LATE MIDDLE PLEISTOCENE ENVIRONMENT AND
ACHEULIAN CULTURE AROUND DIDWANA, RAJASTHAN

V N MISRA, S N RAJAGURU and H RAGHAVAN

Deccan College, Poona 411 006, India

(Received 1 February 1988)

Several primary Acheulian sites have been investigated around Dignawa in
Nagaur district of Rajasthan in the context of relict channel deposits,
calc pans, fossil dunes and palaeosols. On the basis of lithostratigraphy
and a few $^{14}$C, U/Th and TL dates, these sites have been dated to late
Middle Pleistocene (c. 200,000yr B. P.). Acheulian assemblages consist of
handaxes, cleavers, choppers, chopping tools, polyhedrons, spheroids,
scrapers, denticulates, unmodified flakes and cores, and are made on quartzite
and quartz. They occur mostly buried in the calcareous loam of the
Amarapura Formation. The artefacts are in a remarkably fresh condition.
This fact together with the geological context of the assemblages effectively
rules out transportation or re-sorting of the artefacts. The Didwana
Acheulian industry thus provides us a rare example of a true primary context
situation for open air Acheulian sites in the country. Most of the known
assemblages belong to the early stage of Acheulian technology.
They are characterized by predominance of core tools, low proportion of
retouched flake tools, extensive use of stone hammer technique and complete
absence of the use of Levallois technique. Presence of aridic soils
within the aeolian member of Didwana Formation, prolific occurrence of
calciu m carbonate in all the Quaternary formations, and the gradual weakening
of the fluvial system indicate that the climate was semi-arid to arid
during the late Middle Pleistocene.

Key Words: Middle Pleistocene; Palaeoenvironment; Rajasthan; Acheulian Culture

INTRODUCTION

During the last two decades, considerable progress has been made by earth
scientists and archaeologists in understanding the environment of Late Pleistocene
and early Holocene Stone Age cultures of western India and northern Deccan.
Stratigraphic, sedimentological and palynological evidences combined with radiometric
dates clearly show that the semi-arid zone of Rajasthan experienced a
distinct dry climate during the terminal Pleistocene (c.20,000–10,000yr B. P.) and
a marked sub-humid climate during Early and Middle Holocene (c.10,000–4,000yr B. P.).

The paucity of Upper Palaeolithic sites and the abundance of Mesolithic sites can both be explained in terms of climatic fluctuations.

However, our knowledge of Middle and early Late Pleistocene has remained
inadequate due to the paucity of geological, archaeological and geochronological
evidence, specially from Rajasthan. The availability of U/Th series dates on
Miliolite Formation from the Hiran valley in Saurashtra enabled us to understand
the lower and upper Palaeolithic cultures of the region in the context of sea level changes of the Late Pleistocene. The Acheulian culture in Saurashtra peninsula existed when the sea level was lower than the present at least by 20m and the climate was hot and dry. In the northern Deccan, the Acheulian culture flourished in open pediment valleys drained by shallow braided streams which were lined by gallery forests. The climate was dry and semi-arid.

In the Thar desert, one of us (VNM) had discovered Middle Palaeolithic sites with late Acheulian elements in association with palaeo channels of the Luni river in the late fifties. Later on, Allichin et al. discovered Middle Palaeolithic sites in the context of fossil dunes and palaeosols at Budha Pushkar in Ajmer district on the western flank of the Aravallis. They also found a few Acheulian artefacts in a hillslope wash at this site and on surface at Marwar Bagra in Jalore district. Conclusive evidence of any significant Acheulian occupation of the region, however, remained elusive.

This gap in our knowledge has largely been filled by the interdisciplinary research carried out by the scientists of the Department of Archaeology, Deccan College, Pune, over five years between 1980 and 1985. The work involved location and excavation of Acheulian and later sites, mapping of Quaternary sediments, construction of firm stratigraphic sequences, morphometric and chemical studies of sediments and pedogenic products, and dating of sediments and archaeological horizons by several radiometric techniques. While exploratory surveys were carried out across the entire arid and semi-arid zone of Rajasthan, intensive work, specially excavation, has been concentrated around the town of Didwana in Nagaur district of the State.

