NEWS AND NOTES

Geological and Geo-Tectonic Settings of Palk-Bay – Gulf of Mannar Area Between India and Sri Lanka—Their Relevance to Sethu Samudram Shipping Canal Project

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EXTENDED ABSTRACT

This paper discusses the geological and geotectonic setting of the Palk Bay (PB)–Gulf of Mannar (GM) area and its relevance to SSCP

The interiors of Tamil Nadu and Sri Lanka are made up of crystalline rocks of Precambrian age. The coastal and off-shore areas exhibit sedimentary rocks of Mesozoic to Cenozoic age, developed in a series of ridges and basins formed by horst-graben structures trending in NNE-SSW to NE-SW, E-W and N-S directions. Bouguer gravity, aero-magnetic and marine magnetic data over PB-GM and surrounding areas support these structures. The tectonic elements represented by the deep crustal fractures and faults within southern India and Sri Lanka include one more direction in NW-SE, besides the three fault directions of the horst-graben structures. All these faults show evidences of neo-tectonic activity in the form of both vertical and lateral strike-slip movements even during the Present day.

Occurrence of a hot spot/mantle plume termed as Rama's hot spot is inferred in the PB-GM area, from High Heat Flow Zones II and III, thermal manifestations of hot water springs and bore-wells, high gravity – low magnetic signatures, reported occurrences of recent extinct volcanoes off Pondicherry and in GM, as well as from probable volcanic activity from marine magnetic surveys off Vedaranyam coast and in GM.

Occurrence of earthquakes all along the Tamil Nadu coast are known during the last two centuries and the epicenter of one earthquake with 3-4 Magnitude is located within PB area, while 3 epicenters of 5-7 M are seen in GM. The line joining the epicenters in GM roughly coincides with the inferred NE-SW trending Gulf of Mannar - Palk Strait (GM-PS) fault. Geophysical studies also indicate that the GM region showing high gravity - high heat flow characteristic is most potential and vulnerable for future earthquakes. Thus it can be seen that the PB-GM area is not only fragile with respect to tectonic movements, but also highly sensitive for higher heat flow manifestations coupled with seismically vulnerable nature. Studies have also brought out that the RS/AB feature is not merely a group of simple sandy shoal or sandy bars of migratory nature. Evidences are available to prove that below such sandy bars, this physical feature forms a distinct geological, geotectonic, oceanographic and oceanic divide that acts as a barrier in controlling the different geological and oceanographic activities in this highly fragile and sensitive area.

Destabilisation of the multifarious barrier zone of RS/AB feature will bring in the following geo-environmental impacts. Tectonic movements along the active fault zones will bring about subsidence and submergence of areas with inundations and flooding as well as collapse of structures, besides inducing earthquakes, causing submarine landslides, which in turn will lead to changes in ocean currents and mini-tsunamis and blocking ocean passages. Fault movements along this fragile zone of high heat flow will bring in excessive heat to the surface, thus changing current movements, the lives of biota as well as higher corrosive and erosive effects of the hot waters causing instability to the canal and bringing about land-slides and blocking the passage of sea, etc. Most importantly SSCP canal will cause heavy devastations along the coasts in case of future tsunamis.

In order to understand fully the sea level fluctuations and shore-line changes as well as geo-tectonic movements through space and time, it is essential to study in detail from historical as well as recent past, various data such as maritime and bathymetric charts of different periods and generations, toposheets of different scales and generations, satellite imageries of different spectral bands and of different band widths, from different organizations of different countries taken during various periods. It is also necessary to carry out different types of modeling studies under simulated conditions of faults reactivation and channel opening, high heat flow manifestations as well as seismic activities etc. and their impacts concerning the variations in oceanic current movements during different seasons, subsidence, slumping and possible submarine landslides and consequential destruction and blocking of channel passages.

The paper also discusses certain geological evidences available for the possible existence of relics of Rama's Bridge over the RS/AB feature. The term Rama Sethu / Adam's Bridge has been defined and described here to represent the distinct physiographic feature that forms geological, geo-tectonic, oceanic and oceanographic divide between PB and GM areas and that probably existed for millions of years. In contrast to this feature, we would like to define the temporary bridge structure that is built by Lord Rama's army on this basement feature as Rama's Bridge. Usage of the two terms without proper definition by many workers and Govt. agencies have caused much confusion.

Many of the geographical and some geological descriptions of Valmiki's writings are found to be accurate with the present day features, denoting the veracity and authenticity of his writings and establishing Ramayana as a historical fact. Valmiki's description of Rama's bridge clearly states that it was built with rock boulders, earth and trees, over the pre-existing loose beach sand and other marine sediments in the seas. Thus it was a 'rock and earth fill structure' supported by logs of wood. In all probability, this temporary structure would not have withstood the fury of the ocean over a period of about 7000 years since Ramayana and would have been completely destroyed and removed. It is possible that some portions of this structure might have been preserved in rare cases.

