

## Workshop on Western Ghats: Evolution and Environmental Issues (1-2, January 2016 at ESSO-NCESS, Thiruvananthapuram)

Older than the Himalaya, the mountain chain of Western Ghats adjacent to the west coast of India represents a major geomorphic feature of extreme geo-environmental significance. This ~1600 km long mountain ranges extend from the Satpura Range in the north to Kanyakumari in the south and passes through different lithologies. It fringes the west coast in the form of a Great Escarpment overlooking the western coastal lowlands. Geological observations attribute the genesis of Western Ghats to the break-up of supercontinent, Gondwana and subsequent modification in the north due to Reunion hotspot- related volcanism. Being a dominant orographic feature, the Western Ghats is a major climate regulator in the Indian sub-continent. The high mountain forest ecosystems of Western Ghats are treasure troves of biological diversity in the world and have an exceptionally high level of endemism and biological richness. Considering its extreme ecologic and environmental importance, this unique life sustaining system of Peninsular India has recently been declared as a World Heritage Site for preservation by the UNESCO.

The Ministry of Earth Sciences have taken many important initiatives for deep crustal studies in the Western Ghats region using multi-parametric investigations including geological, geophysical and deep drilling methods. But more need to be done from the point of view of its evolution and environmental aspects for evolving a sustainable development frame work for this most ecologically sensitive region in the world. In this context, a two-day National workshop on “Western Ghats; Evolution and environmental issues” had been conducted by the National Centre for Earth Science Studies (NCESS), a premier Research and Development Centre under the Earth System Science Organization (ESSO) of the Ministry of Earth Sciences, Government of India as part of its Foundation Day during 1-2 January 2016. The workshop has been conducted with an aim to understand critical knowledge gaps in the geological evolution, geoenvironmental issues and natural resource management for planning more focused studies on Western Ghats with respect of its evolution role as a climate regulator, ecosystem dynamics for environmental Management.

The workshop was inaugurated by Shri. Y S. Chowdary, Hon'ble Minister of State for Ministry of Earth Sciences, Government of India. The workshop was organized under 3 major Technical Sessions namely: 1. Evolution of Western Ghats, 2. Western Ghats – a Climate Regulator and 3. Ecosystem Dynamics.

There were 16 invited presentations of eminent scientists from various National Institutions namely Physical Research Laboratory, Indian



Sri. Y. S. Chowdary, Hon'ble Minister of State for Ministry of Science & Technology and Ministry of Earth Sciences inaugurates National Workshop by lighting the lamp.

Institute of Science, IIT Mumbai, Geological Survey of India, National Geophysics Research Institute, National Environmental Engineering Research Institute, Birla Institute of Scientific Research, University of Kerala, Borehole Geophysics Research Laboratory (MoES), National Remote Sensing Centre, National Centre for Medium Range Weather forecasting (MoES) and NCESS. Additionally, there were 38 presentations (oral and poster) from young researchers as well. The Foundation Day Lecture was delivered by Dr. Shailesh Nayak, Distinguished Scientist and Former Secretary, MoES, Government of India. Presidential address was delivered by Dr. M. Rajeevan, Secretary, MoES, Government of India.

Salient features of the key presentations from experts in this field are summarized below:

Technical Session I: Evolution of Western Ghats. The session divided into two subsections and are chaired by Dr. B. K. Bansal, Advisor, MoES and Dr. Kusala Rajendran, Professor, IISC, Bangalore. The opening paper of the session was delivered by Sinha Roy S of Birla Institute of Scientific Research, Jaipur. In his paper, *The Western Ghats: product of lithospheres – Asthenosphere dynamics and denudational flexural isostasy*, Sinha Roy opined that the evolution of Western Ghats is linked with on-shore denudational unloading associated with scarp recession due to active drainage system of the terrains and offshore sediment loading under flexural isostasy. The Western Ghats came into existence as an uplifted rift shoulder at ca. 88 Ma. In the paper, *Some insights into the lithospheric electrical structure in the Western Ghats region from magneto telluric (MT) Studies*, Prasanta K Patro revealed the existence of a two layered lithospheric electrical structure with an upper very high resistive layer and lower modestly conductive layer, the depth of the interface was around 80-120 km below ground surface. While the interface is lowest in the northern side, it was at highest level in the southern side. Another important feature that could be highlighted is the presence of a well-defined, near vertical, crustal conductive feature associated with Western Ghats which could presumably be attributed to the tectonic evolution of the Ghats. Pradeep Kumar AP, in his paper, *Cosmogenic radio nuclides  $^{10}\text{Be}$  and  $^{26}\text{Al}$  in deciphering erosion rates and evolution of the Western Ghats*, presented some initial results of the study from Kabani river basin.

