Foraminifera and marine archaeology

One who is proud of his/her rich cultural heritage, always works hard to maintain the high level of civilization and tries to enhance further the living standard of fellow citizens. Beyond the written history, it is archaeology, which reconstructs the past and highlights the cultural heritage. According to Grahamclark, Professor of Archaeology at the University of Cambridge “Archaeology may be subtly defined as the systematic study of antiquities as a means of reconstructing past”. Therefore, based on the artifacts, a number of climatic changes in the past are documented in archaeological investigations, which are reported to have been the cause of the rise and fall of human civilizations.

At the same time, oceans, a source not only of admiration and awe but also of confirming speculations of paleoenvironmental conditions mentioned in literature. The unique contribution of the marine sediments has been for deciphering the changes in oceanographic conditions due to climatic variations in the past.

Since the common aim of oceanography and archaeology lies in the illumination of the past, it is apparent to bring coherence between the two.

The author has made attempts to use his understanding of distribution and ecology of foraminifera along the western continental margin of India to confirm the climatic inferences drawn through archeological studies and even to solve some archaeological controversies peculiar to Indian region.

The author’s contributions in the field of Marine Archaeology can be classified into two main categories i.e. (i) event related to sea level fluctuations and (ii) changes in paleoprecipitational history. Besides this, the author also provided
the bathymetric and sedimentological settings in which most important marine archaeological artifact – shipwrecks can get preserved [40]

The author has collected the evidences of paleo sea level fluctuations in religious and archaeological records and supported them with inferences from the oceanographic studies [38]. Discovery of Lothal dockyard (first Naval dockyard of the world as claimed by archaeologists) in Gujarat and drowning of Dwarka (on west coast) and Pumphar (on east coast) of India are the glaring examples of the role of the sea level fluctuations in shaping the history of mankind over this region of the world. Out of these, “Lothal” is an important and famous name in Indian cultural heritage and presented as evidence of ancient Indian interest in maritime activities around 4,500 years B.P.

Lothal was discovered as a result of systematic survey undertaken by Dr. S. R. Rao in the year 1954 as part of a program for locating Harrapan settlements within the present day borders of India. Out of several important structures excavated, a large rectangular basin like structure became the most important and disputed one. Using almost similar artifacts like triangular stone to interpret the purpose of this structure, two different opinions were advanced by galaxies of Indian and foreign archaeologists. One school proposed the possible use as ‘dockyard’ for maritime activities whereas the other school opined in favour of ‘fresh water storage tank’ for agriculture and bathing.

Since foraminifera are almost exclusively marine organisms, their presence and absence could be a decisive factor in interpreting whether any ancient water body was filled with fresh or marine (brackish) water. With this intention, the author has undertaken a study of sediments deposited in the rectangular body and encountered well-preserved in situ foraminiferal assemblages comparable with marginal marine environment [31]. It was
finally summarized that the rectangular structure was a dockyard, connected through open marine environment with high tidal range and thus settled an old archaeological controversy.

Continuing to highlight the role of sea level fluctuations in shaping the history of coastal regions, the author pleaded with archaeologists [39] to catalogue the monuments of archaeological importance falling in ‘vulnerable zone’ of inundation due to likelihood of suspected sea level rise because of global warming associated with greenhouse effect and plan strategy to safeguard them. Otherwise these monuments will become artifacts for future archaeologists.

Recently, based on foraminiferal ecology [A 45], the author noticed the evidence of drowning the shallow water region off Kachchh. Submerged filled channels (as noticed in seismic records) and evidence of counter uplifting of adjacent land supported the finding. This led to postulate that confluence of ancient mythological river ‘Saraswati’ with sea located in Kori Creek, Kachchh.

In tropical countries like India, monsoonal rain is by far the most important element of climate, which appears often in the form of devastative floods and droughts. Such climatic events (floods, droughts etc.) and their effects on society were recorded right from early historic period. Such historical climatic records are mostly available in form of inscriptions. Such brief accounts of the rise in the food prices, economic conditions of the society, construction of dams/ lakes could be suggestive of severeness of natural disasters, which can cause irreparable destructions to the human society. An abiding regard for the integrity of the archaeological records further increases if compatibility exists between the archaeological and other independent scientific findings. The author has made two such attempts [44 and 61].
In first publication [44], a parallel was exhibited between foraminiferal-based climatic inferences about higher precipitations around 4,000 and 3,500 years before present and archaeological reporting of floods at the same time. It is interesting to note that one of the floods in circa 2,000 (i.e.~4,000 years B.P.) seems to have forced some of the residents of Lothal to move further interior into Rangpur, Koth etc. Harappan devised several measures to save their township from floods. They could not withstand the onslaught of the second great flood in circa 1,500 B.C. (i.e., about 3,500 years B.P.).

If events like construction of dam on "Sudarsana Lake" during the time of Maurya king Chandragupta around 300 B.C. and the memorable flood in Tapti in 1727 when boats sailed over the city walls, damaging the property worth 2,50,000 pounds could be taken as indications of higher precipitations, they are well supported by inferences drawn from foraminiferal variations in marine sediments [61]. Same is the case with droughts around the middle of 13th and 15th centuries.

The above studies suggest a need for more concentrated efforts to compile historical / archaeological records of climatic changes on the one hand and reconstruction of climatic changes through foraminifera from marine sediments on the other hand. The coherent understanding of climatic variability will help to develop futuristic climatic models.