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where it was covered by later marine sediments and protected from destruction and erosion.

Boreholes drilled along and across RS/AB feature by National Institute of Ocean Technology (NIOT) and Sethusamudram Shipping Canal Project (SSCP) have indicated that within the top 8 to 18m, two layers of loose marine sand sediments, separated by a central zone are encountered in RS/AB. NIOT describes the central zone to be made up of boulders and pebbles of varied composition, such as calcareous sandstone, shelly limestone and corals and interprets it to be not due to any natural phenomenon, but probably due to human activity. On the Sri Lankan side also, similar three layers consisting of a boulder conglomerate bed in between two loose marine sand layers are recorded. On the other hand, SSCP considers that the central zone is made up of indurated calcareous sands and all the three zones are due to natural processes.

In order to understand the true nature of this central zone it is recommended to do large scale pitting to 20m depth till the second loose marine sand zone is reached in RS/AB feature and to carry out detailed underwater videography and close spaced sampling of all the four walls and the base of the pits for determining the composition and age of rocks and sediments. It is simple geological knowledge that such boulder beds made up of variegated sedimentary rocks can not be formed along sea shores either by marine processes or along river mouths (spits or deltas) by fluvial processes. If a boulder bed is established on the RS/AB feature, then it is most probably formed by extraneous forces other than natural processes.

It appears that proper geo-technical and geo-environmental evaluation of Sethusamudram Shipping Canal Project (SSCP) has not been done as a part of pre-project studies. It is therefore recommended that a committee of experts drawn from the various scientific disciplines such as geology, geophysics, remote sensing, seismology, oceanography, environment etc be formed to review all available data and to suggest suitable corrective and remedial measures before proceeding further with the project. Unless all the above investigations and studies are carried out, the existence of the remnants of Rama’s bridge over the RS/AB feature cannot be conclusively disproved.

Lecture delivered on December 18, 2007 at the monthly meeting of the Geological Society of India

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**Perspectives of Prehistory: New Dimensions in the Study of India’s Earliest Culture**

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**EXTENDED ABSTRACT**

The first prehistoric archaeological cultures in India were discovered and studied by the geologist, Robert Bruce Foote, in the 19th century. Since then, a close relationship between the sciences of geology and archaeology played an important part in influencing research into India’s past. This paper discusses ways in which this relationship has evolved and focuses on new approaches being adopted to address questions related to the earliest Palaeolithic cultures in India. In this process of breaking barriers between disciplines, archaeology has often been seen to play a key role in the study of Quaternary landscapes. This paper discusses some key studies conducted in the field of Indian prehistory in this respect, and proceeds to focus on studies being conducted in Northern Tamil Nadu. In this region, a project investigating prehistoric archaeology and palaeoenvironments, under the author’s direction, focuses on using multiple approaches towards the study of past human adaptations.

Explorations and excavations at the site of Attrampakkam are discussed in the context of their contribution towards a new understanding of the earliest cultures of South India.

Lecture delivered on January 30, 2008 at the monthly meeting of the Geological Society of India

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**New Report of Palaeontological Interest**

A well preserved complete fossil apterous heteropteran insect with large thorax considered as true bug is reported from the Holocene sediments near Uttarkashi, Uttarakhand (Parabat Kumar and Mathur, 2007, Jour Paleont Soc India, v 52, pp 163-174).

A new palm leaf *Amesoneuron ladakhensis* sp of Arecaceae is recorded from Tsokar in eastern Ladakh from the Hemis Formation (Middle-Late Eocene) of the Indus Suture Zone, Ladakh Himalaya (India) (Mehrotra et al 2007, Jour Paleont Soc India, v 52, pp 159-162). It is large fragmentary palm leaf with a distinct mid-vein. The importance of the fossil lies in the fact that it was collected from a height of about 15,000 ft where trees are not found now. This finding indicates that the Himalayas were not as high during the middle-Late Eocene as they are today.

A primate dentary pertaining to a new taxon *Suratius robustus* gen & sp., cf. *Onomyidae* is described from the early Eocene Cambay shale deposits of the Vastan Lignite Mine, Gujarat, western India (Bagai et al 2007, Jour Paleont Soc India, v 52, pp 231-234). The described material adds significantly to our knowledge of Early Eocene Primates of South Asia and is potentially important in evaluating current hypotheses advocating Out-of-India or Indo-India-dispersal.

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