Didwana (74° 35'; 27° 24') is located on a flat, undulating plain formed by stabilized longitudinal and obstruction dunes (Fig. 1). South of the town there is a salt lake 7km long and 2.5km wide. To the southwest of the town there is a shallow depression known as Singi Talav. It is 3km long and 1km wide and is oriented almost east to west. This depression is bound on the north by the Didwana-Jayal road, on the west by low hills and on the south by sand dunes and sand sheets which separate it from the salt lake. The hills are outliers of the Aravallis. They are composed of carbonaceous phyllites and schists with quartzitic intrusions in them. The quartzites in turn are traversed by vein quartz. Quartzite inselbergs are also seen further west near Kolia village. Towards north of Didwana the land rises gently and becomes more sandy until near Ladnun where Vindhyan sandstone crops up on the surface.

Observations on superficially exposed deposits reveal the existence of three major geological formations of Quaternary age in the area. These are; (1) Jayal, (2) Amarpura, and (3) Didwana. To understand the internal stratigraphy of these formations, their relationship with one another and to recover archaeological material buried in them a large number of available exposures were examined. Besides, regular excavations were carried out at four sites, namely, (1) Jayal, (2) Singi Talav, (3) Indola-ki-Dhani, and (4) 16R locality, the last three located close to Didwana.
town. The exposures available for study consist of (1) quarries of calcareous loam, tanks and Bangur canal dug in Amarpura Formation, (2) quarries in colluvium along hill slopes, (3) road and rail cuttings, Bangur canal and wells dug in the sand member of Didwana Formation, and (4) wells and trenches dug in the playa
member of Didwana Formation in several salt lakes for commercial extraction of brine.

**Jayal Formation**

This formation is best exposed over a stretch of nearly 50km between Ladinun and Jayal. Patches of gravel bed are also observed between Rol and Jenana. This formation is nearly 20–60m thick and is composed of poorly sorted, clast-supported bouldery-cobbly gravel. Lenticular patches of silty and clayey sands are common. Lithologically the boulders and cobbles are dominated by orthoquartzite, quartzitic sandstone and vein quartz. Gneiss and sandstone are also present in minor amounts. The gravel is well sorted to rounded and exhibits two generations of cementation. Evidence of ferricretisation is observed in the quarries at Ambali, southeast of Jayal.

This represents one of the earliest evidences of humid climate in the region. Ferricretised outcrops of the formation are overlain conformably by calcritised gravels. The gravel spread is in the form of an undulating ridge. Considerable modification of the gravel bed by erosional processes and the degree of calcritisation suggest high antiquity for the formation. The high degree of rounding of the gravels is indicative of long distance transport over a steep gradient on the basis of the occurrence of similar gravels near Mokheri, south of Phalodi and stratigraphical observations on Shumar and Marh Formations in Bikaner district. The Jayal Formation can be tentatively dated to Late Neogene to Early Pleistocene.

**Amarpura Formation**

This formation is named after village Amarpura located 3km west of Didwana. It rests either against or on the Jayal Formation. It comprises calcareous loam, marl and calcrite nodules. It is extensively exposed in low lying areas. The formation extends from Didwana to Pallu, about 100km north and to Ramgadh, 90km east. The thickness of the formation varies from 1 to 20m. It is best exposed in the lime quarries of Amarpura village. The following description is based on observations made in several quarries around Didwana and on detailed geocorarchaeological excavations between Singi Talav and 16R locality.

