using laser diffraction particle size analyser and the surface structure is examined by scanning electron microscope. The study showed that the particles are spherical and their sizes vary from 0.1 to 300 microns. The particles have tri-modal distribution with modes at 1, 4 and 70 microns.

Thomas (VSSC) described the safety issues in large scale solid propellant processing for PSLV and GSLV class vehicles. One aspect that came up was safety in the use of fluid energy mill for fine ammonium perchlorate grinding on which practices in ISRO and HEMRL seemed different. It was suggested that this aspect needs to be discussed further. B. Chellathurai (ISRO Propulsion System Complex, Mahendragiri) described the production, storage and handling of storable and cryo-liquid propellants, namely, UH-25, di-nitrogen tetroxide, mono methyl hydrazine, MON-3 and hydrazine, liquid oxygen and liquid hydrogen. The major hazards associated with earth storable propellants were identified as toxicity, corrosivity, fire, explosion, air and water pollution. The major hazards with cryogenic propellants and the various safety precautions taken during storage and handling of these hazardous propellants were discussed in detail. Safety lessons learnt from incidents during testing of liquid propulsion systems at IPRC were also discussed for understanding the extreme hazardous nature of liquid propellants.

Holding the workshop at the VSSC, Thiruvananthapuram brought a large number of practitioners of rocket science and technology and allowed intensive discussions on current problems and ways of overcoming them. It is possible that a few collaborations and joint projects of relevance to aerospace combustion science will emerge from this workshop.

1. Shivakumar, V., Ramakrishna, P. A. and Mukunda, H. S., *Curr. Sci.*, 2015, **108**(8), 1412–1413.

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MEETING REPORT

Quaternary climate: recent findings and future challenges*

The ongoing Quaternary period is marked by several glacial and interglacial cycles. These long and short-term variations are well preserved in the proxy record. Long-term proxy climate records provide a perfect setup to understand the response of earth towards these long and short-term variations in climate. To address recent findings and future challenges within the Quaternary period, a national conference was held in Goa. The main objectives of the conference include understanding of Quaternary climate changes and anthropogenic influence on earth's climate using both marine and terrestrial archives and thereafter quantification of key climate factors during the past with development of stable isotopes and elemental ratios as proxies. The principle themes of conference include recent developments in the field of Quaternary climate studies, climatic proxies, glacial–interglacial climate fluctuations, Holocene climate change and archaeological studies especially in Indian context. The event also included a dedicated session for the discussion on future directions in Quaternary climate studies especially in context of the Indian subcontinent and adjoining seas.

The event included ten oral and two poster sessions followed by field trip to nearby historic sites. The inaugural function was chaired by S. N. Bhalla (Aligarh Muslim University, Aligarh). The inaugural lecture by Rajiv Nigam (NIO, Goa) focused on the environmental implications of the foraminifera and otoliths from the Indian Ocean waters. He discussed the consequences of global warming, accelerated rise in sea level, change in monsoon pattern as well as the increase in intensity and frequency of storms. He also gave an overview of the unique aspects of town planning from Dholvira, a Harappan time archaeological site in Gujarat. The massive outer protective walls were built to protect the city from sea storms/tsunami. He also emphasized on the need to develop reliable proxies to fill the gaps in chronology for better understanding of climate change and management of future strategies and to avoid the devastations caused by natural hazards. He also threw light on the unexplored otolith (fish ear bone) proxy and its applications in the palaeoceanography. He concluded his talk by explaining the usefulness of foraminifer proxy in the indication of marine pollution and emphasized that the future research in this field lies in foraminifera culturing experiments.

The first three sessions were dedicated to palaeoclimate proxies. Talat Ahmad (Jamia Millia Islamia University, New Delhi) delivered the keynote talk. In his talk entitled 'Rising Himalaya, monsoon and climate', he emphasized on the major issues of earth system sciences including the high seismicity of Himalaya which makes North India one of the most earthquake-prone zones. He also added a note on the big event happened on earth around 55 Ma and the history of earthquakes that occurred around the Indian sub-continent in the past. He also gave a brief account on rainfall documentation

*A report on the National Conference on 'Quaternary climate: recent findings and future challenges', held at CSIR-National Institute of Oceanography, Dona Paula, Goa during 28–30 April 2016. The conference was convened and co-convened by Rajeev Saraswat, National Institute of Oceanography (NIO), Goa and Niloy Khare, Ministry of Earth Sciences (MoES), New Delhi respectively. The event was organized in association with MoES and Past Global Changes (PAGES).

