisingly different sectors of the WDC were well watered, with relative variation between granite-greenstone and Purana Basins (Sudheer *et al.* 2019). Human occupation of these regions, as revealed by the archaeological record, was largely governed by the ground water resources on the senile rocky terrain, especially by the springs emanating in the undulating topography, faults associated with geological junctions, fissures in rocks (secondary porosity), primary porosity of rocks and accompanying biomass of plant and animal foods. As noted earlier enclaves of supracrustal belts are rich in gold, copper and iron ore on the one hand and a variety of gem stones and cryptocrystalline silica minerals on the other.

Western Dharwar Craton: Palaeolithic Archaeology on the Mysore Plateau (Bangalore Plain)

The modern state of Karnataka occupies the whole of WDC and western parts of EDC. Geographically the region is referred to as Karnataka Plateau, divisible into Northern Karnataka and Southern Karnataka. Longitudinal subdivision of Karnataka Plateau includes the western Kanara Coast, the Sahyadri range (Western Ghats Escarpment and Malnad) and the inland Maidan (Plain open country). The Maidan is further divided into Northern and Southern Maidan. The Southern Maidan is coterminous with the Mysore Plateau, lying between Latitude 15° 2' and 11° 36' North and Longitude 74° 40' and 78° 36' East. The Tungabhadra and Upper Kaveri drainage basins constitute the lifeline of the region. The eastern plains of the region, north of the river Kaveri are drained by the Upper Palar (Paleru) and Pennar (Penneru) rivers and the combined Tungabhadra River. Older Peninsular Gneiss, older and younger supracrustal greenstone formations make up the geology of the WDC and are repositories of lithic raw material resources for ancient inhabitants. Quartzite the chief raw material during the Lower and Middle Palaeolithic times occurs interbedded in the greenstone belts.

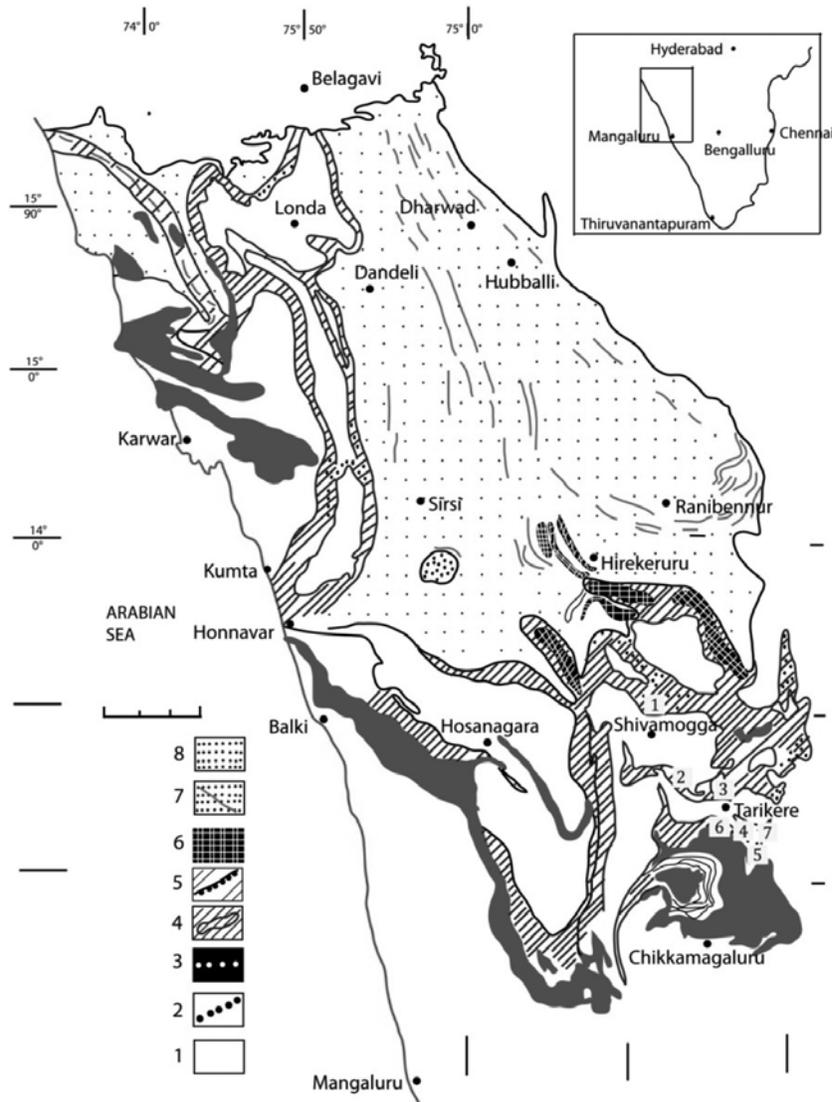


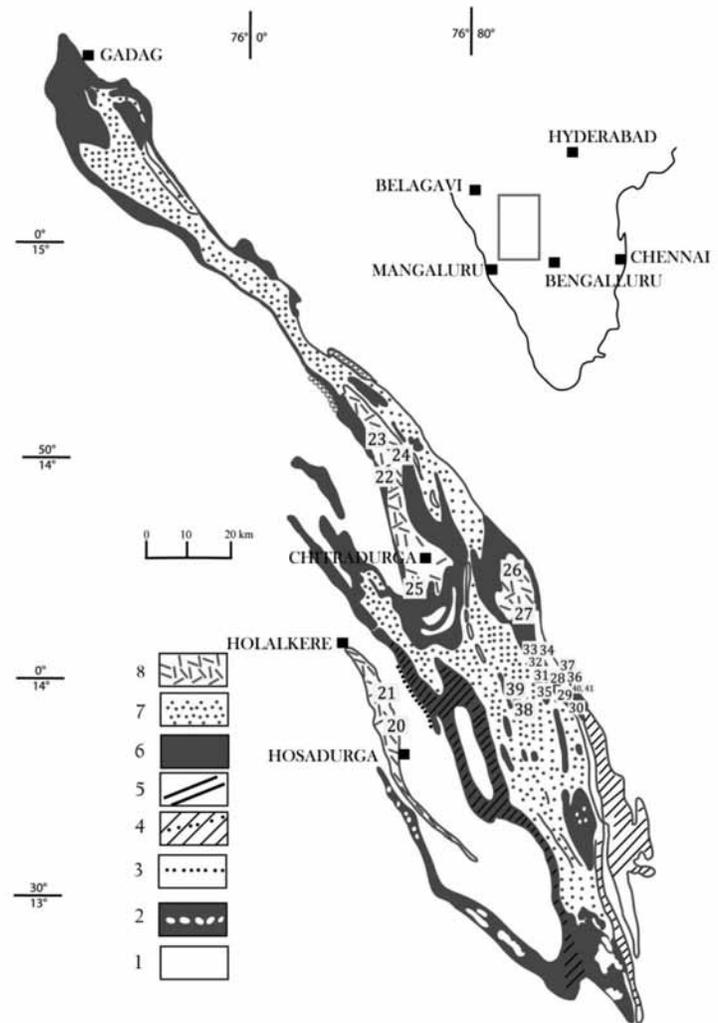
Fig. 4. Shimoga Greenstone Belt. Legends: 1. Gneiss, 2. Conglomerate, 3. Mafic flows with interbedded quartzite, 4. Phyllites and banded iron formations, 5. Iron manganese marker horizon, 6. Felsic volcanics, 7. Greywacke with minor bands of ferruginous chert, 8. Granite (intrusive). The map presents the Palaeolithic find spots along the eastern margins of the Shimoga Greenstone Belt. Numbers on the map indicate sites listed in the Table 1. Base map from Radhakrishna and Ramakrishnan (1990)

Both EDC and WDC have preserved evidence for Palaeolithic human adaptations. However, the density and frequency of sites varies between the two regions. The EDC presents relatively much higher density and frequency of sites relative to the WDC. It should be noted that despite the presence of a series of greenstone belts across the EDC, unlike the WDC belts, the Palaeolithic sites are not as yet known. The density of prehistoric settlements in the Purana Basins is higher. This variation

is attributed to the presence and absence of habitable environments, including lithic raw material resources, perennial water bodies, plant and animal food resources and sustainable climate and environment throughout the Quaternary.

In the WDC a series of greenstone belts, such as Shimoga Greenstone Belt, Chitradurga Greenstone Belt and Sandur Greenstone Belt (western margin

Fig. 5: Chitradurga Greenstone Belt. Legends: 1. Gneiss, 2. Conglomerate, 3. Quartzite, 4. Phyllite with iron manganese marker horizons, 5. Banded iron formation, 6. Mafic flows, 7. Greywacke, 8. Intrusive granite. The map presents the Palaeolithic find spots along the eastern margins of the Chitradurga Greenstone Belt. Numbers on the map indicate sites listed in the Table 1. Base map from Radhakrishna and Ramakrishnan (1990)