Light yellowish brown (2.5YR 6/4 or 10YR 6/4), 1.10m thick, structureless and pedogenised aeolian sand disconformally overlies the Amarpura Formation in the Amarpura quarry. This brownish sand is similar to Litho-unit 1 of 16R dune. The upper 2m of the formation consists of calcrite nodules varying in size from 3 to 6 cm across. The top 60cm of this unit comprises calcium carbonate clasts. They are pale brown (10YR 6/3), well-rounded and vary in size from 2 to 3cm across. The matrix between the calcrite nodules is predominantly greyish green or light grey (2.5YR 7/0), fine sand, mottled and crudely laminated. This unit grades into a unit of alternating pinkish, medium to coarse grained, moderately calcritised sand. It varies in thickness from 15 to 20cm with a dip of 5–8° southeast, i.e., towards the depression of Singi Talav. Laminations are crude. Desiccation cracks in
sandy layers are filled with greyish, calcareous silty clay. Lenses of greyish clay occur within the bands of fine silty clay. Three hard, indurated calcritised horizontal layers of 5 to 30cm thickness occur within this horizon at depths of 2.60-2.90m, 4.50-4.60m and 5.40-5.45m, indicating periodic subaerial exposures. Lower Palaeolithic tools commonly occur just above these calcritised bands. The lower part of this formation is best exposed in Singi Talav quarry (Figs. 2 and 3) where 3.50m deposit of greyish silty calcareous clay is strongly mottled and well laminated. The Amarpura Formation rests on Precambrian granites and phyllites, and has a total thickness of 15 to 20m. Field characters such as crude laminations, alternations of medium coarse sand with silty clay, mottling, weak calcritisation in the lower unit, abundance of diffused carbonate and a high content of calcareous clay suggest that these sediments were deposited in shallow water pans or in flood plain flats or in weakly organised low energy channel pools. The upper part of this formation has yielded Middle Palaeolithic tools at Mangalpura and several other localities while the lower part has preserved Acheulian assemblages. On the basis of archaeological data, the formation spans in time from Middle to early Late Pleistocene.

**Didwana Formation**

This formation consists of aeolian and lacustrine sediments which are well and extensively exposed in the desert. The best exposure of the aeolian member of this formation is seen in the profile of the 20m trench excavated by us at 16R locality in the Bangur canal near Didwana (Fig. 3). This dune section has been divided into three major lithological units. Litho-unit I consists of well-sorted, loose, structureless fine sand which is yellowish brown in colour (10YR 6/4) in the upper 80cm from the surface. This sand is noncalcareous in the upper part and grades to a pale brown (10YR 7/3), structureless, loose fine sand, and contains small (1 to 2cm) powdery calcite pellets down to a depth of 4.90m. Litho-Unit I is separated from Litho-Unit II by a 10cm thick layer of coarse sand comprising angular to sub-rounded pieces of schist, phyllite, slate, quartz and quartzite. This layer is of colluvial origin. The following 3.05m of Litho-Unit II is characterised by densely packed calcitic nodules (2 to 4cm) within light grey (10YR 7/2), loose, well-sorted calcareous fine sand alternating with calc bands of 3 to 5cm thickness. The sediments within the bands reveal a light yellowish brown (10YR 6/4) to pale brown (10YR 7/4) loose, massive, moderately sorted loamy sand. The underlying sequence of 10.95m of Litho-Unit III is brown to pale red (7.5YR 7/4), medium sand with strong development of large, hard, microcrystalline calcareous nodules (5 to 25cm). These nodules are concentrated in the upper layer of 1m and are randomly dispersed in the lower part. This unit is interspersed with eight calc bands of 5 to 20cm thickness. The calc band at 18.60m is pinkish, strongly indurated, oolitic and is calcified as petrocalcic horizon.

Field observations reveal that the top 80cm of Litho-Unit I is a cambic horizon and the 3.50m of Litho-Unit II is a complex BCa horizon. Litho-Unit III is largely affected by calciorthid type pedological processes. The occurrence of colluvial
Fig 2 Stratigraphical sections around Didwana.
Fig 3 Excavated trench (16R) showing three Lithounits of aeolian origin.

Fig 4 Early Acheulian handaxes, Singi Talav.
wash in the form of locally derived schists and slate fragments and the presence of calcrete clasts in units II and III indicate local fluvial contribution in the formation of this entire profile. All the three lithological units of 16R section are exposed in a well owned by one Mr Ram Lal, 1km northeast of 16R and several other places in Nagaur district. Mesolithic artefacts have been found on the surface of the dune. Upper Palaeolithic tools occur between 5.40 and 6.10m of Litho-Unit II, Middle Palaeolithic between 9 and 13m of Litho-unit III and a few Lower Palaeolithic tools between 17.20 and 18.40m in Litho-unit III.