and the highest rainfall regions of the world. Devesh Sinha (University of Delhi) discussed about the importance of stratigraphy in the Quaternary climatic and oceanographic studies. He also discussed the relative importance of planktonic foraminifera over benthic foraminifera in the Quaternary biostratigraphy as excellent recorder of stress conditions over sea surface. B. Nagendra Nath (NIO, Goa) delivered keynote talk on the geochemical proxies and diagenesis. He classified the geochemical proxies into three types, viz. biotic, chemical and sedimentological. He also discussed the significance of opal and cadmium (Cd) proxies to determine the palaeoproductivity and bottom water conditions respectively. Thamban Meloth (National Centre of Antarctic and Oceanic Research (NCAOR), Goa) gave an overview of cryosphere, its importance in the livelihood and its effect on climate dynamics of the Himalaya as well as its global implications.

Shramik M. Patil (NCAOR, Goa) explained the environmental settings of Southern Ocean using morphological variation of the coccolithophore *Emiliania huxleyi* with special emphasis on their poleward extension. Purnima Bejugam (Goa University) presented an overview of depositional environment of the surface sediments off Mahanadi to Pennar river mouth in the eastern coast of India. She also explained the role of dissolved oxygen to maintain oxic conditions in the area which played a major role in the distribution of manganese (Mn). V. Sarangi (IISER Kolkata) discussed the effect of pedogenesis on the late Quaternary palaeosol deposits of Rayka, Mahi River, India. He emphasized on proper selection of samples for palaeoclimatic and palaeovegetational reconstruction due to the difference in degree of pedogenesis. Saurav Dutta (IISER Kolkata) outlined the palaeoseasonality reconstruction of Chandipur, Orissa using isotopic signatures of biogenic carbonates using three co-occurring individuals of *Crassostrea* sp. (bivalve). A. A. Fosiya (Anna University, Chennai) discussed the rainwater isotopic characteristics from Manicoy Island, Lakshadweep, India to understand the complex behaviour of rain from the Western Ghats mountain range of India. P. Balaraman (University of Madras) gave an account of vertical distribution of benthic ostracod from Kurusadai Island, south-east coast of India. G. Sreenivasulu (Yogi Vimana University, Kadapa) outlined the usefulness of foraminifera as pollution indicators by determining the metal accumulation near Dugarajapatnam port, Nellore district. Ishfaq Ahmad Mir (Geological Survey of India, J&K) presented a 45 ka record of productivity in the Bay of Bengal with implications on the Indian monsoon and Atlantic climate. Ravi Bhushan (Physical Research Laboratory, Ahmedabad) discussed the marine record of northern Indian Ocean to describe the oceanographic settings of the region using multi-proxy approach. Shubham Tripathi (NCAOR, Goa) gave an overview of denitrification in the eastern Arabian Sea since late Miocene. V. Yoganandan (Bhartidasan University, Tiruchirapalli) discussed the Late Quaternary climate change and productivity dynamics using multi-proxy studies from a SE Arabian Sea sediment core. Uttam Pandey (Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow) threw light on the reconstruction of temperature to understand climate dynamics using tree ring data of *Cedrus deodara* from Lidder valley, Kashmir Himalaya. He also presented the global teleconnection of his observations to strengthen the significance of tree ring studies for high resolution climate reconstructions. Syed Azharuddin (BSIP, Lucknow) gave an overview of the monsoonal climate and productivity variations during the Holocene from NE Arabian Sea using high resolution multiproxy record. He identified three major periods of climate variation during the Holocene and also gave an overview of abrupt events due to monsoon and sea level dynamics.

The last two sessions of the conference were dedicated to archaeology and its significance in the flourishment of civilization. P. D. Sabale (Deccan College, Pune) gave an overview of palaeoenvironmental studies of flood-affected archaeological sites around the middle reaches of Bhima basin.

The conference provided an opportunity for budding researchers to interact with the galaxy of scientists and experts working on Quaternary climate change from all over the country. Moreover, several M Sc students from different colleges and universities also attended the conference to get the motivation and research orientation for their future. The participants, especially the students and young researchers gained a lot of knowledge through exchange of opinions/ suggestions to have a broad idea of the recent developments as well as future challenges in the field of Quaternary climate.

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