SANDUR GREENSTONE BELT

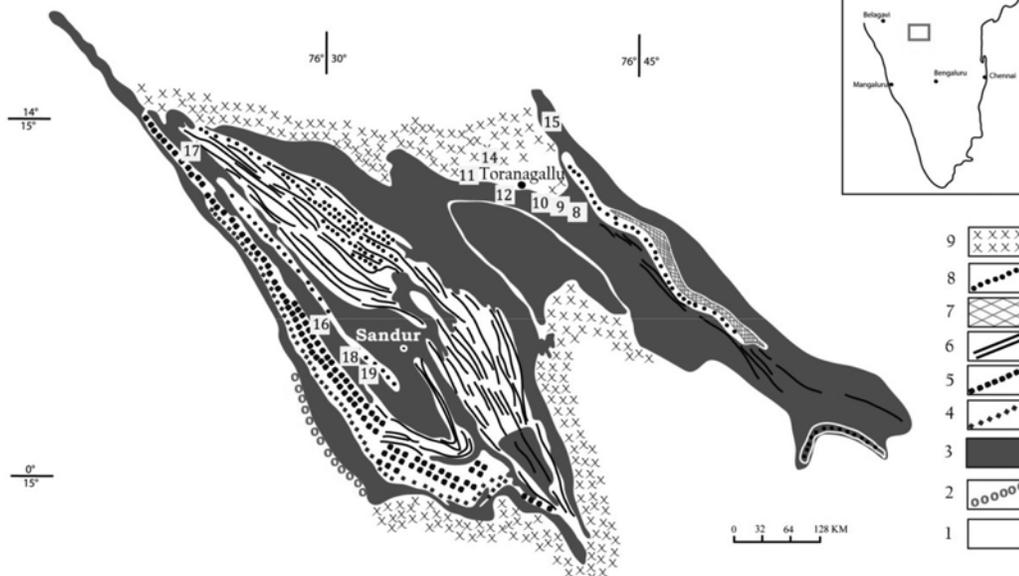


Fig. 6: Sandur Greenstone Belt. Legends: 1. Gneiss, 2. Conglomerate, 3. Mafic flows, 4. Quartzite, 5. Manganiferous horizon, 6. Banded iron formations, 7. Felsic volcanics, 8. Greywackes, 9. Granite (intrusive). The map presents the Palaeolithic find spots along the eastern margins of the Sandur Greenstone Belt. Numbers on the map indicate sites listed in the Table 1. Base map from Radhakrishna and Ramakrishnan (1990)

of EDC), have preserved evidence for Palaeolithic human presence, though revealing spatial variation in the number and density of Palaeolithic sites. The lithic resources from Bababudan and Chitradurga Groups of the Dharwar Supergroup were utilised for making tools and implements. Their occurrence along these belts has controlled hominin ranging habits between the Purana Basins in the northern WDC and Bababudan formations in the Malnad Borderlands. As mentioned above this paper deals with unpublished Acheulian to Middle Palaeolithic assemblages from the Malnad Borderlands that forms part of the western uplands of the Mysore Plateau also referred to as Bangalore penneplain, lying above the Madras penneplain (Budell 1957, 1965). In the following a brief history of research is given as a background to the study undertaken by us.

Palaeolithic Investigations

As elsewhere on the Indian Peninsula, Robert Bruce Foote laid the foundations of Palaeolithic archaeology in this region (Foote 1916). He identified the occurrence of Lower Palaeolithic artefacts on the leeward of the WGE as early as 1896 (Table 1). As he expected they were associated with quartzite outcrops in the main Bababudan range. He found the occurrence of fifteen artefacts at Lingadahalli and one or two artefacts at Nidaghatta, Jodikatte, Sakrepatna, Kadurand Nyamati (in the Malnad Borderlands). Foote had found direct relationship with the occurrence of Lower Palaeolithic artefacts with the quartzite outcrops of the Bababudan formations. He substantiated this observation by reporting more such occurrences in the inland semi-arid region of Chitradurga Schist Belt (now designated Chitradurga Greenstone Belt). Sites such as Talya, Jyankal, etc. were documented from this belt. These artefacts are preserved in the Madras Government Museum, Chennai (Foote 1916). Around the same time Foote documented a large number of Palaeolithic occurrences in the Proterozoic Kaladgi and Bhima Basins, northwest of the Chitradurga Greenstone Belt (Foote 1876). Obviously Foote's identifications set a threshold for future investigations. The density of artefact assemblages and frequency of sites occurring in the greenstone belts and Proterozoic basins were not comparable, but for observable typo-

technological similarity. This differential geographical distribution also led to disparity of survey intensity and investigations into the Palaeolithic succession of cultures (Seshadri 1956; Joshi 1955; Pappu 1974; Sankalia 1974; Pappu and Deo 1994; Paddayya 1982; Korisettar 1979). Sankalia (1974) provides comprehensive information on the distribution of Palaeolithic sites and includes excellent maps. While quartzite was the most common lithic raw material its geological context varied between Archaean and Proterozoic sources. The Hunsgi Valley assemblages are an exception, the Palaeolithic artefacts were made from siliceous limestone of the Bhima series (Paddayya 1982).

Geologists' contribution to survey, documentation and systematic study of Palaeolithic occurrences in the southern Archaean terrain continued to be made in the early part of the twentieth century. This was also a follow up of Robert Bruce Foote's work on the Archaean gold bearing schist belts of the former Mysore Principality. As founder Director of Mysore Geological Department under the patronage of Maharaja of Mysore, Foote in addition to reporting Palaeolithic occurrences had also documented the presence of Neolithic and Megalithic sites in the region (Foote 1916). Details are beyond the purview of this paper.

The 1920s witnessed revival of documentation of Palaeolithic occurrences in the region. Sampath Iyengar (1924, 1924-25, 1925), a geologist, reported the occurrence of Lower Palaeolithic artefacts along the Banasandra Hills in the present Tumakuru District. A large collection of artefacts collected from several localities in the area were subject to detailed typo-technological study. The assemblage comprised Lower and Middle Palaeolithic artefacts, including handaxes, cleavers, choppers and retouched flake tools. These artefacts that were kept in the museum of the Central College Department of Geology, Bengaluru, have now been lost. Efforts are going on to trace them. Bridget Allchin made the first typo-technological analysis of the collections made by Sampath Iyengar and his colleagues L. Rama Rao and Sripada Rao (Allchin 1952; Seshadri 1956). Sripada Rao (1930) published notes on stone tools from the Mysore region, including an artefact from Ranganathapura. A Palaeolithic tool he describes is said to be in the Geology Museum of Central College, Bengaluru. This was also the decade that

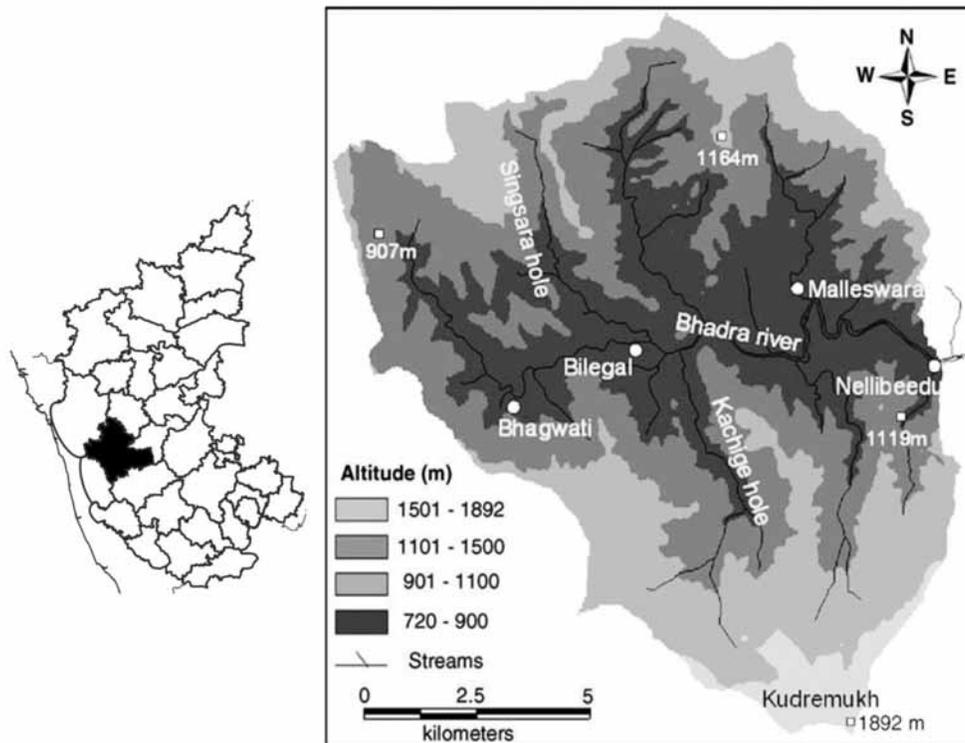


Fig. 7: Relief map of the Western Ghats Escarpment, the source region of the Bhadra and Tunga rivers, showing the plateau and the denuded valleys

witnessed the visits of L.A. Cammiade and M. Burkitt to sites earlier reported by Foote, including the Billa Surgam caves, in southeast India. Following this they proposed a four-fold succession of Pre-Neolithic cultures in India (Cammiade and Burkitt 1930). It appears that they were not aware of the discoveries at Kibbanahalli and related sites in the western parts of Mysore Plateau.

Bridget Allchin's study revealed 18 cleavers, 52 handaxes, 10 rostro-carinates, 34 discs, 43 chopper tools, 16 concave scrapers 3 small cores, 8 blade cores, 34 small flakes 2 digging tools, 3 fabricators and 20 borers and clearly indicated the Lower and Middle Palaeolithic nature of the assemblage. This study was carried out as a follow up of Sampat Iyengar (1924 and later works) and agreed with his identification of the site as a factory, located away from the channelled water courses. She placed on record that these artefacts resemble artefacts found by Foote at Attirampakkam (now a globally well known site) (Pappu *et al.* 2011). Some artefacts from Kibbanahalli are preserved in the British Museum and Victoria and Albert Museum in London. Korisetar was given access to these

collections for a cursory study in 1996. Allchin's work was followed by Seshadri's PhD dissertation, carried out at the Institute of Archaeology, UCL, London. Chapter II of *Stone Using Cultures of Mysore* deals with a comparative study of Kibbanahalli Palaeolithic assemblage with those well known sites in India and abroad, including those preserved in the Madras Government Museum, Chennai. Seshadri's (1956) work presents a comprehensive and scholarly study of the archaeology of Mysore Plateau, ranging from Early Palaeolithic to the Megalithic time periods.

But for the mention of a solitary biface made from quartz by Seshadri (1956) from Karadigudda all later explorations have resulted in the discovery of sporadic occurrence of Middle Palaeolithic artefacts (Shivarudrappa 1990; Shivarudrappa and Gururaja Rao 1985). Thanks to Akash Srinivas and Shivatarak (Srinivas 2014a and b, 2017a, b and c; Shivatarak 1996, 1999 and 2001). Their reinvestigations in the Kibbanahalli area clearly reveals the way Palaeolithic archaeology has developed in the twenty-first century: application

of modern field techniques and development of a new research design for inland sites.