Radiometric ($^{14}$C and U/Th) dates were obtained by one of us (HR) on pedogenic carbonates of various lithological units. One $^{14}$C date on calcium carbonate nodule from the Upper Palaeolithic layer is 26,210 ± 2,200yr B. P. (PRL 911). Three uncorrected U/Th dates on pedogenic carbonates from three different levels of Litho-unit III are: 1,44,000 ± 12,000yr B. P. (12.65m), 1,50,000 ± 10,000yr B. P. (14.25m), and 1,31,000 ± 15,000yr B. P. (17.55m). These dates represent minimum ages only. TL dating on quartz grains has been attempted for the fine as well as coarse grains at the depth of 17/18m. The date for the fine fraction ranges between 1,08,000 and 1,44,000yr (Alpha Lab No. 963) whereas the date for the coarse fraction is 1,63,000 ± 21,000yr B. P.

Lithostratigraphy, archaeological finds and the few radiometric dates together strongly indicate that the dune building activity began > 2,00,000yr ago and continued with interruptions almost throughout the Late Pleistocene. The playa member of the Didwana Formation is represented in the salt lake sediments which range in age from c.13,000yr B. P. to c.4000yr B. P. Field observations indicate that Litho-unit I of 16R is contemporary with the aeolian sand disconformably capping the Amarpura Formation. A few TL dates on quartz sands from the Amarpura quarry indicate terminal Pleistocene and early Holocene age. Detailed study of litho-facies exposed between 16R and Singi Talav has shown that lower part of Litho-unit II of 16R interferes with the upper part of Amarpura Formation, and a part of Litho-unit III of 16R is contemporary with the lower part of Amarpura Formation. Thus on the basis of field data and available absolute dates we can assign a late Middle Pleistocene age to the Acheulian sites located in dune-palaeosol context of 16R and in mud flat-pool context of Singi Talav. In order to understand the depositional environment of aeolian sediments of the Didwana Formation, detailed sedimentological studies were carried out and they have been summarised below.

**Sedimentological Studies**

Textural study of the sediments of Litho-unit I shows that the mean grain size of the sands ranges from 2.19 to 4.13phi. The sands are well-sorted with standard deviation varying between 0.040 and 1.435. The sand grains are negatively skewed and have greater percentage of fine population. These textural characters strongly indicate aeolian deposition. On the other hand, the sand grains of Litho-units II and III range in mean size from 2.42 to 3.07 phi. They are moderately sorted, negatively skewed and have an admixture of fine and coarse populations. Since
textural attributes of units II and III did not provide an unequivocal answer to the mode of deposition of the sand, we carried out SEM studies on ten samples covering the entire 16R profile. SEM studies reveal aeolian features like well-rounded grains with dish-shaped concavities, upturned plates, and chemical solution pits on fine sand grains in Litho-unit I. As against this, the grains of litho-units II and III show a combination of fluvial and aeolian features. Characters such as sub-angular grains with V-shaped pits, parallel steps and grooves indicate fluvial activity while subrounded grains with solution pits, upturned plates, and striations suggest modification of the original fluvial material by aeolian agency. Thus textural and SEM studies together suggest wind as the major agency responsible for the deposition of the sands of the entire profile. Micromorphological analysis of 24 samples covering all the three litho-units reveals two sub-populations of grain size; coarse and fine. Proportion of coarse (300 to 500 μm) to fine (110 to 20 μm) is 1:4. The coarse population predominantly consists of rounded quartz and quartzitic grains with weakly developed corrosion fissures infilled with iron oxide. On the other hand, the fine sand fraction is moderately to well-sorted, rounded to subangular, and consists of quartz (30–35 per cent), feldspars (15–20 per cent), quartzitic schist (10–12 per cent), amphiboles (5 per cent) and other minerals like zircon, tourmaline, garnet, pyroxene and opaques (5 per cent). All these mineral grains are fresh to weakly altered. Hornblende and plagioclase grains in Litho-units II and III have hematitic coatings around them. Other mineral grains have a clay coating with weak orientation, medium birefringence and wavy extinction. Development of channels and calcium carbonate nodules within dune sediments indicates pedogenesis. Clay eluviation and illuviation features were not observed in any one of the soils. The red colouration in Litho-unit III is due to in situ weathering of iron rich minerals like hornblende and plagioclase. Weak pedogenesis of the dune sediments appears to have kept pace with the slow rate of aeolian sedimentation and thus has given rise to cumulative aridic soils within Litho-units II and III. In order to understand the mode of calcification of the sediments we carried out detailed studies on varieties of calcretes encountered in 16R profile, Amarpura Formation and on valley pediments. Important aspects of these studies are summarised below.