Kusala Rajendran in her paper, *Updates on our understanding of the Seismicity of Peninsular India*, stressed the need for monitoring seismic activity in areas of Peninsular India which was once thought to be free from devastating earthquakes. The historically recorded earth quake (M~6) at Coimbatore in 1900, the reservoir triggered earth quake (M 6.3) occurred near Shivaji Sagar Reservoir of Koyna Dam and the Latur (Killari) earth quake (M 6.1) are eye openers to mankind that even the intraplate areas are also not free from devastating earth quakes. Apart from earth quakes, landslide is another natural hazard felt in mountainous terrains and cliffed coasts. In a paper, *Landslide management in Western Ghats; Challenges, preparedness and early warning*, Pankaj Jaiswal reiterated the need for enhancing the capability of individuals through preparedness and early warnings. Community based disaster management programme including participatory mapping and mock drills is the most cost effective way to make people understand the inherent and residual risk. The need for high resolution hazard zonation maps of landslide prone areas was the central theme of the paper, *Evaluation of Western Ghats in Kerala and recognition of Landslide prone topography*, presented by John Mathai. Sukanto Roy in his paper, *Evolution of the Western Ghats: Perspective from scientific drilling in the Koyna region, Deccan Volcanic Province, Western India*, disclosed the new information from deep drilling at Koyna area and opined that the data could throw light onto the evolution of Western Ghats in addition to deciphering the origin of the near coast parallel belt of hot springs in the Deccan Volcanic Province as well as the tectonic setting of the region. Radhakrishna M made an overview of various models for the evolution of Western Ghats and highlighted the importance of flexural strength of the lithosphere and process oriented approach to generate models for the flank – uplift topography.

Technical Session II was devoted for the theme *Western Ghats – A climate regulator*. The key papers in this session are dealt with rainfall characteristics and thunder clouds in Western Ghats. Siddharth Kumar, in his paper, *Organization of rainfall over the Western Ghats and the Myanmar Coast*, opined that although the Western Ghats and the Myanmar Coast have similar orographic features, precipitation

characteristics differ significantly in these two regions. While the Myanmar coast receives more rainfall than the Western Ghats, the intensity of rainfall is larger over Western Ghats. The nontrivial differences in rainfall characteristics of the two regions could be explained in terms of the feedback mechanism between cloud microphysics and large scale dynamics. Another important paper in the session was on *Lightning hazard and the role of Western Ghats*, delivered by Murali Das S. The paper dealt with the case of Kerala State in south western India. The proximity of the sea and the mountain range result in formation of thunder clouds in the region. Unlike the other parts of the country, the thunder cloud formation and lightening are rather more predictable in southern Western Ghat part of Kerala and this makes the state one of the classical site for lightning studies.

The Technical Session 3, Ecosystem dynamics comprises 7 important presentations that are made into two subsections and chaired by Dr. V. K. Dadhwal (NRSC). The first paper in the session was on *Coastal Management in the Climate Change Scenario with particular reference to the West Coast of India*, by N. P Kurian. The paper deals essentially with the existing regulations and present coastal management practices in India. He also addressed how climate resilience can be attained in the management of Indian coastline. In the paper presented by Dadhwal V, an overview of NRSC activities on Land Use/Land Cover, Environment monitoring and Forestry in Western Ghats has been made. Sekhar M, presented a paper on the studies carried out on modelling the hydrological variables for improved Water Management taking the case of the Kabani river basin in Western Ghats as an example. He also highlighted the challenges and gaps in the Critical Zone studies in high altitude terrains. In another presentation, Paras R Pujari discussed the significance of Geophysical Imaging of Critical Zone. A few papers were there on weathering, erosion and transport of geochemical fluxes from terrestrial environment to ocean realm. In a paper Sunil Kumar Singh revealed that the weathering rates of the west flowing rivers are significantly higher than that of the East flowing rivers primarily because of denudation due to chemical alteration. Padmalal *et al.* estimated that the rivers flowing through southern Western Ghats of Kerala transport an amount of about  $3.04 \times 10^6 \text{ ty}^{-1}$  of suspended particulates and  $2.12 \times 10^6 \text{ ty}^{-1}$  of dissolved sediments into the Arabian sea. In addition to the lead papers, a few papers presented by young researchers were the other attraction of the session. Apart from invited talks and oral presentations there were 32 poster presentations were also included in the workshop proceedings. These papers deal with different aspects related to the hydrological, ecological and environmental problems of the Western Ghats and its adjoining areas.

The last session was devoted for discussion and critical assessment of the papers presented in the workshop. This session was chaired by Prof. Somnath Das Gupta, Chair Professor of Jamia Milia Islamia University & Chairman, NCESS Research Adversary Committee. At the end, the Chairman and the Members stressed the imminent need for strengthening multi-disciplinary studies that can lead to various scientific and environmental aspects of elevated passive continental margins like that of Western Ghats. Further, the expert panel expressed the need for high resolution multi-parametric studies in order to unfold the interactive and competing processes that shape this part of the Earth from its origin to the present.

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