Foote's early account of Palaeolithic assemblages in the Upper Bhadra catchment is of relevance to the present study undertaken by us, especially those from Lingadahalli. His discovery of Early Palaeolithic sites in 1881 at Lingadahalli, Nidaghatta, etc. are associated with Archaean quartzites belonging to the Bababudan Group of Shimoga-Goa Greenstone Belt (Fig. 4). His mention of sporadic occurrence of Palaeoliths along Chitradurga Greenstone Belt (Fig. 5) is also associated with Archaean quartzite of the Bababudan Group. Furthermore he also mentioned the occurrence of sporadic Palaeolithic artefacts made from quartzite (Bababudan Group) along the margins of the Sandur Greenstone Belt in the present Ballari and Vijayanagara districts (Fig. 6). Strictly speaking the Sandur Greenstone Belt lies immediately to the east of Younger Granite range between the WDC and EDC. Its proximity to the Chitradurga belt and occurrence of Palaeolithic artefacts made from quartzites, which are said to be part of Dharwar Supergroup and that it forms the northern borders of the Mysore Plateau are the reasons to include them in the present geographical scope of study. Foote had paid particular attention to quartzite formations in the schist belts of Western Dharwar Craton and was successful in locating Early Palaeolithic occurrences, though sporadic, e.g. Hampasagara on Gauri Nala in the Tungabhadra Valley (Vijayanagara District).

These areas were not subject to intensive survey from the perspective of Palaeolithic archaeology and the focus of survey was restricted to Proterozoic basins and, major and minor rivers valleys flowing through these basins. Poonacha's survey of Malnad region also did not focus on the Palaeolithic despite the presence of sites like Lingadahalli (Poonacha 1990: 109-110, 2011). Recently Sharathbabu carried out a detailed survey in the region by retracing the footsteps of Foote (Nagarajappa 2011; Nagarajappa and Sharathbabu 2012; Sharathbabu 2019). Rajaram Hegde's keen eyes on the colluvial gravel spreads on the campus of Kuvempu University did not fail to recognise the presence of Palaeolithic artefacts. This ushered in a systematic search around the campus and westwards on the northern shores of the Bhadra Reservoir.

During times of lowered water level, a cluster of sites came to be identified and gradually other coauthors also joined in the study. Details of our study are given in the following section.

Section II: The Study Area and Sites

The study area lies in the Upper Tunga and Bhadra Doab on the eastern fringes of the Sahyadri range (Western Ghats Escarpment) between Lat.13°43' N; Long 75°38' E. Both the rivers are autochthonous and flow through the descending landscape between 1800- 700 AMSL, whereas the Malnad Borderlands varies from 720 and 640 m AMSL (Fig. 7). These two rivers meet on the plains of Malnad Borderlands and flow in a northeasterly direction as Tungabhadra, and form the northern boundary of Mysore Plateau. The major landmark in the area is the Bhadra Reservoir built in the year 1965. Consequently the relict landscapes on which the artefacts have been found largely remain submerged. Both the rivers are consequent streams and are effluent in nature. Low order streams are adventitious and the general drainage pattern is dendritic. After the confluence the river attains the fourth order. The streams are fed by Indian Summer Monsoon and post-monsoon ground water seepage. This is a region of water surplus.

Environment

The Upper Bhadra region receives an average rainfall of 2320 mm annually. This is a transitional zone between Tropical evergreen forest ecosystem of the WGE and the plains of the Mysore Plateau. The forests of this region have been classified into five types occurring between the plateau and the lowlands: (a) southern Tropical Evergreen Forest, (b) southern Tropical Semi-evergreen Forest, (c) southern Moist Deciduous Forest, (d) southern Dry Deciduous Forest and (e) Scrub forest. The hilltops are covered by grasslands which are fringed by Shola forest. The climax vegetation of the study area is predominantly covered the semi-evergreen and mixed deciduous forests and less agricultural landscapes. The study area is also a part of Bhadra Tiger Reserve and Wildlife Sanctuary and Kudremukh National Park, with predominant tree species such as *Xylocarpus*, *Tectona grandis* and

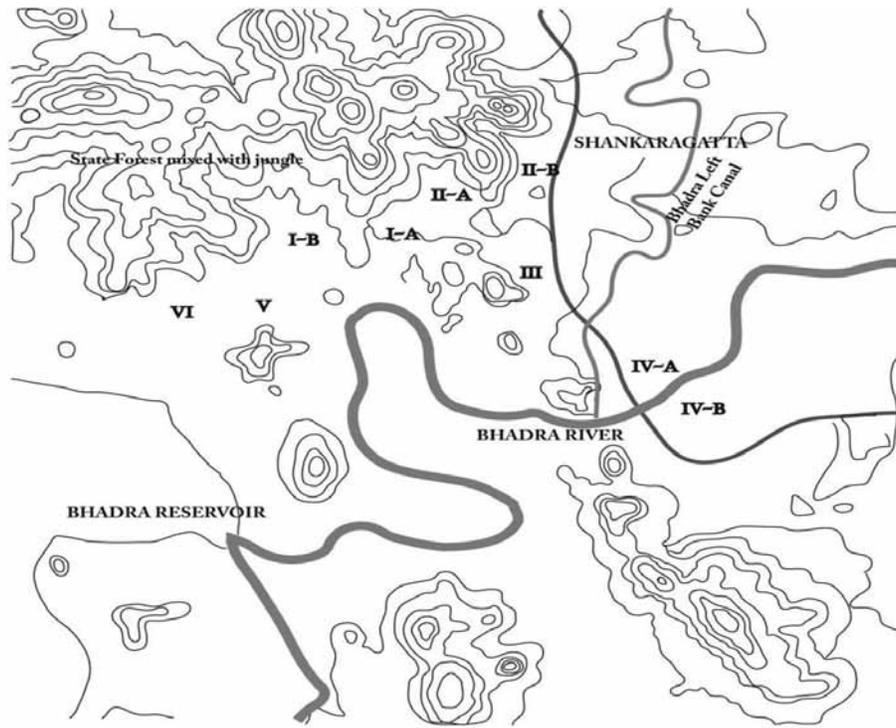


Fig. 8: Topographic features of the study area showing the location of Shankaraghatta Palaeolithic Complex. The sites are located in the denuded valleys on the piedmont and pediment surfaces in proximity to regolith features

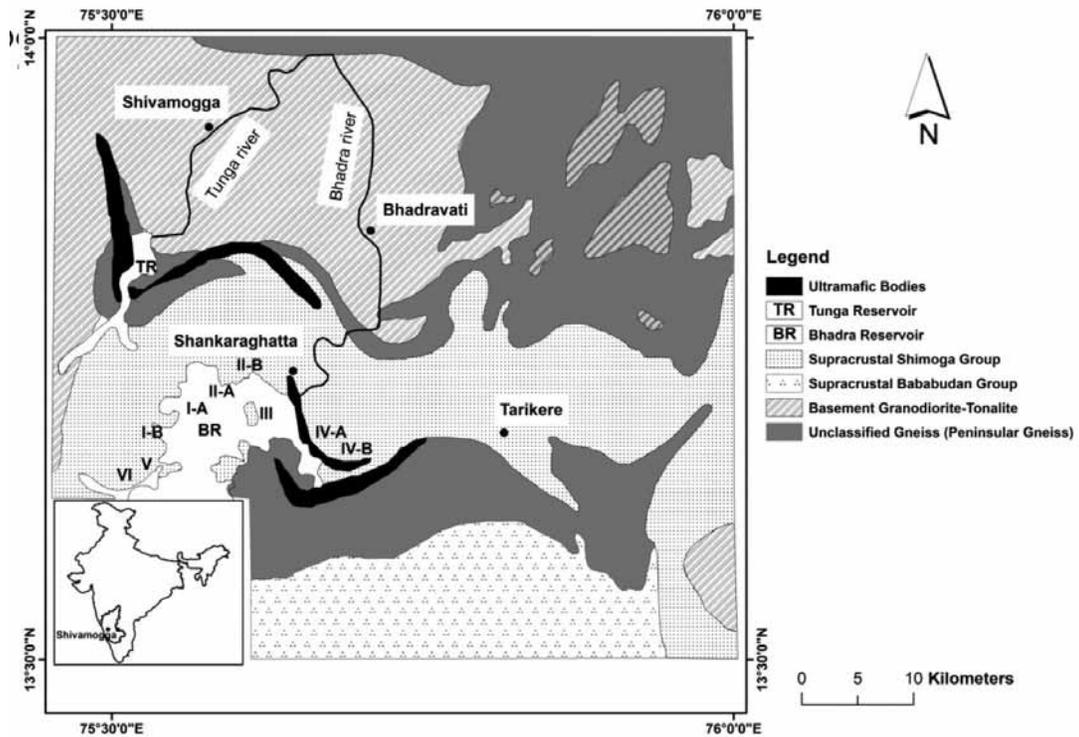


Fig. 9: Geological map of the study area showing the location of Shankaraghatta Palaeolithic Complex

Randiadumetorum, *Terminalia paniculata*, *T. tomentosa*, *Pterocarpus marsupium*, *Dalbergia latifolia*, etc. (Krishnamurthy *et al.* 2010; Manoj Chandran 2015). The aquatic ecosystem is rich in a variety of fish. Nearly 81 fish species have been documented from this region.

Local Geology

Lower and Middle Palaeolithic sites occur in an area of 30 sq. km (Fig. 8). The documented Palaeolithic sites are in proximity with Bababudan Schist Belt (BSB), an arm of the Shimoga-Goa Greenstone Belt. The eastern, western and northern boundaries of the BSB are marked by prominent faults and lineament features. The BSB encompasses a basal oligomictic quartz-pebble-conglomerate, associated quartz arenite, quartzite at various stratigraphic horizons, polymictic Kaldurga Conglomerate and phyllite. The quartzites are generally medium grained, compact and grey to brown in colour. Fuchsite quartzite with its peculiar green colour is also present at many places. Geology in the immediate vicinity of the Shankaraghatta Complex of Palaeolithic sites (SPC) is covered by supracrustal Shimoga Group, Bababudan Group, Basement Granodiorite Peninsular Gneiss and ultramafic rocks. The Ultramafite lenses occur both within the granitoids and supracrustals. They are co-folded with quartz-chlorite schist and metabasalts. The metabasalts include current bedded quartzite. The chlorite schist includes thin bands of carbonaceous phyllite, quartzchlorite-carbonate schist and sericite quartzite (Devaraju *et al.* 2004; Seshadri 1956). As mentioned above the Bababudan Group was the major source of quartzite for making Palaeolithic tools by the inhabitants of the SPC sites (Fig. 9).