Calcretes vary in their morphology, spatial extent, degree of cementation and crystallinity. On the basis of these characters they have been classified as (a) calcrete soil, (b) powdery calcrete, (c) nodular calcrete and (d) hardpan calcrete. Calcrete soil and powdery and nodular calcretes are found to occur in the 16R dune profile, Singi Talav and Amarpura quarry. Hardpan calcretes are observed as valley pediments over granites, calc-phyllites and the Jayal Formation.

Micromorphological studies of all types of calcrete reveal that in general the calcretes, irrespective of their type, shape and size, consist of detrital grains of quartz, plagioclase, microcline, biotite, muscovite, harnblende, etc. They are cemented by low magnesium calcite. Micrite (2–4 μm) occurs as a cementing material between the grains and also as a rim around the nodules. Biological features are represented by root pores, channels and voids. Nodules within the aeolian sedi-
ments are at times diffused and show high porosity, and the soils adjacent to nodules are depleted of calcium carbonate. Some of the nodules, particularly in the hardpan variety, have coating of fibrous attapulgite. These characters of various calcretes show that they have formed subaerially either in pure pedogenic environment or in fluctuating groundwater conditions. Calc bands of 16R profile owe their origin primarily to groundwater fluctuation, while nodules, soft pellets and powdery calcretes and crystalline concentrations of 16R profile are the product of pedogenic as well as groundwater processes. Presence of attapulgite suggests highly evaporating environment.

Field and laboratory studies of the profile thus show that these aeolian sediments have undergone slow but complex pedogenesis in semi-arid and arid environment.

**Palaeoenvironment**

To understand the changes in stream behaviour and the interplay between fluvial and aeolian processes in the area it is necessary to know the effective role played by two important physical parameters, neotectonism and climate, in shaping the early Quaternary landforms of western Rajasthan.

**Neotectonics**

Recent investigations by Das Sarma and Sinha Roy clearly show that features like raised terraces, stream captures in the continental divide of the Aravallis, uplifted Gossan zones and changes in the hydrology of the lakes are suggestive of the activation of gravity and strike slip faults (e.g. conspicuous east-west running Didwana-Dausa fault). The renewed tectonic activity probably took place along the faults in the Delhi ridge and/or at the contact of Bundelkhand-Berach massif and the Vindhyan ridge. These neotectonic movements can be explained as a backlash due to the resistance to the Indian plate movements at its northern collision front.

Geomorphic features like Jayal gravel ridge, raised hardpan calcrete and salt lakes like Didwana not only support observation of Sinha Roy but also help us in dating the Quaternary tectonic activity as follows.

(a) **Jayal Formation**: As mentioned earlier, it represents braided fluvial system of late Tertiary or early Pleistocene age. Petrographic study of lithocomponents of this formation shows that the ancient stream was draining the western slopes of the Aravallis. Today this formation occurs as a ridge in an otherwise flat landscape and does not have any linkage with the Aravallis. Thus the anomalous geomorphic expression of the gravel ridge is suggestive of Late Neogene tectonic activity.

(b) **Raised Calcrete Beds**: These are conspicuous calcrete platforms around Jayal, Didwana and other places in Nagaur district. Detailed micromorphological studies of these hardpans have shown that they represent valley floor accumulations. These valley floor calcretes are older than Amarpura and Didwana Forma-
tions and probably younger than the Jayal Formation. The exposition of these valley floor calcrites as raised plateaux therefore supports tectonic activity during the Early Pleistocene.

