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Pleistocene Climatic Changes in Western India: A Geoarchaeological Approach

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Recently Dhavalikar in his A. Ghosh memorial lecture titled "Indian Archaeology in the 21st Century" delivered on 25th September 2011, in New Delhi, strongly emphasized the need of understanding past cultural changes in terms of palaeoenvironment. He has suggested that growth and decay of protohistoric and historic cultures in India have been largely influenced by changes in the intensity of monsoonal rainfall during the Holocene, approximately last 10,000 years. In the last 25 years considerable new scientific data have been generated for the Holocene climatic changes in India (Singhvi and Kale 2009). It is observed that the early Holocene (~ 10 ka years to 4 ka years) was significantly wetter than the late Holocene (< 4 ka years). These changes in summer rainfall of India have been mainly due to global climatic factors. In the present communication we have attempted to understand prehistoric cultural changes against the background of climatic changes of the Pleistocene, approximately covering time span from about 2 Ma years BP to about 10 ka BP. Recently Sanyal and Sinha (2010) and Singhvi *et al* (2011-12) have attempted reconstruction of palaeomonsoon in Indian subcontinent by using data generated through multidisciplinary studies of marine cores, continental- fluvial, fluvio-lacustral, aeolian, glacial and littoral deposits- preserved in different parts of India. However, there is no input of prehistoric cultural changes in these publications. We have, on the other hand, taken a review of palaeoclimate studies in the context of early human cultures in India in general and western India in particular (Mishra and Rajaguru 2001, Mishra *et al*. 2003, Deo *et al.* 2007). Following is a summary of cultural ecology of Western India.

Western India comprises parts of Rajasthan (Thar desert), Gujarat and Maharashtra. This region has varied climate and landscape. Western Rajasthan is an area of internal drainage, with dunes, playas and rock-cut pediments. The Luni, Sabarmati, Mahi river basins to the south of Western Rajasthan, show influence of both fluvial and aeolian processes, Aeolian landforms are absent in Western Upland Maharashtra which is drained by allochthonous rivers such as Godavari, Bhima and the Krishna having catchment in humid Western Ghats. The region is semi-arid to arid receiving summer monsoonal rainfall (80%) and winter rainfall (20%). Evapo-transpiration rate is high and wind activity is strong during summer months (May to July).

The Quaternary deposits are unusually thick (~300 m) in structural basins of Central Gujarat and Northwestern Rajasthan and they are thin (< 30 m) in erosional rocky landscape of Upland Maharashtra, Saurashtra peninsular and Western Rajasthan. These deposits unconformably rest on rocks ranging in age from pre-Cambrian to Tertiary. Pleistocene deposits of fluvial, aeolian, fluvio-lacustral, and littoral origin have at places preserved prehistoric stone artefacts, animal fossils, molluscan shells and volcanic ash.

We have attempted to reconstruct palaeomonsoon on the basis of geomorphological, sedimentological and mineralogical studies of stone tool bearing sediments and have also built up archaeo-litho-stratigraphy, relative in major part and absolute stratigraphy in a few cases. Following table gives summary of our findings:

Geological Period	Geomorphic context	Palaeoclimate	Cultural phase and Important Prehistoric sites (see Fig. 1)
Tertiary (Eocene to Early Miocene)	Laterite regolith; Littoral deposits	Humid, Equatorial/Monsoon	Nil
Neogene (Late Miocene to Early Pleistocene)	Anomalous fluvial gravel – affected by ferricrete and calcrete pedogenesis	Sub-humid to wet semi-arid	Nil
Early Pleistocene (1.5 Ma to 0.8 Ma)	Hard pan calcrete with relief inversion; gravel with laterite clasts but without calcrete clasts; volcanic ash lenses	Wet-semi-arid	Acheulian culture (Morgaon, Bori, Chirki-Nevasa)
Middle Pleistocene (> 350 ka to 130 ka BP)	Colluvio-alluvial sediments; calcretised playas, dunes, sand sheets, palaeosols (calcisols) with animal fossils; Littoral Milliolite	Dry-semi-arid with short spells of wet-semi-arid	Acheulian (Didwana, Madhuban)
Late Pleistocene (~125 ka to 10 ka BP)	Colluvio-alluvial calcretised sediment; palaeosols; dunes with palaeosols; playas; Milliolite formation	Arid (22-18 ka BP) to dry-semi-arid with short wet-semi-arid phases (125-100 ka, 60-30 ka)	Middle to Late Palaeolithic (Didwana, Nevasa)