Geomorphic Context of Palaeolithic Sites

The sites are located on the gentle pediment sloping from 640 to 620m AMSL (Fig. 10). A total number of 387 Palaeolithic artefacts were collected from 8 localities in the neighbourhood of Kuvempu University campus. At a couple of sites the presence of microlithic artefacts was also documented. The localities are situated on the piedmont to pediment interface, between contour intervals of 640-620 m AMSL. All these localities are

associated with the regolith lying unconformably on the bed rock (Plate 1). Locality IV (A and B) is situated on the floodplain of the Bhadra River at 620m contour and from here on the river flows on the plains in a northeasterly direction and the two rivers meet at Kudli in the Bhadravati Taluk. Sporadic occurrence of Lower Palaeolithic artefacts made from quartzite rock were collected from Hadonahalli (Lat. 14°05' N; 75° 65' E) near Honnali town on the floodplains of the Tungabhadra. Quartzite was the most preferred lithic raw material utilised for making artefacts and was obtained in the form of slabs and blocks from the regolith exposures.

Assemblage Composition

For the purpose of this study, all the artefacts from 8 localities are treated together for a preliminary typological and technological analysis. The assemblage can be broadly divided into Lower and Middle Palaeolithic assemblages. The vast majority belong to the Lower Palaeolithic, comprising large cutting tools including handaxes and cleavers. Cleavers are a minor component (18), handaxes (91) are a dominant component of the assemblage. Core tools (53) and the rest are amorphous large and medium flakes. Large cutting tools were made from angular to subrounded blocks of quartzite. Smaller subrounded clasts from the regolith were also utilized for small implements. The sites of SPC are surface occurrences and appear to retain their spot provenance, especially the large cutting tools. It is, therefore, not clear whether the assemblage can be subject to delineating the processing sequence. However, systematic field walking for documenting the field context is to be undertaken. The assemblage comes from the proximity of raw material and utilisation of tabular blocks quartzite is common. The artefacts belong to Mode II Acheulian Techno-complex.

Technology of Production

The assemblage is a random collection of finished artefacts. Obviously the selection bias does not facilitate a proper analysis of the technology. The localities need to be revisited to collect additional data, relating to the presence of flake blanks, the large flake component and primary blanks (blocks of quartzite) and if there is gradual

development from Acheulian to the Middle Palaeolithic. The recorded artefacts can be broadly divided into two groups (a) shaped tools and (b) simple artefacts. Shaped tool category includes large cutting tools including bifaces and chopper/core tools (Plate 2a and b). Simple artefacts include flakes with no clear evidence for secondary retouch. The majority of bifaces were reduced from blocks of quartzite detached from the regolith.

Majority of artefacts collected by us come from regolith context. Akash Srinivas's technological and *chaîne opératoire* of the Kibbanahalli Palaeolithic assemblages is also applicable here, in view of similarity in geomorphic and geologic context of Palaeolithic assemblages at Kibbanahalli and Shankaraghata (Fig. 11). Our observations on these aspects are, however, provisional. Absence of large flake Acheulian artefacts is distinct, perhaps owing to constraints on extracting large blocks of quartzite from regolith exposures. It is provisionally concluded that the assemblage can be assigned to the Late Acheulian phase (modified after Srinivas 2017a)

Section III: Discussion

The Upper Tunga and Bhadra Doab region is relatively less attended by Palaeolithic archaeologists. Palaeolithic occurrences in the Malnad Borderlands of the Upper Tunga and Bhadra Doab need to be understood in the larger geographical context of WDC and the Western Ghats Escarpment (WGE). The latter region has long been considered an area of isolation. However, in the last five decades several Palaeolithic sites have been identified along the windward and leeward sides of the Western Ghats Escarpments (Joshi and Bopardikar 1972; Guzder 1980; Goudellar and Korisettar 1993; Joglekar and Deo 2017; Marathe 1983; Rajendran 1989; Pappu 2001; Paddayya and Deo 2017). Therefore, we have initiated this project to examine the scope for considering the potential of the region for systematic survey and assess the distinctive ecosystems across the WDC as potential habitats for hominin adaptations.

Palaeolithic investigations in the WDC have revealed geographical gaps in the distribution of sites as well as lack of emphasis on retracing the footsteps of Robert Bruce

Foote in the southern parts of the craton. The occurrence of Palaeolithic sites in the three parallel and longitudinal sectors of the WDC such as (a) the coastal lowlands along the Arabian Sea, (b) the Western Ghats Escarpment and (c) the transitional zone between the upland plateau and the eastern plains, is not consistent and uniform in terms of Palaeolithic succession. Possible reasons for this scenario could be (a) inadequate survey, (b) spatially limited occurrence of suitable raw materials, such as quartzite, (c) laterite formations covering more than 60% of the WGE on its windward and leeward sides that would have hindered easy access to lithic raw material resources, (d) spatial variation in the habitability of semi arid scrubland ecosystems and (e) the dense tropical evergreen forests of the Malnad Borderlands were not areas of attractions and had remained isolated during much of the Pleistocene.

Absence or sporadic occurrence and low density of hunter-gatherer site-distribution in granite-greenstone geological provinces are generally attributed to inadequacy of survey and lack of problem oriented investigations. In order to adequately address the issue of scarcity of Pleistocene archaeological sites in some areas on the Peninsula, Korisettar (2007) attempted a logical explanation for the relative variation in the geographical distribution by invoking environmental parameters critical to the formation of hunter-gatherer habitats during the Pleistocene. He identified (a) core areas, (b) peripheral areas and (c) isolated areas. Such observations were previously made by the pioneer Robert Bruce Foote (1916), followed by B. Subbarao (1958). The latter identified (a) areas of attraction, (b) areas of relative isolation and (c) isolation. Their observations have remained valid to a large extent and provide clues to formulating new research designs and also application of modern methods of survey and documentation. These models are based on identification of resource rich and resource poor areas as well as inferred hominin population size, and the factors governing the dispersion and colonisation of new geographical environments from the source region. Indeed in the Indian subcontinent there are these three culture areas. We wondered whether it is necessary that hunter-gatherers were expected to colonise resource poor areas across the subcontinent. Productive and sustainable environments were definitely areas of attraction.

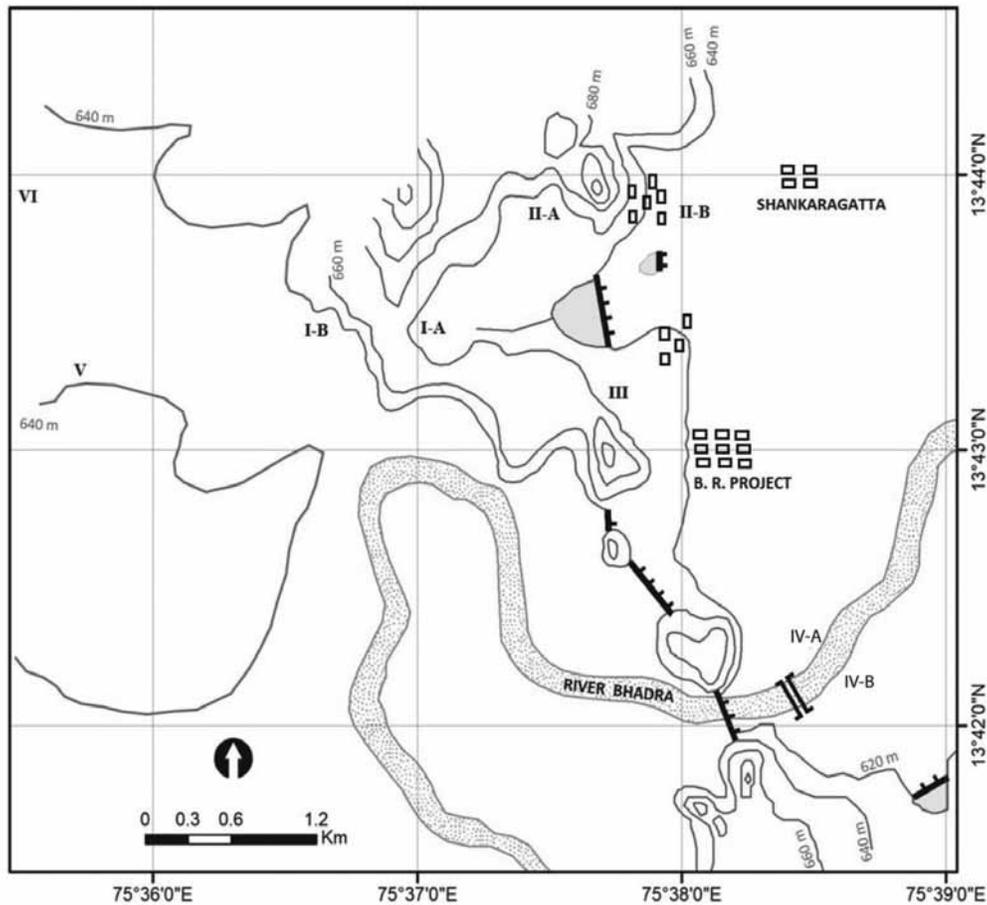


Fig. 10: Map showing the Shankaraghatta Palaeolithic Complex lying to the north of the Bhadra River

The problem of asserting the presence or absence of Palaeolithic sites arises when viewed from the perspective of filling gaps in respect of modern districts, states, river valleys, etc. This was a working model to place different sectors of the Peninsula, for e.g. a state, a river valley, or district through explorations, on the archaeological map of India. Since Independence, district and state boundaries have undergone reorganisation and subdivision several times and likely to happen in the future as well. Therefore, archaeological maps tend to have contemporary validity and need to be redrawn in response to such changes. Therefore, a basin model approach was advocated (Korisettar 2007) in order to emphasise the one to one relation between Palaeolithic sites and natural environment and its sustainability. Korisettar (2007) identified important components of a network of biomes in terms of (a) perennial water bodies, (b) stable plant and

animal biomass, (c) topographic/physiographic parameters as critical resources for defining hunter-gatherer habitats and accessibility to suitable lithic raw material resources, e.g. the Purana-Gondwana Basins. He emphasised on their unaltered state despite long and short term changes in monsoon circulation and human exploitation during the Pleistocene. In other words, the core areas were the well defined refugia in the subcontinent (Dennell 2009). This landscape approach enabled strengthen the earlier geographical model (Subbarao 1958) for explaining the presence or absence of prehistoric sites. We also wondered whether it is necessary that the diverse geo-environmental regions across the subcontinent should reveal uniform distribution pattern; whether prehistoric population experienced a steady population density that entailed widespread colonisation of diverse network of biomes or; there were refugia, restricting hominin mobility, which

provided long term sustainable conditions despite long and short term fluctuations in climate. Both Foote and Subbarao had identified environmental deterrents.