(c) *Didwana Salt Lake*: Detailed geoarchaeological studies\(^4\) have shown that the salt lake is at least 20,000 years old. Recent studies of the subsurface geology between Sambhar and Didwana by the Geological Survey of India (1985) have shown that valley floor calcrites occur as channel deposit which in turn got affected by tectonic activity during the late Pleistocene along the Didwana-Dausa strike fault.

These three geomorphological features thus clearly show the importance of neotectonic activity in shaping the Quaternary landforms of the area.

**Palaeoclimate**

In view of the importance of Quaternary tectonics in the Thar desert, it is very difficult to interpret geomorphic events like shift from a braided to anastomising or meandering system, formation of inland lakes, disorganisation of drainage systems and expansion and stabilisation of dunes in terms of climatic changes alone. As stated earlier, the late Quaternary climatic history of the Thar desert is comparatively well-documented due to the availability of adequate number of \(^{14}C\) dates and of climatically sensitive parameters like evaporites and pollens of inland lakes. For the late Middle Pleistocene (200,000–130,000yr B. P.) we have to depend heavily on mineral characters of the Didwana and Amarpura Formations.

**Amarpura Formation**

It represents sedimentation either in an interdunal pan environment or pools in structural depressions or in mudflats associated with an anastomising stream system or a meandering system with low sinuosity. Presence of dolomite in these calcium carbonate-rich loamy sediments indicates a system with highly fluctuating groundwater under the influence of strong evaporation. Microscopic features such as sesquioxide minerals cement and micritic rims indicate shallow waterlogging. Study of borehole logs down to a depth of 50m east and northeast of Didwana reveals presence of medium to coarse sands resting disconformably on valley floors and complete absence of well rounded pebbly-cobbly gravels. These two features indicate ephemeral braided streams characteristic of desertic environment. Gradual weakening of drainage system and more or less steady decline in southwest monsoon both perhaps influenced by Himalayan orogeny have produced late Middle Pleistocene landscape of the region. The depositional environment of Amarpura Formation reveals the existence of a moderately organised drainage system in the area which implies existence of surface water on a significant scale. How this became possible has to be investigated. Precipitation during this period would have been relatively higher than in the terminal Pleistocene when the drainage system became totally defunct.

**Didwana Formation**

Detailed field and laboratory studies of 16R aeolian sand and associated carbonates and palaeosols (of 16R) have shown that the sand accumulation was slow,
and weak pedogenesis kept pace with it. These processes were periodically interrupted by the accumulation of colluvium. Calc bands, hardpan calcretes and hard kankar concretions (of unit III) show strong influence of groundwater as a result of fluctuations in precipitation. These features broadly suggest strong evaporating environment characteristic of semi-arid climate. In this dry environment dust storms were not rare. This is indicated by the presence of sand-silt grade calcic grains. Similarly, colluvial gravels indicate intermittent rainstorm activity during the late Middle Pleistocene.

ACHEULIAN OCCUPATION

Except for sites located on the surface of the Jayal gravel ridge, Acheulian, as indeed all Palaeolithic, sites in western Rajasthan are buried beneath the surface in the Quaternary deposits. Absence of stream channels, low rainfall and high porosity of the sandy mantle have all contributed to the almost total elimination of fluvial erosional processes and consequently to the lack of natural exposures of the Quaternary deposits. This in turn has greatly restricted the scope of locating Palaeolithic sites. Such sites as are known to us have all been exposed because of human activities like quarrying for calcareous loam of the Amarpura Formation or hillslope colluvium and tank digging. Most of these sites are located near and around Didwana town where our exploration work was largely concentrated. However, we have also found Acheulian sites far away from this core area at places where artificial exposures are available. One small late Acheulian handaxe was found in the calcareous loam spread along roadside near Ramji-ka-Gol village north of Sanchor in Jalor district. This loam came from a nearby calcareous loam quarry. A small Acheulian assemblage was found in the section of an irrigation channel dug through the hillslope colluvium near Bhadrajun village between Pali and Jalor towns. Thus it seems fairly certain that Acheulian occupation was widely distributed in the desert. Investigation of available exposures will certainly bring to light many more Acheulian and later Palaeolithic sites.