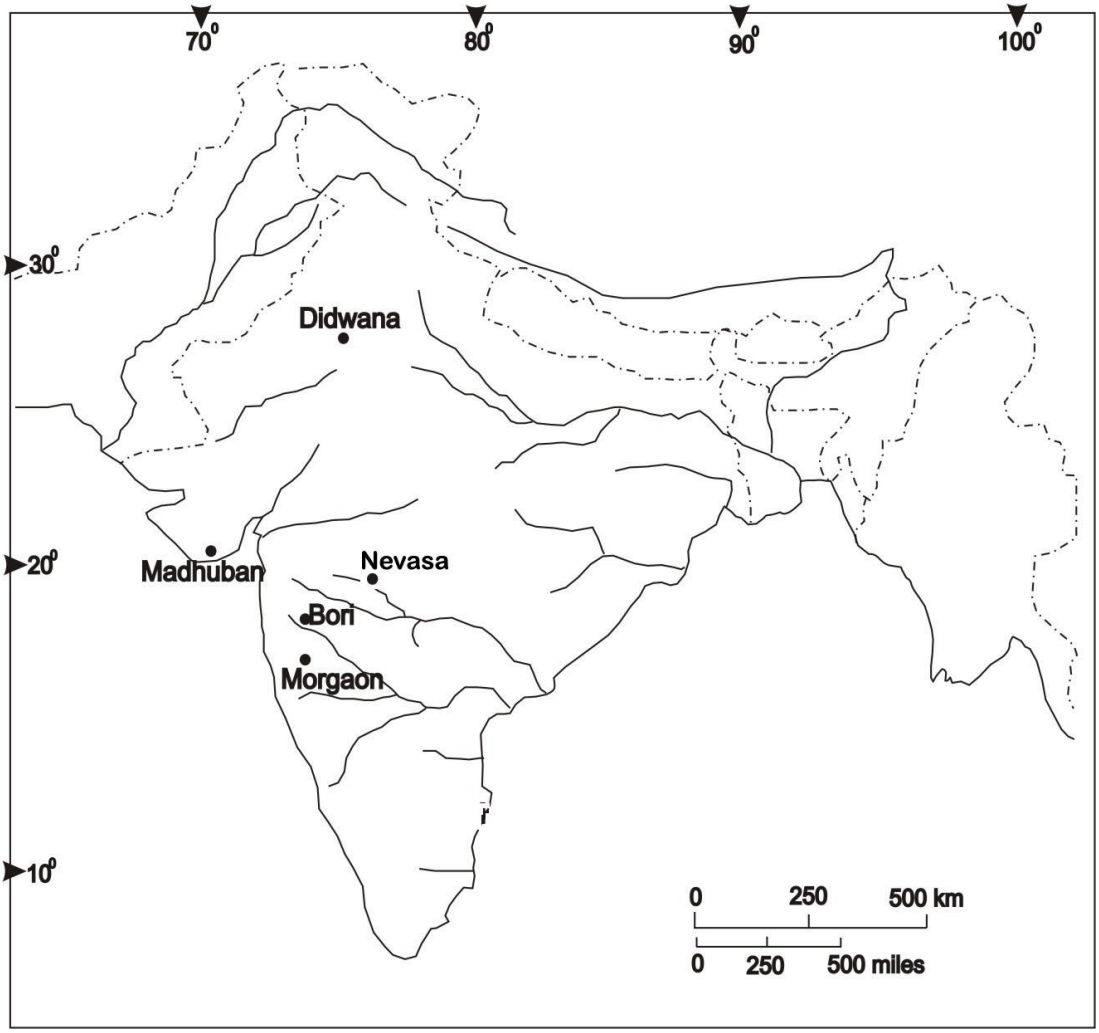

Fig. 1. Map showing location of Prehistoric sites discussed in text.

Briefly Western India has preserved patchy record of prehistoric sites (Early Acheulian to Micorlithic) in varied environmental settings. The climate was primarily arid to semi-arid with minor wet-semi-arid interludes. There is overall tendency of increasing dry climate from Tertiary to the late Pleistocene. These findings go well with findings in Siwalik sediments of Northwest India, Karewa deposits of Kashmir valley and lacutsral deposits of Tibetan Plateau (Basavaiah *et al*. 2010). We have not discussed tectonic and biological aspects of the Pleistocene in Western India. We have also avoided using Marine Isotopic Stages (MIS) as absolute chronological data generated is of limited value due to inheriting problems involved in radiometric dating methods.

In our opinion, climatic changes in Western India were of degree only and not drastic as in higher latitude regions. Therefore, this region might have provided overall congenial climatic environment, arid-semiarid-sub humid since the appearance of early man in the late Early Pleistocene.

Our suggestions for future studies in the cultural ecology of Western India include close collaboration amongst earth scientists, bio-scientists, geochronologists and prehistoric archaeologists for further investigations of promising sites such as Didwana (Rajasthan), Madhuban (Gujarat), Nevasa and Morgaon (Maharashtra).

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