Foote's geological and archaeological field observations were immaculately meticulous. His geological resource maps are even today found useful and accurate to the level of inches and centimeters, so also was his observations on the occurrence of archaeological material remains. His surveys identified sites with dense occurrence of artefacts where follow-up investigations have been more productive beyond expectations. Since Sampat Iyengar's initial work periodic surveys have added to further understanding of the context of Kibbanahalli and related sites, composition of the assemblages and their similarity with other well known sites (Sampat Iyengar 1925; Allchin 1952; Seshadri 1956; Gururaja Rao and Shivarudrappa 1985). However, stratified sites are as yet to be identified. Fifty years after the first discovery and investigations at Kibbanahalli, and nearly a hundred years after the discovery of Yedihalli (Foote 1876), stratified Palaeolithic sites were identified in the inland region of the Bhima Proterozoic Basin (Paddayya 1975). The potential of these sites has been fully revealed by the three decade long investigations in the Hunsgi-Baichbal Valley in the northern parts of the WDC. Recent investigations at Tikoda in the Vindhya Basin and Attirampakkam in the context of Upper Gondwana formations are stratified sites and the findings have placed Indian Palaeolithic archaeology at the forefront of global prehistoric research (Paddayya and Deo 2017).

In some areas where Foote had reported sporadic occurrence of artefacts have remained so till date. For example, Subbarao's (1949) retracing of Foote's work in Bellary (now Ballari) region and in the Raichur Doab by Korisetar (1979) only revealed sporadic occurrence of Palaeolithic sites. Similarly in the Chitradurga District, around the greenstone belt, where Foote had mentioned find spots of stray Palaeolithic artefacts systematic field work was carried out by Sharathbabu (2018-19) for his Ph.D. project, but resulted in a frustrating experience. While only one suspected Palaeolith could be added, whereas Neolithic-Megalithic sites are abundant. Similar resurvey in the Malnad region, in the vicinity of Kadur, for instance, the surveys were unproductive. On the other hand

resurveys in the areas where Foote (1916) had reported sizeable number of artefacts, for instance at Lingadahalli in the Upper Bhadra Valley, have led to identifying dense occurrence of artefact assemblages in the immediate neighbourhood of these sites and beyond, for example the Shankaraghatta Palaeolithic Complex.

It is interesting to note that as early as the first quarter of the twentieth century Palaeolithic sites were reported and documented from inland regions, especially on the piedmont and pediment surfaces. In the Malnad Borderlands and in the inland Banasandra range (the Mysore Plateau) the sites are located away from alluvial network. They are located on piedmont and pediment surfaces which have undergone considerable modification under denudational processes and historical period anthropogenic impact. At some localities the artefacts are associated with the regolith. And in many cases relation between relict landscapes and Palaeolithic occurrences has been obscured. Presence of microlithic assemblages in juxtaposition with the Palaeolithic sites has also been documented (indicating exploitation of aquatic fauna by hunter-gatherers). Neolithic and Megalithic sites are widespread in this region. Systematic exploration in the area hold promise for locating stratified contexts and fill the gaps in the Palaeolithic succession. The best examples are Kibbanahalli on the Mysore Plateau and Shankaraghatta in the Malnad Borderlands, in two different biomes.

The Mysore Plateau lies in the rain shadow of the WGE and is characterised by semi-arid and hot climate. Riverine alluvial grasslands are common in the plains of the Mysore Plateau, along the Kaveri and Tungabhadra valleys. They lie beyond the flood banks of the rivers. Riverine trees are common as one move away from the flood bank. The grassland community along the rivers is dominated by *Saccharum spontaneum* (popular as thatch grass). As noted above the Malnad Borderland is a transition zone between montane Western Ghats Escarpment and inland semi-arid plains of the Mysore Plateau. The region's biome is characterised by Tropical Moist Forest (lower montane), a sub-biome of the Tropical Moist Forest along the Western Ghats Escarpment. Longitudinal variation in the precipitation regimes of Indian Summer Monsoon, from

west to east, has given rise to the formation of Tropical Moist Forest (montane) on the Western Ghats plateau, Tropical Rain Forest (lower montane) on the west coast of Indian Peninsula and Tropical Dry Scrub Plains biome lies to the east. Reconstruction of Palaeolithic man-land relationships in these two regions will help in delineating dispersion and colonisation of contrasting biomes and explode the myth of uninhabitability of rainforest biomes.

Dispersals in the Intra-Peninsular Plateau

On the Indian Peninsula, the Vindhya Basin is one of the highland grassland biomes. To date this basin has presented evidence for a large number of Palaeolithic settlements as well as continuity of human adaptations during the Quaternary. The Vindhya and Satpura hill ranges are considered the corridors between the Western Ghats and the Himalayas for migration of species. These grasslands are intermixed with tropical dry deciduous forests on rocky patches and can be called montane or hill savanna, chiefly because the region receives higher monsoon precipitation during the SW monsoon and is partially covered by the NE monsoon. Similarly, the Deccan Plateau areas of Karnataka and Maharashtra also have several patches of Tropical Savannas and form good habitats for several herbivores such as black buck and also birds like the Great Indian Bustard.

The archaeological record from different parts of the Dharwar Craton is indicative of hunter-gatherer adaptation to the grasslands, which are integral to the diverse network of biomes across the Indian Peninsula. They have played the role of corridors facilitating movement of humans and animals. They not only perform the function as a major producer biome, but serve as habitats to a variety of birds and mammals.

As shown in Table 1, the number and density of Palaeolithic sites is not as large as those in the Kaladgi and Bhima Proterozoic Basins. Only around 43 sites are documented so far (Table 1) along the greenstone belts and several hundred sites from the combined Kaladgi and Bhima Basins. Whether this variation is deliberate or accidental or because of survey bias need to be put in perspective. As yet there is no record of Palaeolithic

sites on the plateau regions of the greenstone belts. All the known sites are at the foothills and pediments associated with the greenstone belts. These were the zones of perennial pools and ponds, if not large lakes, fed by spring activity in the zones of tectonic contact between supracrustals and granitoids. Surprisingly geologists do not agree that there were lakes in the inland regions on the Mysore Plateau (Radhakrishna and Vaidyanadhan 2011). However, we are inclined to agree with Shivarudrappa *et al.* (1985). If lakes did not exist, there were denudational troughs facilitating formation of perennial pools and ponds. High water table and ground water flow in the past governed the existence of active springs especially in the region of geological junctions between OGC and granite/charnokites and between basic dyke intrusive in the older rock formations. High water tables during the Pleistocene certainly facilitated the formation of inland perennial water bodies (Gururaja Rao and Shivarudrappa 1985; Gururaja Rao 1990; Shivarudrappa 1990; Radhakrishna and Vaidyanadhan 1994, 2011). Although quartzites are known from these belts, their easy access for hominin exploitation is spatially restricted. Similarly, continuous hominin occupation is also not known because of limited occurrence of chert rock (the chief raw material during Middle Palaeolithic), generally concealed in the host rock, unlike in the Purana Basins. However, as one moves towards the Malnad Borderlands the biome characteristics dramatically change, including greater access to quartzite outcrops interbedded in the Bababudan Group of rocks. Not surprisingly the density of Palaeolithic occurrences increases. Encouraged by the findings of this project, it is proposed to undertake systematic field walk for identifying sites and their geomorphic context, absolute chronology and provenance studies are to be undertaken. We feel it is premature to arrive at any generalisations regarding hominin ranging habitats, paths of dispersal within the Indian Peninsula and the meaning of relative variation in the density and frequency of Palaeolithic settlements. Obviously investigations at Kibbanahalli and Shankaraghatta have clearly indicated the scope for further research.

Foote's documentation of Palaeolithic sites had established a correlation between quartzite occurrences and Early Palaeolithic sites (Foote 1916). This was

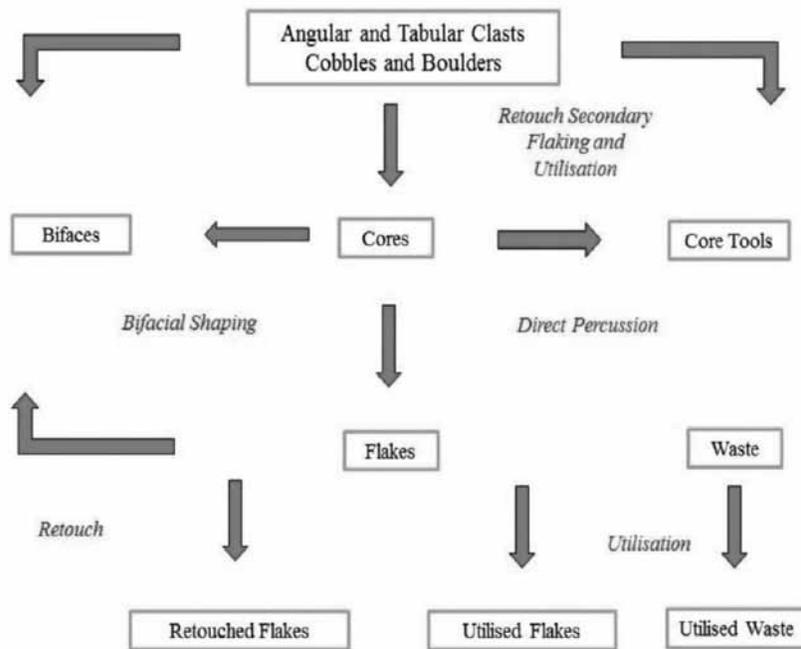


Fig. 11: Lithic Reduction Sequence at the Shankaaraghata Palaeolithic Complex

treated as a dictum until Early Palaeolithic assemblages made from alkaline and acidic varieties of basalts were discovered in the Upper Godavari Basin (Gangapur, Nevasa etc.) and Saurashtra region of Gujarat (Sankalia 1974).