Our knowledge of the Acheulian culture is at present confined essentially to stone tool technology and the nature of the settlement pattern. At no site has any biological material been preserved to give us an insight into the Acheulian diet and hunting and butchery practices. Most of the known Acheulian sites are located in the Amarpura Formation which implies that the Acheulian populations lived when this formation was being deposited. Our excavations at Singi Talav near Didwana and our examination of many quarries in the area has shown that the artefacts are not uniformly spread through this deposit; instead they occur in clusters at some spots intervened by sterile zones. The artefacts are remarkably fresh, often giving the impression of having been made only yesterday. These facts together with the complete absence of coarse sediment in the formation effectively preclude the possibility of archaeological material having been transported or resorted. In other words, the Acheulian sites in the Didwana area are in a true primary context. Infact, among the buried open air Acheulian sites known in India the Didwana group of sites provide the best primary context example. The depositional environment of Amarpura Formation suggests that the Acheulian
human groups camped along the shores of floodplain pools and along the banks of low shallow energy channels. Extensive Acheulian scatters occur on the surface of the Jayal gravel ridge over several kilometres south of Jayal. Here no doubt the main attractions for Acheulian populations were the unlimited supply of suitable raw material for tool making and the commanding view of the landscape from the height of the ridge. Adequate water must have been available to the human and animal populations in the inter-ridge depressions and stream channels in the vicinity. One such channel survives to this day near Chhajoli village south of Jayal. The same attractions must have operated in the case of hillslope occupations.

The raw material used for making artefacts was generally quartzite and quartz. These were obtained, in the case of sites close to Didwana, as blocks from the nearby Aravalli exposures, in the case of hillslope sites as cobbles from the colluvium, and in the case of sites on the Jayal gravel ridges as boulders. The material on the Jayal gravel ridge sites is of a fine-grained quality while that from the other sites is usually coarse-grained. The assemblages comprise handaxes, cleavers, chopping tools, polyhedrons, spheroids, scrapers, denticulates, flakes and cores. Majority of the tools including the bifaces are made on cores (Fig. 4). Cleavers are rare and are crudely made. Most of the sites represent early stage of Acheulian technology. However, a fairly large assemblage collected from the loam removed during the digging of a tank at Jankipura village, 3km west of Didwana includes thin and symmetrical handaxes representing late Acheulian technology. Since the upper part of the Amarpura sedimentation contains at least two phases of the Middle Palaeolithic at Mangalpura and Jenana, respectively, the presence of a late Acheulian stage in the area is perfectly understandable.

CONCLUSION

To sum up, the Acheulian sites investigated around Didwana are in the best primary context situation known for open air Acheulian sites in India. Detailed field studies of Quaternary geological formations and laboratory studies of sediments and soils have provided us a fairly clear picture of the environmental setting in which Acheulian populations flourished in western Rajasthan. And finally, application of C14, U/Th and TL dating techniques on pedogenic carbonates and sands has given us a fairly reliable timeframe for the Acheulian culture in this region. At the moment this kind of multidisciplinary effort for understanding the nature of Acheulian technology, settlement pattern, environmental setting and temporal context is confined only to the semi-arid regions of Rajasthan and Saurashtra. Extension of similar effort to other parts of the country will considerably help in augmenting our knowledge of the Acheulian culture.

ACKNOWLEDGEMENTS

The authors are grateful to Drs Martin Williams of Geography Department, La Trobe University, Melbourne and Marie Court of Agronomical Research Institute of Grignon, France, for their help in the study of Quaternary geology and
pedology around Didwana. Thanks are also due is Drs D P Agrawal and S K Gupta for their help in radiometric dating of carbonate samples and Dr R P Dhir of CAZRI, Jodhpur and Shri Das Sarma of the GSI, Jaipur, for academic discussions. The financial support received from the Ford Foundation, New Delhi, for carrying out the research reported in this paper is gratefully acknowledged.

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