National Science Policy without Earth Sciences

Recently the Government of India has reconstituted the Scientific Advisory Committee to the Cabinet (SAC-C) under the chairmanship of A. P. J. Abdul Kalam, Principal Scientific Advisor to the Govt. of India (see *Curr. Sci.*, 2000, **78**, 942). The committee comprises 38 members including a few Secretaries to the Government of India, representatives of scientific organizations, ASSOCHAM, CII and software giant Azim Premji (WIPRO). Unfortunately it did not have any representation from the earth sciences community. The Geological Survey of India (GSI), a 150-year-old premier earth sciences organization, was a notable omission. This organization is entrusted with responsibilities of geological, geochemical and geophysical survey of on-land and off-shore India, airborne survey, discovery and exploration of mineral resources, tapping the resource of the seabed, geothermal resources, glaciology, earthquake and seismic hazard studies, management of landslides, geo-environmental assessment and geotechnical consultancy services for major engineering projects like dams, tunnels, etc. and research and development in the earth sciences, under the charter of the Parliament. More than 2300 geoscientists are employed in GSI. It is comparable to the cumulative strength of scientists employed in CSIR laboratories. Minerals are fundamental to nation building. The mineral wealth of our nation is discovered and explored by GSI. The Director General, a Secretary level post to the Government of India, heads it. Infrastructure components like cement, iron, building materials, glass, sand, etc. are derived from mother earth. Exploitation of these minerals is done by user agencies like Steel Authority of India Ltd, Coal India Ltd, Hindustan Zinc Ltd, etc. Power plants and fuels meet the energy requirements of the nation. Coal, water and nuclear mineral run the power plants. Optimum exploitation and conservation of surface and groundwater resources is the need of the hour. The Central Groundwater Board (CGWB) is responsible for groundwater resources of India. Transport economics and industry are based on the oil resources. Oil and Natural Gas Commission (ONGC) and Oil India are custodians of our oil resources. All these organizations are off-shoots of GSI. Conservation of environment is not feasible without adequate knowledge of earth sciences. SAC-C will be responsible for formulation of National Science & Technology policies, programmes and their implementation. Absence of earth scientists in such a vital committee will be detrimental to the scientific pursuits and nation building. Appropriate representation from earth sciences is desirable and a need of the hour.

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Need to define deep crustal structure of the Bay of Bengal, a major constituent of the north-eastern Indian Ocean

The proposed plate reconstruction models for the juxtaposition of eastern Gondwana continents are mostly based on the concept of Du Toit[1], and Smith and Hallam[2]. However, the reconstruction models in circulation have remained poorly constrained[3] for the early opening of the north-eastern Indian Ocean due to inadequate magnetic data. Recent studies[4] in the Bay of Bengal revealed the presence of Mesozoic magnetic anomaly sequence M11 through M0, NW–SE trending new oceanic fracture zones[4,5] and the magnetic quiet (or smooth) zone[6]. This magnetic smooth zone is a vital missing link in the earlier plate reconstruction models, that accounts for an inaccuracy of ~ 13 m.y.

The Ninetyeast Ridge, a trace of a Kerguelen hotspot, and an approximately N10°W trending subsurface 85°E Ridge are the two major tectonic features in the Bay of Bengal. Different views prevailed about origin of the 85°E Ridge. However, detailed study[7] of the magnetic, gravity and multi-channel seismic reflection data suggests that the ridge was a manifestation of a short sporadic volcanic outpouring of magma through a weak zone, wherein a portion of crustal breakthrough occurred during a reversal within the Cretaceous long normal polarity epoch (118–84 Ma). Different opinions prevailed about the separation time[8,9] and placement[10] of India. Inadequate magnetic data on the conjugate margins constrained severely the hypotheses for break-up of the eastern Gondwana. Understanding of the geological evolution of the eastern continental margin of India has improved considerably with the recent studies[4,6,7]. These new constraints facilitated in tracing the continuous evolutionary history of the north-eastern Indian Ocean since early Cretaceous break-up of the eastern Gondwana continents.

Though the Indian continental margins have been explored since the early 70s for hydrocarbons, much emphasis was not laid to unravel the evolutionary history of the region. Most of the drilling activity in the past was confined to the shallow shelf region and information from deep offshore regions was not available to infer the age and nature of the underlying basement rocks except the drill sites of Deep Sea Drilling Programme (DSDP) 218 and 219 and Ocean Drilling Programme (ODP) Leg 116.

R&D activity has gained momentum in the recent times to explore the continental shelves and deeper parts of the