Over the last 160 years of research it has become increasingly clear that quartzite was preferred to other lithic raw materials in areas where multiple varieties of lithic sources were available, indicating the role of other environmental parameters governing the habitability of areas of Palaeolithic settlements and their long term continuity. The Hunsgi-Baichbal valley, where densest occurrence of Palaeolithic sites has been documented, is a geological tri-junction of Deccan basalts, Proterozoic Bhima Series (limestone, shale, orthoquartzite, etc.) and Archaean granitoid rocks. Despite limestone being a soft rock among the three, it was the most preferred raw material for making Palaeoliths. Similarly in the Proterozoic Kaladgi Basin quartzite was preferred to sandstone. In the Proterozoic Kurnool sub-basin, the Jwalapuram complex of sites is associated with multiple varieties of suitable lithic sources such as quartzite, siliceous limestone, etc. Here quartzite was preferred to limestone for making Early Palaeolithic artefacts. In the

Narmada Valley, recent investigations at the Palaeolithic site of Tikoda lying in the geological junction of Deccan basalts and Vindhyan quartzite formations, the latter was preferred to basalts. Survivorship of basalt artefacts is also considered the cause for low density of sites in the Basaltic province. Yet on the present showing the density of sites is relatively lower in the basaltic province. In addition, suitable topographic features, perennial water bodies, plant and animal subsistence biomass that were essential ecofacts governing the habitability of the geological basins, irrespective of their occurrence on either erosional or depositional surfaces, in the much larger basaltic province. However, more than 80% of sites from either alluvial or inland regions were correlated with geological formations comprising quartzite strata or alluvial/colluvial conglomerates containing quartzite clasts. These examples give us scope to infer high frequency of sites in the quartzite bearing geological formations and that Purana-Gondwana Basins were refugia during the Pleistocene (Korisettar 2007).

The Basin Model clearly stated that the best exposures of quartzite are found in the Proterozoic Purana Basins, followed by Permo-Carboniferous Gondwana Belts on the Indian Peninsula (Korisettar 2007). The sporadic

occurrence of Palaeolithic artefacts in the Maidan region of Karnataka Plateau, largely covered by granitoid rocks has been known since the last quarter of the nineteenth century. However, these clues and retracing of Foote's steps were during the last hundred years were not stimulating. Therefore, a closer look at the geological and environmental aspects of the region was initiated. The absence of Palaeolithic settlements in the granitic areas was attributed to the absence of quartzite and low productivity of the landforms, as they lie in the rain shadow of both Eastern and Western Ghats. Yet sporadic occurrence of Palaeolithic sites were documented since the time of Foote (1916), followed by the discovery of Kibbanahalli by Sampat Iyengar (1924). Based on nearly 160 years of survey, we infer that future surveys are unlikely to reverse the distribution of pattern of sites on the Indian Peninsula.

Concluding Remarks

We have identified three distinctive Precambrian geological sources of quartzites on the Indian Peninsula, with which Early Palaeolithic sites are correlated: (a) Archaean greenstone belts with varying relief features, (b) Proterozoic Purana Basins and (c) Permo-Carboniferous Gondwana Basins. Archaean greenstone belts are the oldest supracrustal belts on the Indian Peninsula followed by Proterozoic Basins including the Aravallis, Vindhya, Kaladgi, Bhima, Cuddapah, Bastar, etc. The Gondwana quartzites are known from Satpura, Mahanadi, Damodar, Pranhita-Godavari valleys and as enclaves along the east and southeast coast of India. On the Western Dharwar Craton the occurrence of Early Palaeolithic sites is found in the areas of greenstone belts and Purana Basins. The density of sites varies from very low to very high between greenstone belts and Purana Basins. This variation is also observed between the greenstone belts and Purana-Gondwana Basins on the Eastern Dharwar Craton.

Our study of the artefact assemblages from the Upper Bhadra Valley, is being subject to (a) detailed typotechnological and morphometric study (Korisettar *et al.* in preparation), (b) situate the evidence in its environmental context and (c) also apply the basin model criteria to explain the differential spatial distribution by relating

them to the geologic and physiographic features that facilitated sustained resource base to the hunter-gatherers across the Dharwar Craton, the Precambrian basement of Indian Peninsula.

Predictive modelling is advantageous for identifying (a) potential regions for locating potential sites for initiating problem oriented investigations, (b) stratified contexts for the application of geochronological methods, (c) reconstructing man-land relationships, (d) differentiating point provenance and spot provenance, (e) delineating taphonomical processes and (f) for minimising investment of resources and time. Modelling also aims at understanding (a) human-biome relationships in response to Quaternary long and short term climatic changes, (b) settlement location with respect to geomorphic features and (c) search for hominin fossils, etc. Both the basin model (Korisettar 2007) and the present paper suggest that there are geological provinces with higher density of sites and historical settlement continuity reflecting on ranging behaviour of hunter-gatherers. These geological basins deserve priority attention of investigators. The basin model does not suggest that peripheral and isolated areas are not worthy of serious consideration. And that Palaeolithic sites do occur in diverse geological basins, including Deccan basaltic region. Lower density of sites and their intermittent occupation of peripheral areas were governed by productivity of the environments under congenial climatic conditions in the past. Stratified sites in the core areas of Palaeolithic occupation such as the Bhima Basin have been investigated over a period of two and a half decade and the findings are an inspiration for focussed investigations in the Purana Basins of the WDC (Paddayya 1982, 1985, 1987a and b, 2006-7, 2007; Paddayya *et al.* 2000, 2002) as well for generating models.

Although supracrustal schist belts are common in the intermediate zones, south of the Purana Basins in northern Karnataka (e.g. the Hutti and Mangalur greenstone belts), they are flat belts without physical relief and are surrounded by the intrusive Archaean granitoids. Unlike in the Kaladgi and Bhima Basins lithic raw material resources such as quartzite, limestone and crypto-crystalline silica minerals are either not easily accessible to hominins or totally absent in these belts. The crypto-crystalline minerals

(e.g. chert) derived from Inter-trappean formations, are found only along the floodplains of the Krishna in the Raichur Doab, where quartzites are distinctively absent. The Hutti Greenstone Belt is composed of metabasalts, amphibolites, quartz conglomerates and gold bearing quartz reefs, all strata deep down in the sub-surface. In such geological environments it is difficult to predict the presence of Palaeolithic settlements but since the Neolithic period, the settlement density has steadily increased in the granitic plains. This situation changes dramatically as one enters the Purana Basins. Furthermore the relative higher productivity of the Purana Basins is indicated by the change in the biome composition as well.

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Table 1: Palaeolithic occurrences in the Archaean Greenstones Belts (Schist Belts) of Western Dharwar Craton

Sr. No.	Name of site	Context as mentioned in the reference	Culture	No. artefacts	Lithic source	Geological and tectonic context	Modern district	Reference
1	Nyamathi	Shingle bed, on the left bank of the Tungabhadra	Palaeolithic	Two artefacts	Archaean quartzite	Shimoga Greenstone Belt	Shivamogga	Foote (1916); Seshadri (1956)
2	Shankaraghatta Palaeolithic Complex	Hill slope, colluvium	Lower and Middle Palaeolithic	400 artefacts six localities	Archaean quartzite	Shimoga Greenstone Belt	Shivamogga	Rajaram Hegde (Personal Communication)
3	Hadonahalli	Floodplain or high level gravel	Lower Palaeolithic	Find spot	Archaean quartzite	Shimoga Greenstone Belt	Shivamogga	Rajaram Hegde (personal communication)
4	Kadur	Quartzite	Lower Palaeolithic	Single biface	Archaean quartzite	Shimoga Greenstone Belt	Chikmagalur	Foote (1916) ; Seshadri (1956)
5	Nidaghatta	Lateritic debris	Lower Palaeolithic	Three artefacts	Archaean quartzite	Shimoga Greenstone Belt	Chikmagalur	Foote (1916); Seshadri (1956)
6	Lingadahalli	Lateritic debris	Lower Palaeolithic	Twelve artefacts	Archaean quartzite	Shimoga Greenstone Belt	Chikmagalur	Foote (1916); Seshadri (1956)
7	Joddikatte	Conglomerate	Lower Palaeolithic	One artefact	Archaean quartzite	Shimoga Greenstone Belt	Chikmagalur	Sampath Iyengar (1924)
8	Halakundi-Sugulammadevi	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1895), Foote (1916); Subbarao (1949)
9	Nittur	Shingle gravel, River bed dyke	Lower Palaeolithic	Dolerite dyke	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Ansari 1970
10	Bedar Belagal	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Subbarao (1949)
11	Gadiganur	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Subbarao (1949)

Sr. No.	Name of site	Context as mentioned in the reference	Culture	No. artefacts	Lithic source	Geological and tectonic context	Modern district	Reference
12	Kurikuppa	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Subbarao (1949)
13	Joga	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Subbarao (1949)
14	Daroji	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Subbarao (1949)
15	Badanatii	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Ballari	Foote (1916); Subbarao (1949)
16	Hampasagara	Gauri Nala, Tungabhadra valley, cemented gravel	Pebble tools/ biface	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Vijayanagara	Foote 1895; Subbarao (1949)
17	Itagi	Tungabhadra	Pebble tools	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Vijayanagara	Foote (1916); Subbarao (1949)
18	Anguru	Foothill shingle fans	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Vijayanagara	Foote (1916); Subbarao (1949)
19	Hirekuravatti/	Hill slope shingles	Lower Palaeolithic	Stray finds	Archaean quartzite	Sandur Greenstone Belt	Vijayanagara	Foote (1916); Subbarao (1949)
20	Jyankal	Talus deposit	Lower Palaeolithic	Two artefacts	Archaean quartzite	Chitradurga Greenstone Belt	Chitradurga	Foote (1916); Seshadri (1956)
21	Talya	Lateritic gravel	Lower Palaeolithic	Three artefacts	Archaean quartzite	Chitradurga Greenstone Belt	Chitradurga	Foote (1916); Seshadri (1956)
22	Kunabevu	Pediment gravel	Lower and Middle Palaeolithic	Find spot	Archaean quartzite	Chitradurga Greenstone Belt	Chitradurga	Sharath Babu 2018-19
23	Sangenahalli	Pediment gravel	Lower Palaeolithic	Find spot	Archaean quartzite	Chitradurga Greenstone Belt	Chitradurga	Sharath Babu 2018-19

Sr. No.	Name of site	Context as mentioned in the reference	Culture	No. artefacts	Lithic source	Geological and tectonic context	Modern district	Reference
24	Yadlagatti	Pediment gravel	Lower Palaeolithic	Find spot	Archaean quartzite	Chitradurga Greenstone Belt	Chitradurga	Sharath Babu 2018-19
25	Godabanahal	Pediment gravel	Lower Palaeolithic	Find spot	Archaean quartzite	Chitradurga Greenstone Belt	Chitradurga	Sharath Babu 2018-19
26	Y.N. Hosakote	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
27	Appanahalli	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
28	Doddaguni	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
29	Mooganayakankote	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
30	Marasetthalli	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
31	Galigekere	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
32	Sivapura	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
33	Obalapura	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
34	Manchallore	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
35	Bommenahalli	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
36	Avaregallu	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
37	Gutte	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)

