inhibitory process in the brain and inhibition of noradrenergic REM-OFF neurons by GABA, which determines rapid eye movement sleep (REMS) regulation.

Sandeep Verma (IIT Kanpur, Kanpur) spoke on metal–nucleobase interactions and the different structures synthesized by various modifications in the adenine molecule at the N9 position. The structural transformation of gold clusters has been investigated by Ayan Datta (Indian Institute of Science Education and Research, Thiruvananthapuram). He explained that adding a single heteroatom to a planar Au cluster can lead to the formation of stable bimetallic alloys.

A. K. Ganguli (IIT Delhi, New Delhi) focused on the pnictide superconductors developed so far, their transport properties, and the commonalities and differences with other superconducting families. The phases and phase transitions obtained by trapping bosons in optical lattices were explained by Subroto Mukerjee (IISc). Basudeb Datta (IISc) discussed stacked spheres (*k*-stacked and *k*-stellated) and the combinatorial proof of the lower bound theorem. D. S. Nagaraj (The Institute of Mathematical Sciences, Chennai) described how given two varieties, one tries to describe all possibilities, the morphisms between them, and study the properties of these morphisms.

The first public lecture by Sudhir Kakar (a psychoanalyst and writer) on 'A creative melancholy: the paintings of Rabindranath Tagore' dealt with the subconscious elements that wanted expression through his paintings. The crisis in the philosophical foundations of science and social science, due to intense commercialization and materialism, was described by Sudarshan Iyengar (Gujarat Vidyapith, Ahmedabad) in the second public lecture on 'Science–social science interface'.

Overall, this meeting gave a historical, cultural, scientific and artistic flavour to the technical proceedings.

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MEETING REPORT

Revisiting the Shiva crater hypothesis*

The mass extinction that occurred at about 65 million years (m.y.) ago, at the Cretaceous–Tertiary (K/T) boundary was enormous, significant and very much debated. The bolide (asteroid) impact as the cause of mass extinction is bolstered with the discovery of the Chicxulub crater of 180 km diameter beneath the shore of the Yucatan Peninsula in Mexico[1]. The detailed geochemical and petrological studies, radiometric age dating of impact-caused-melt rocks within this crater, and presence of tsunami deposits in the surrounding locations confirm the impact origin of the Chicxulub crater at 65 Ma and its contribution to global mass extinction. In contrast, the Deccan flood basalt volcanism at 65 Ma is considered by many others, as the possible reason for mass extinction at the K/T boundary[2]. Rapid warming and cooling of global ocean water by about 3–4°C, emission of roughly 10,000 Gt of sulphur gas into the atmosphere and gigantic extension of the basalt province are considered to have played a pivotal role in this mass extinction.

In this contrasting scenario, an international meeting was held at the National Institute of Oceanography, Goa. The meeting discussed newer evidences for multiple major meteoritic impacts on the Earth across the K/T boundary. This includes, besides Chicxulub, the Shiva crater (diameter ~ 500 km) off the shore

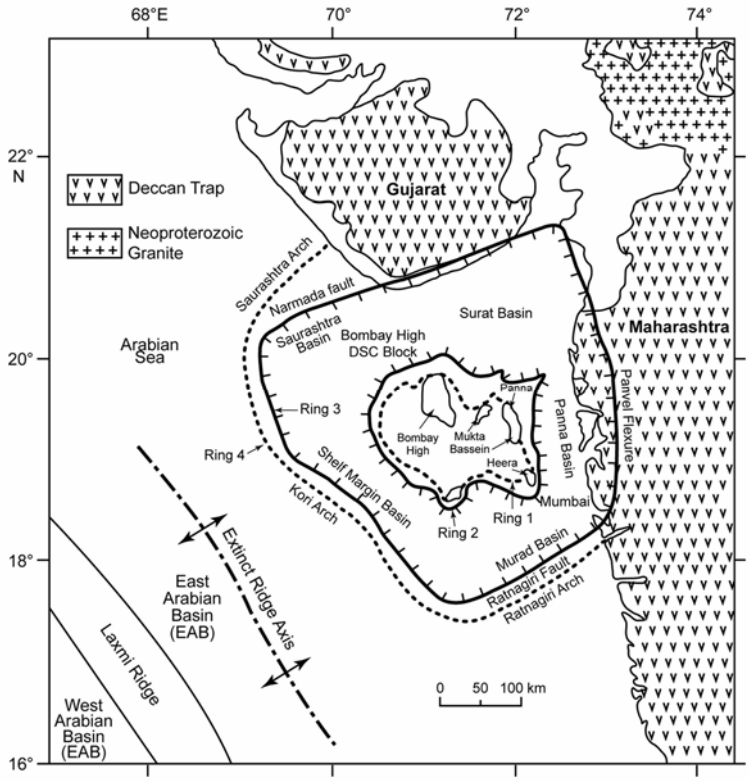

Figure 1. Oil-bearing multi-peak Shiva crater, offshore Mumbai, western shelf of India. Note four ring structures with annular trough and faulted outer rim (after Chatterjee *et al.*[3]).