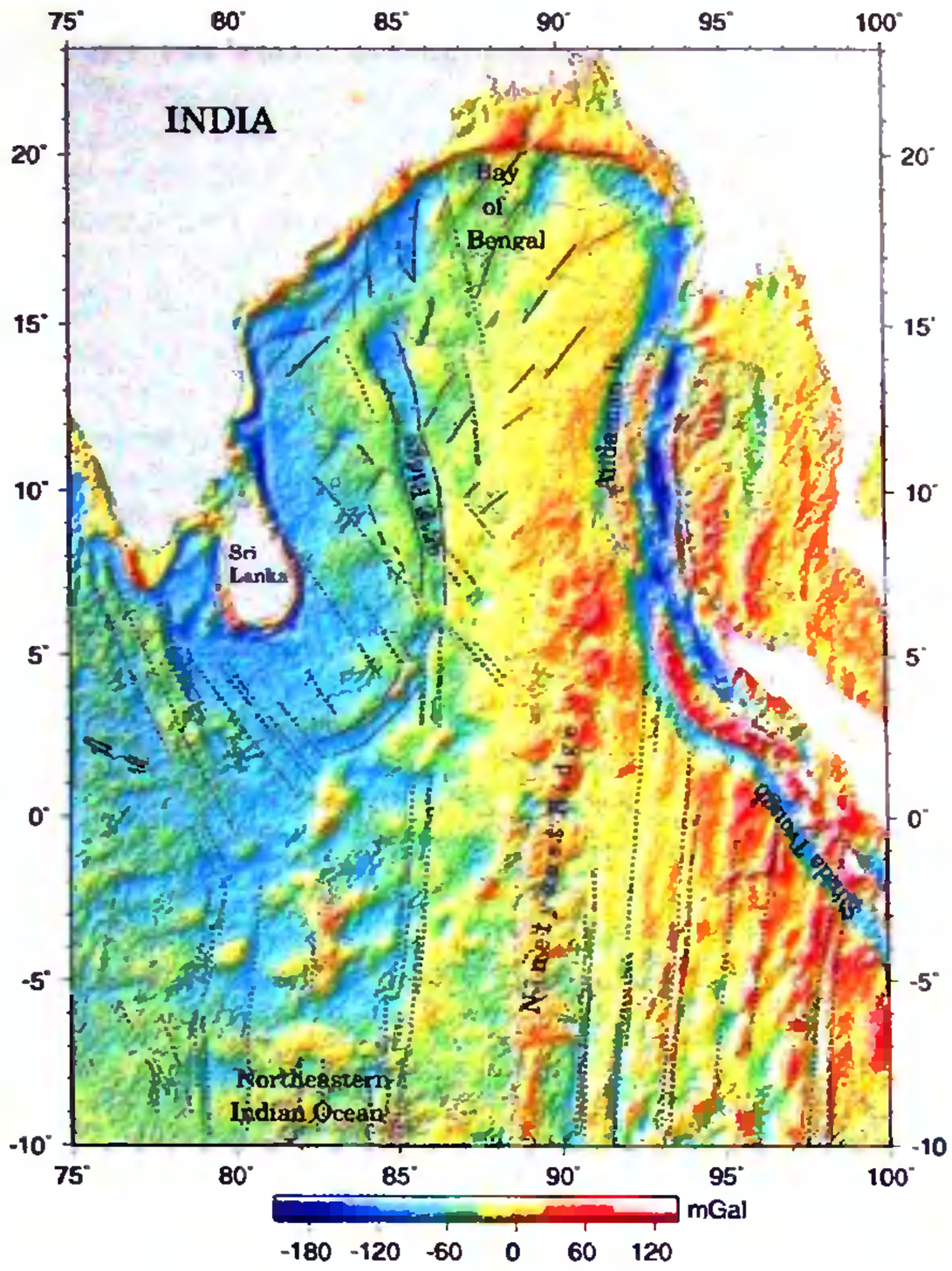

Figure 1. GEOSAT-derived free-air gravity anomaly mosaic[12] of the Bay of Bengal. The approximate NW–SE to NNW–SSE[4] and N-S[11] tending broken lines represent the early Cretaceous to Tertiary fracture zones in the north-eastern Indian Ocean. The 85°E Ridge (thick broken lines with dots), reflected as a N10°W trending feature between 6 and 16°N latitudes and dislocated towards north of around 16°N. The NW–SW trending segments designate the basement fabric and parallel the Mesozoic magnetic anomaly isochrons[4]. The arcuate shape of the 85°E Ridge south-east off Sri Lanka represents the imprint of rotation of the Indian plate from its NW–SE to N–S during in the middle Cretaceous. The gravity mosaic does not reflect the southward continuity of the 85°E Ridge beyond the equator.

margin, which have been recognized as potential areas of hydrocarbons and gas hydrates. The tectonic framework of the Indian continental margin inferred to date is based on the syntheses of the results of several marine geophysical investigations[11] complemented by the bore hole lithologs on the shelf region and a few deep sea drilling results.

The isolated feature that encircled the south-eastern and south-western margin of Sri Lanka and the Indian Ocean geodal low are well-reflected on the GEOSAT gravity anomaly mosaic[12] (Figure 1). These features appear to have evolved during the reorganization of major plates in the middle Cretaceous. These tectonic features, besides the basement rocks of the eastern conti- nental margin of India, require a thorough understanding before proposing any valid plate reconstruction models for the early opening of the north-eastern Indian Ocean.

Understanding the nature and age of the crustal structure of the continental margins of India and the adjoining Indian Ocean basins is therefore of paramount importance if speculation is to be brought to rest. The required information can be obtained only through the judicial and careful planning and implementation of the ODP. Countries in the western hemisphere have had the privilege of ground truth information through the ODP, and have enhanced the geological understanding of offshore areas of their interest. India should now join this programme and be a partner in understanding the evolution history of the Indian Ocean in general and the north-eastern Indian Ocean in particular, along with adjoining countries. Such a step will generate new geological and geophysical data sets that will assist in conceptualizing the various geodynamic processes responsible for the evolution of the Indian continental margins.

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