Sr. No.	Name of site	Context as mentioned in the reference	Culture	No. artefacts	Lithic source	Geological and tectonic context	Modern district	Reference
38	Kibbanahalli	Rain wash	Lower Palaeolithic	236 artefacts, artefacts lost.	Archaean quartzite	Shimoga Greenstone Belt	Tumakuru	Sampat Iyengar (1924); Allehin (1952)
39	Kibbanahalli Palaeolithic Complex	Pediment surface, 23 localities, 260 artefacts	Lower and Middle Palaeolithic	Factory site	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Srinivas 2014 a and b, 2017a, b and c
40	Biligere	Rain wash	Lower Palaeolithic	Stray finds	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Sampat Iyengar (1924); Seshadri (1956)
41	Chikkegoudan-arop-pa	Not available	Lower Palaeolithic	Not available	Archaean quartzite	Chitradurga Greenstone Belt	Tumakuru	Shivatarak (2004)
42	Ranganathapura	Alluvium, Kaveri river	Lower Palaeolithic	Two artefacts	Quartz	River gravel	Mysuru	Sripada Rao (1930)
43	Karadigudda	Lateritic debris	Lower Palaeolithic	One artefact	Quartz	Not available	Hassan	Seshadri (1956)

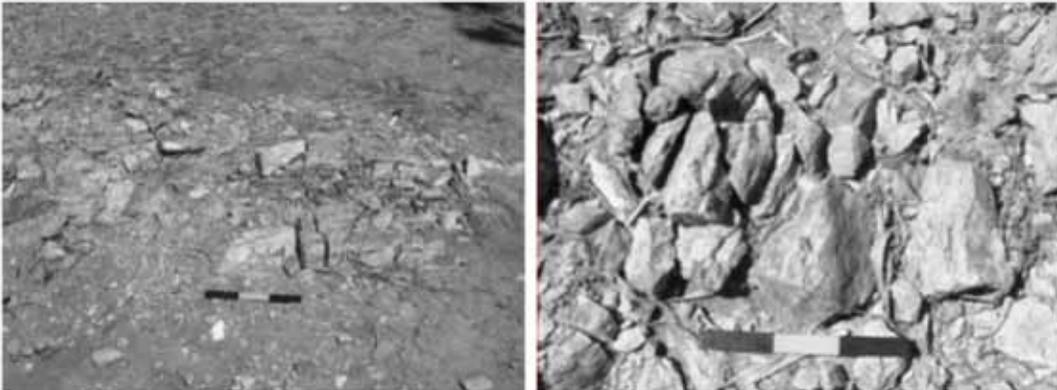
Note: the Shimoga Greenstone Belt, Chitradurga Greenstone Belt and Sandur Greenstone Belt. Presence of quartzite formation as a distinctive lithological unit has been mapped by geological surveys. The Bababudan Group of rocks containing quartzites is common to all these belts. All the abovementioned Palaeolithic occurrences occur in close proximity with these outcrops. However, dense cluster of Palaeolithic artefacts are found only at Lingadahalli, Kibbanahalli Palaeolithic Complex and Shankaraghatta Palaeolithic Complex clearly indicate that not all parts of the Greenstone Belts were favourable for human occupation. Ecosystems marginal to Tropical Evergreen and Moist Deciduous Forest were also areas of attraction. Intrusive relationship between the Greenstone Belts and the surrounding Older Gneissic Complex in the WDC would have facilitated perennial spring activity and created shallow water bodies on the pediment surfaces, if not large lakes. We thus subscribe to Foote's conviction "despite much hunting of the old alluvial shingle beds of the Tungabhadra and other rivers" he could not locate consistent Palaeolithic occurrences. This supports our observation that gneissic and granite landforms in the semi-arid plains were not suitable habitats during the Pleistocene.

References

- Allchin, B. 1952. A Study of Some Palaeolithic Artefacts from South India. *Current Science* 10 (October): 268-271.
- Ansari, Z.D. 1970. Pebble Tools from Nittur (Mysore State). In *Studies in Indian Archaeology* (Professor H.D. Sankalia Felicitation Volume), eds. S.B. Deo and M.K. Dhavalikar, 1-7. Bombay: Popular Prakashan.
- Bongale, P. and A. Kshirsagar. 2015. Geology of the Western Dharwar Craton. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*: 22-26.
- Budel, J. 1957. Double Surfaces of Levelling in Humid Tropics (English Summary). *Zeit Geomorphologie* 1(2): 223-225.
- 1965. The Relief Types of the Sheetwash Zone of Southern India on the Eastern Slopes of the Deccan Highlands Towards Madras (English Summary). *Colloquium Geographicum* 8.
- Cammiade, L.A. and M.C. Burkitt. 1930. Fresh Light on the Stone Ages of South-east India. *Antiquity* 4 (15): 327-339.
- Chandran, M. 2015. Grassland vegetation of India: An update. In *Ecology and Management of Grassland Habitats in India, ENVIS Bulletin: wildlife and Protected Areas, Vol. 17*, eds. G.S. Rawat and B.S. Adhikari, 13-27. Dehradun: Wildlife Institute of India.
- Clarkson, C., C. Harris, Bo Li, Christina M. Neudorf, Richard G. Roberts, C. Lane, K. Norman, J. Pal, S. Jones, C. Shipton, J. Koshy, M.C. Gupta, D.P. Mishra, A.K. Dubey, N. Boivin and M. Petraglia. 2020. Human Occupation of Northern India Spans the Toba Super-eruption ~74,000 Years Ago. *Nature Communications* (11). <https://doi.org/10.1038/s41467-020-14668-4>
- Dennell, R. 2009. *The Palaeolithic Settlement of Asia*. Cambridge: Cambridge University Press.
- Devaraju, T.C., T.T. Alapieti and R.J. Kaukonen. 2004. Ni-Au-PGE Mineralization in the Ultramafic Body at Shankaraghata, Shimoga Schist Belt, Karnataka: a Mineralogical and Geochemical Study. *Journal of Geological Society of India* 63 (6): 611-624.
- Foote, R.B. 1876. The Geological Features of the South Mahratta Country and Adjacent Districts. *Memoirs of the Geological Survey of India*, Vol. XII, Part I.
- 1895. Geology of the Bellary District. *Memoirs of the Geological Survey of India*, No. 25.
- 1916. *The Foote Collection of Indian Prehistoric and Protohistoric Antiquities: Notes on Their Ages and Distribution*. Madras: The Superintendent, Government Press. (republished in 1999)
- Goudeller, L.D. and R. Korisettar. 1993. The First Discovery of Acheulian Bifaces in Goa: Implications for the Archaeology of West Coast of India. *Man and Environment* XVIII, No. 1: 35-42.
- Gunnel, Y. 2014. Granite Landforms of the Indian Cratons. In *Landscapes and Landforms of India*, ed. V.S. Kale, 195-201. Dordrecht: Springer.
- Gururaja Rao, B.K. 1990. A Note on the Lower and Middle Palaeolithic Industries of Southern Karnataka. In *Archaeology in Karnataka*, ed. A. Sundara, 5-7. Mysore: Directorate of Archaeology and Museums in Karnataka.
- and T.V. Shivarudrappa. 1985. *Geo-Archaeological Exploration around Kibbanahalli*. Mysore: Mysore University.
- Guzder, S. 1980. *Quaternary Environment and Stone Age Cultures of the Konkan Coastal Maharashtra*. Pune: Deccan College Post-Graduate and Research Institute.
- Haslam, M., S. Oppenheimer and R. Korisettar. 2017. Out of Africa into South Asia: A Review of Archaeological and Genetic Evidence for the Dispersal of *Homo sapiens* into the Indian Subcontinent. In *Beyond Stones and More Stones: Defining Indian Prehistoric Archaeology*, Vol. I, ed. R. Korisettar, 117-149. Bengaluru: The Mythic Society.
- Hegde, R. 1995. Bhadra Project Parisarada Silayudhagalu. *Itihasa Darshana* 9: 3-10.
- 1997. Stone Tools from Bhadra Valley. *Archaeology, Anthropology, History- South Asia Network News Letter* 5.
- and R. Korisettar. 1994. *Discovery of Acheulian to Middle Palaeolithic Artefacts in the Upper Bhadra Project, Shimoga District, Karnataka*. Paper Presented at the New Delhi Session of the World Archaeological Congress 3, at the Environment and Technology Session (organised by R. Korisettar and M.D. Petraglia).
- Joglekar, J. and S.G. Deo. 2017. Artefactual Evidence of Early Hominin Adaptability in the Deccan Trap Region of the Upper Krishna Basin. In *Rethinking the Past: a Tribute to Professor V.N. Misra*, eds. S.G. Deo, A. Baptista and J. Joglekar, 16-24. Pune: Indian Society for Prehistoric and Quaternary Studies.
- Joshi, R.V. 1955. *Pleistocene Studies in the Malaprabha Basin*. Poona and Dharwar: Deccan College Post-Graduate and Research Institute and Karnatak University.
- and B.P. Bopardikar. 1972. Stone Age Cultures of Konkan (Coastal Maharashtra). In *Archaeological Congress and Seminar Papers*, ed. S.B. Deo, 47-57. Nagpur: Nagpur University.
- Korisettar, R. 1979. Prehistory and Geomorphology of the Middle Krishna. PhD diss., University of Poona, Pune.
- 2007. Toward Developing a Basin Model for Palaeolithic Settlement of the Indian Subcontinent: Geodynamics, Monsoon Dynamics, Habitat Diversity and Dispersal Routes. In *The Evolution and History of Human Populations in South Asia: Interdisciplinary Studies in Archaeology, Biological Anthropology, Linguistics and Genetics*, eds. M.D. Petraglia and B. Allchin, 69-96. Dordrecht: Springer.
- 2017. The Genus *Homo* and the African Exodus. In *Beyond Stones and More Stones: Defining Indian Prehistoric Archaeology*, Vol. I, ed. R. Korisettar, 63-116. Bengaluru: The Mythic Society.
- 2021 (in press). Late Quaternary geoarchaeological and Paleoenvironmental aspects of Kurnool Basin in the Indian Peninsula. In *Holocene Climate Change and Environment*, eds. N.K.P. Kumaran and D. Padmalal. London: Elsevier.
- Krishnamurthy, Y.L., H.M. Prakasha, A. Nanda, M. Krishnappa, H.S. Dattaraja and H.S. Suresh. 2010. Vegetation Structure and Floristic Composition of a Tropical Dry Deciduous Forest in Bhadra Wildlife Sanctuary, Karnataka, India. *Tropical Ecology* 51(2): 235-246.