*A report on the 'Brainstorm meeting', participated by scientists from USA and India, held at National Institute of Oceanography, Goa, on 5 and 6 July 2011 to examine the 'K–T boundary status and associated geodynamics on the West Coast of India'.

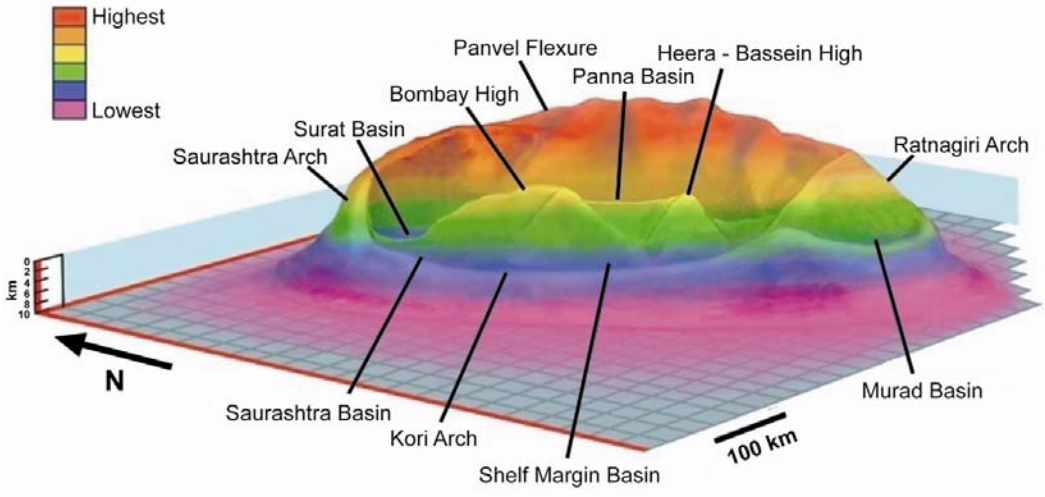

Figure 2. Three-dimensional reconstruction of geophysical data showing submerged Shiva crater off Mumbai (after Chatterjee *et al*.[3]).

of western India[3], and the much smaller Boltysh crater (diameter ~ 24 km) in Ukraine. The deliberations proposed revisiting the buried Shiva crater, off Mumbai.

The indirect evidences for the existence of the Shiva crater have come from seismic, gravity and limited drilling data (Figure 1)[4], all of which indicated that the Mumbai offshore lithosphere is highly shattered, deformed and considerably sheared following the probable impact of a huge asteroid/bolide. The closely spaced repeat passes of ERS-altimeter data show a distinct low-gravity anomaly (~ 5 mGal) over the central ring of peaks, that increases up to + 40 mGal towards the rim[5]. The crater is bordered by Panvel Flexure in the east, Narmada Fault in the north, Kori Arch in the west and Ratnagiri fault in the south (Figure 2)[3,4].

The Shiva crater is presently buried by 7 km thick strata of post-impact Tertiary sediments[5]. The largest hydrocarbon accumulations of India are localized in the Shiva crater by a unique convergence of tectonic events. The possible role of the Shiva bolide impact and crater-making in triggering the eruption of Deccan alkali volcanism, facilitating the separation of the Seychelles from India, creating a radial rift-basin on the western Indian craton and accelerating India's journey towards north was discussed in detail.

The meeting deliberated upon all the hypotheses proposed for the mass extinction at the K/T boundary and stressed on initiating measures to confirm the role of the Shiva bolide impact. This includes looking for evidence such as iridium anomalies, shocked quartz, nickel spherules and pseudo-tachylite (a volcanic glass formed by the remelting of target rocks). In addition, a study to understand the network of rhyolite and mafic dikes, as well as associated seismic events and the timing and duration of the main phase of the Deccan volcanism should be taken up. Considering the huge geodynamic consequences of the Shiva impact, the meeting stressed on the need to undertake comprehensive field (including seafloor drilling through Integrated Ocean Drilling Programme) and laboratory studies to establish the mechanism behind the origin of the Shiva crater.

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