

Problems of Global Warming and Role of Micropaleontologists

Rajiv Nigam

National Institute of Oceanography, Dona Paula, Goa - 403004

Email : rajeev@darya.nio.org.

One of the most challenging problems faced by the mankind today, is the constantly increasing mean annual temperature of the atmosphere of the earth. The gradual increase in the mean annual temperature of the earth's atmosphere during the last century, as a result of natural (?) and anthropogenic influences, is termed as 'global warming'. According to AccuWeather, the world's leading commercial forecaster, global air temperatures as measured by land-based weather stations show an increase of about 0.45°C over the past century. This may be no more than normal climatic variation, or the result of anthropogenic activities, as well as several biases in the data may be responsible for some of this increase. The projections of future climate changes are uncertain. Although some computer models predict warming in the next century, these models are very limited. The effects of cloud formations, precipitation, the role of the oceans, or the sun are still not well known and often inadequately represented in the climate models, although all play a major role in determining our climate.

Origin, existence and welfare of man have inseparable relationship with climate. In past, change in climate caused rise and fall of many civilizations in different parts of the globe. However, the human race has absorbed number of such changes and kept on flourishing as changes were natural and spread over long spans thus giving sufficient time for adaptation and some time even migration. But lust of man for consumerism in 20th century presented the looming danger of global warming in 21st century to

its own race. Accelerated sea level rise and associated inundation of large chunk of land mass, modification of rainfall pattern and associated agricultural pattern, enhance frequency of storms as well as loss of coastal property are some of the consequences of global warming due to greenhouse gasses which require our immediate attention.

Since both the natural and anthropogenic causes are supposed to influence the global warming, so there is a need to quantify both of them. The future furies in nature can be faced with less hardship if they can be predicted, even with certain uncertainties. Prediction is a delicate task and depends on our understanding of paleoclimate. As far as the role of micropaleontologists is concerned they are of immense use for the study of past climate. During the last few decades, the microfossils, especially foraminifera became the prime source to generate paleoclimatic records. Out of several consequences of global warming, the foraminifera have been used extensively, and in certain cases have acquired the position of rule, for deciphering, accelerated sea level rise, changes in monsoon pattern and increasing intensity and frequency of cyclonic storms etc. which are the main concerns of marine scientists.

To formulate the future plans for guarding against the furies of the nature, our understanding of paleoclimatic fluctuations, particularly of the Holocene is of immense use. Over the years, we attempted to enhance our understanding of past changes in sea levels and monsoonal rainfall through

studies of marine sediments as such information are prerequisite to develop reliable long term predictive models.

Changes in past sea levels can be inferred either by shoreline movement or through depth fluctuations at particular point. For the West Coast of India, foraminiferal-based technique for identification of paleo shoreline and the model for paleodepth determination are now available. Efforts were also made to update sea level curve along with identification of gaps in data points (time intervals). Areas, which have undergone substantial emergence and contain foraminifera can be related to some paleo sea level stand. One such exposure has been explored in Goa, which contained well-preserved foraminifera of shallow water origin. Now our agenda should be to fill these gaps for the precise understanding of the paleo sea level fluctuations for the West Coast and similar efforts for the East Coast of India. Till then we have to depend on international figures of anticipated sea level rise due to greenhouse effects for estimating socio-economic implications for our country.

Since the common aim of the oceanography and archaeology lies in the illumination of the past, it is apparent to bring coherence between the two. 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. 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 several important structures excavated at Lothal, a large rectangular basin like structure became the most important and disputed one. 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 other school favoured 'fresh water storage tank' for agriculture and bathing. With this intention, the study of sediments deposited in the

rectangular body and encountered well-preserved insitu foraminiferal assemblages along with gypsum crystals was undertaken. The foraminifera] assemblage is compared with the recent marginal marine environment. It was finally summarized that rectangular structure was a dockyard, connected through open marine environment with high tidal range and thus settled an old archaeological controversy.

In the tropical countries like India, monsoonal rain is by far the most important element of climate, which appears often in the form of devastating floods and droughts. For India, it is more necessary to assess the impact of the changes in the monsoonal rainfall as her economy largely depends on rainfall. 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 the form of inscriptions. But to assess the net impact of the greenhouse effect we require record of paleomonsoonal fluctuations for the last few thousand years and on much finer resolution of time. Such information is prerequisite to understand the climatic systems and the development/testing of reliable long-term predictive models. The high-resolution proxy records for paleomonsoonal precipitation are the need of the hour over which man's impact could be more easily evaluated. Using foraminifera (marine organisms) in marine sediments as proxy for rainfall, attempts have been made to enhance the understanding of paleomonsoons.

One of the most severe natural calamities that frequently strike both east and west coast of India is storm, which causes a huge loss of lives and wealth. To predict the imminent storms the knowledge of cyclicity and frequency of storms during the historic as well as pre-historic past is very much required. The recent study reveals the utility of foraminifera to decipher paleostorms. One of the most storm-prone areas of the west coast of India, the Kachchh, was studied in search of presence of paleostorm signatures. It is postulated that ~8,000 years B.P. sea level had reached in the study area, and sedimentation was influenced by the neotectonics, relative sea level changes and severe storms. The model shows that after ~8,000 years B.P. the

sediments of ~10,000 and ~12,000 years B.P. age were eroded from the deeper region by severe storm(s), transported and redeposited in shallower region thus giving rise an inverted sequence followed by normal sequence deposited between -8,000 and 7,000 years B.P. Thus the study indicated that foraminifera can be used as a tool to decipher paleostorms.

In spite of a number of limitations, the present study established the potentiality of foraminifera in solving variety of site-specific problems of Kachchh region. The study, though directly does not solve, but provides the conceptual framework to find solutions to some of the archaeological phenomena like confluence of ancient river (may be Saraswati), drowning of the legendary city of Dwarka, tectonic features on land like shallowing at Lakhpatt port and formation of Allah band etc.

Quest for an additional tool to decipher the global climatic variations guided us to fishes also. A vast amount of such information is stored in the remains of fishes. In the food chain the fishes form a major contributor to the marine ecology. The west coast of India is not only rich in its mineral resources but also contribute a major portion through fisheries to the economy of our country. A slight change in the climatic condition will lead to the migration or extinction of these fishes, which would in turn affect

the economy of the country. No direct data is available to understand the migratory changes of fishes in the past, but some amount of information, used as proxy for such studies, has been stored in Otolith - the hard parts of fishes. Otolith, which are calcified concretions found within the membranous labyrinth of bony fishes have been studied by ichthyologists, micropaleontologists and fisheries biologists for well over a centuries. These are useful in determining the age of fishes by counting the growth rings or seasonal band on its outer surface. Oxygen isotope studies on otoliths help the paleontologists in determining the paleoclimate/paleotemperature, and are as useful as foraminifera and other calcium carbonate bearing shells.

All these studies prove the importance of micropaleontology for the very existence of mankind. Though foraminifera has acquired the position of a very important and even essential tool for such studies, still there is a need and scope for further development of foraminiferal techniques. Efforts should be made to enhance the applied aspects of foraminifera in various fields, *e.g.* sediment transport, pollution etc. More cores should be studied along with the emphasis on the high resolution paleoclimatic reconstruction for the last 6,000 years. In addition to above a detailed foraminiferal-culture programme with molecular biological approach is the need of the hour.