- Marathe, A.R. 1983. Prehistoric Explorations in the Mandvi and Zuari Basins, Goa. *Bulletin of the Deccan College Research Institute* 42: 104-109.
- Nagarajappa, S. 2011. Chitradurga Talukina Kelavu Pragaitihāsika Nelegalu. *Itihasa Darshana* 26: 18-19.
- and K.S. Sharathbabu. 2012. Kunabevu Parsarada Ittichina Pragaitihāsika Samsodhanegalū. *Itihasa Darshana* 27: 8-9
- Paddayya, K. 1975. Acheulian Occupation Site at Hunsgi, Gulbarga District, Karnataka: a Preliminary Report. *Bulletin of the Deccan College Post-Graduate and Research Institute* 35 (1/2): 87-93.
- 1982. *The Acheulian Culture of the Hunsgi Valley: a Settlement System Perspective*. Pune: Deccan College Post-Graduate and Research Institute.
- 1985. Acheulian Occupation Sites and Associated Fossil Fauna from the Hunsgi-Baichbal Valleys, Peninsular India. *Anthropos* 80: 653-658.
- 1987a. Excavation of an Acheulian Occupation Site at Yediapur, Peninsular India. *Anthropos* 82: 610-614.
- 1987b. The Stone Age Cultural Systems of the Baichbal Valley, Gulbarga District, Karnataka: a Preliminary Report. *Bulletin of the Deccan College Post-Graduate and Research Institute* 46: 77-100.
- 2006-2007. Evolution within the Acheulian in India: a Case Study from the Hunsgi and Baichbal Valleys, Karnataka. *Bulletin of the Deccan College Post-Graduate and Research Institute* 66-67: 95-111.
- 2007. The Acheulian of Peninsular India with Special Reference to the Hunsgi and Baichbal Valleys of the Lower Deccan. In *The Evolution and History of the Human Populations in South Asia*, eds. M.D. Petraglia and B. Allchin, 97-119. Dordrecht: Springer.
- and S.G. Deo. 2017. *Prehistory of South Asia*. Bengaluru: The Mythic Society.
-, R. Jhaldiyal and M.D. Petraglia. 2000. Excavation of an Acheulian Workshop at Isampur, Karnataka (India). *Antiquity* 74 (286): 751-752.
-, B.A.B. Blackwell, R. Jhaldiyal, M.D. Petraglia, S. Fevrier, D. A. Chaderton II, J.I.B. Blickstein and A.R. Skinner. 2002. Recent Findings on the Acheulian of the Hunsgi and Baichbal Valleys, Karnataka with Special Reference to the Isampur Excavation and Its Dating. *Current Science* 83 (5): 641-647.
- Pappu, R.S. 1974. *Pleistocene Studies in the Upper Krishna Basin*. Pune: Deccan College Post-Graduate and Research Institute.
- 2001. *Acheulian Culture in Peninsular India: an Ecological Perspective*. Delhi: D.K. Printworld (P) Ltd.
- and S.G. Deo. 1994. *Man-Land Relationships during Palaeolithic Times in the Kaladgi Basin, Karnataka*. Pune: Deccan College Post-Graduate Research Institute.
- Pappu, S., Y. Gunnell, A. Kumar, R. Braucher, M. Taieb, F. Demory and N. Thouveny. 2011. Early Pleistocene Presence of Acheulian Hominins in South India. *Science* 331 (6024): 1596-1599.
- Poonacha, K.P. 1990. Archaeology of Malnad Region Comprising the Districts of Hasan Chikkamagalur and Shimoga with special reference to Pre and Proto-History. PhD diss., Karnatak University, Dharwad.
- 2011. *Archaeology of Karnataka (Pre and Protohistory of South Western Region)*. Delhi: Bharatiya Kala Prakashan.
- Radhakrishna, B.P. and M. Ramakrishnan (Eds.). 1990. *Archaean Greenstone Belts of South India (Bellur Rama Rao Volume)*. Bangalore: Geological Society of India.
- and R. Vaidyanadhan. 1994. *Geology of Karnataka*. Bangalore: Geological Society of India
- and R. Vaidyanadhan. 2011. *Geology of Karnataka*. Bangalore: Geological Society of India.
- Rajendran, P. 1989. *The Prehistoric Cultures and Environment: a case study of Kerala*. New Delhi: Classical Publishing Company.
- Sampat Iyengar, P. 1924. A Palaeolithic Settlement and Factory in the Mysore State. *Journal of the Indian Scientific Congress*.
- 1924-25. A Palaeolithic Settlement and Factory in the Mysore State. *Quarterly Journal of the Mythic Society* 15(1): 17-21.
- 1925. On Some Hand-Grasp Designs in Palaeoliths Found in Mysore. *Journal of the Indian Scientific Congress*.
- Sangurmath, P. 2015. Geology, Gold Mineralization and Explorations of Mangalur Gold Mine, Yadgir District, Karnataka. *Journal of Economic Geology and Geo Resource Management* 10: 103-110.
- Sankalia, H.D. 1974. *Prehistory and Protohistory of India and Pakistan*. Pune: Deccan College Post-Graduate and Research Institute.
- Seshadri, M. 1955. The Palaeolithic Industry of Kibbanahalli, Mysore State. *Artibus Asiae* 18 (3/4): 271-287.
- 1956. *Stone-Using Cultures of Prehistoric and Protohistoric Mysore*. London.
- Sharathbabu, K.S. 2019. Chitradurga Parasarada Pragaitihāsika. PhD diss., Vidyaranya: Kannada University, Hampi.
- Shivarudrappa, T.V. 1990. Environment Aspects of Early and Middle Palaeolithic Cultures in Southern Karnataka. In *Archaeology in Karnataka*, ed. A. Sundara, 23-40. Mysore: Directorate of Archaeology and Museums in Karnataka.
- and B.K. Gururaja Rao. 1985. *Geo-archaeological Implications of the Talakad Sand-Dunes*. Mysore: Mysore University.
- Shivatarak, K.B. 1996. Tumakuru Jilla Pradeshada Hale Shilayuga Samskriti. *Itihasa Darshana* 11:1-7.
- 1999. Tumkuru Jillya Puratatva Kuruhugalu: Ondu Samskritika Adhyayana. Unpublished Ph.D. diss., Vidyaranya: Kannada University, Hampi.
- 2001. *Karnatakada Puratatva Nelegalu*. Hampi: Kannada University.

- 2004. Prehistory and Protohistory of Tumkur Region. In *Proceedings of R.B. Foote Memorial National Seminar (1995) on Indian Prehistory and Protohistory (Recent Studies)* ed. A. Sundara, 179-185. Hospet: Directorate of Archaeology and Museums, Govt. of Karnataka.
- Srinivas, A. 2014a. Palaeolithic Landscapes around Kibbanahalli, Southern Karnataka. M.A. diss., Deccan College Post-Graduate and Research Institute, Pune.
- 2014b. Palaeolithic Archaeology at Kibbanahalli, Southern Karnataka, India. *Antiquity* 88 (342) (Project Gallery). <http://journal.antiquity.ac.uk/projgall/srinivas342>
- 2017a. Preliminary Observations: Palaeolithic Investigations at Kibbanahalli, Southern Karnataka. *Man and Environment* XLII, No.1: 21-35.
- 2017b. Role of Social Matrices in the Preservation of the Archaeological Record: A Case Study of the Differential Preservation of the Archaeological Record in the Kibbanahalli Palaeolithic Complex, Southern Karnataka, India. In *Sustainability and Sociocultural Matrices: Transdisciplinary contributions for Cultural Integrated Landscape Management*, Vol. III, eds. L. Oosterbeek, B. Werlen and L. Caron, 27-36. Arkeos 42.
- 2017c. The Missing Piece: A Review of Lower and Middle Paleolithic Archaeology in Southern Karnataka, *Heritage: Journal of Multidisciplinary Studies in Archaeology* 5: 715-734.
- Sripada Rao, K. 1930. On Some Stone Implements from South India. *Journal of Mysore University*. 4 (2): 1-8.
- Subbarao, B. 1949. *Prehistoric and Early Historic Bellary* (2 volumes). PhD diss., University of Bombay, Bombay.
- 1958. *The Personality of India*. Baroda: The MS University of Baroda.
- Sudheer, K.P., K. Srinivasan, B. Narasimhan, J. Thomas and Mrs. Jesna. 2019. *Morphological Study of Krishna and Tungabhadra Basins Using Remote Sensing Technique*. Chennai: IIT Madras.
- Swaminath, J. and M. Ramakrishnan. 1981. Early Precambrian Supracrustals of Southern Karnataka. *Memoirs of the Geological Survey of India*, No. 112.
- Tandon, S.K., P.P. Chakraborty and V. Singh. 2014. Geological and Tectonic Framework of India: Providing Context to Geomorphologic Development. In *Landscapes and Landforms of India*, ed. V.S. Kale, 3-14. Dordrecht: Springer.
- Tenginkai, S.G. and A.G. Ugarkar. 1987. Gold Bearing Rocks of Mangalur Greenstone Belt, Gulbarga District, Karnataka. *Proceedings of the Indian Academy of Sciences (Earth and Planetary Science)* 96 (2): 103-117.
- Westgate J.A. and N.J.G. Pearce. 2017. Quaternary Tephrochronology of the Toba Tuffs and Its Significance with Respect to Archaeological Studies in Peninsular India. In *Beyond Stones and More Stones: Defining Indian Prehistoric Archaeology*, Vol. I, ed. R. Korisettar, 199-233. Bengaluru: The Mythic Society.



Korisettar *et al.*, Pl. 1: Regolith exposure around Kuvempu University campus, Shankaraghatta



Korisettar *et al.*, Pl. 2a and b: Acheulian Bifaces from Shankaraghatta Palaeolithic Complex, Malnad Borderlands, Karnataka



Sinha and Murty, Pl. 1: Muchchatla Chintamanu Gavi-II (MCG-II) – Excavation in progress