

## Neogene climate evolution in Eurasia\*

The third Neogene Climate Evolution in Eurasia (NECLIME) Asian meet aimed to reconstruct the palaeoclimate using a multiproxy approach, viz. megafossils (plants, vertebrates and invertebrates), microfossils (pollen-spores, phytoliths, diatoms, forams, nanofossils, etc.), isotopes, geological and geochemical signals. The meeting also provided an opportunity to enhance the database of low-latitude area of Eurasia, where monsoon pattern is considered as an important factor for floral and faunal evolution and their biodiversity. The major themes covered in the meeting included palaeobiogeography and biodiversity, climate and fauna, palaeoclimatic reconstruction as well as climate and vegetation dynamics of Neogene and Quaternary time.

The meeting was inaugurated by K. S. Valdiya, an active environmentalist known for his contributions in the field of geodynamics. In his inaugural speech, Valdiya gave an overview about the role played by the Himalayas on the derivation of the Indian climate. He emphasized that the Indian rainfall should not only be characterized by the southwest (SW) monsoon, but the role of westerlies should also be understood. Thereafter addressing the audience, he released the abstract volume of NECLIME.

The lectures were arranged in five technical sessions, grouped according to their themes. The first session was based on the theme of palaeobiogeography, biodiversity and climate. The session included two keynote lectures. David Dilcher (Indiana University, Bloomington, USA) hypothesized the low-latitude migration pattern of many tropical floras. He also discussed about the already published records of high-latitude floral migrations. According to him, migration of flora is not a result of one route, but due to migrations at different times and through different environments. In another keynote, Volker Mosbrugger (Senckenberg Research Station of Qua-

ternary Palaeontology, Germany) expressed concern that biodiversity loss is linked with loss in ecosystem services, which is worth US\$ 4 trillion. He emphasized on focusing upon the Sino-Himalayan region which is important in order to understand the hotspots and decipher their future threats. Rajesh Agnihotri (Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow) presented an account on phylogenetic diversity of the Western Ghats based on anthropogenic global warming and its comparison to the spatio-temporal variation in temperature and precipitation over the period from 2001 to 2015 AD. He also presented the enhanced temperature and rainfall pattern observed over the Indian subcontinent in the last 15 years and emphasized that it must be cross-checked with the increase in global warming over the region. Navya Reghu (French Institute of Pondicherry, Puducherry) gave her view on the poor preservation conditions of pollen in the warm and semi-arid climate of southeast India. She also commented on the need for a vegetation survey to be carried out for quantitative analyses of pollen spectrum.

The next session was themed on climate and fauna. Sunil Bajpai (BSIP, Lucknow) gave an overview about the tertiary mammal fauna of India. He spoke about the finding of fossils from ~42 to 50 Ma, supporting the macroevolution and origin of whales from a four-footed land mammal. Rajeev Patnaik (University of Punjab) presented the shift in vegetation type during early to late Miocene based on faunal and stable isotope records. He also talked about the increase in *Elephas*, *Camelus*, *Equus*, *Hippotragus* and *Cervus* around the Indian sub-continent during the Pliocene, which demarcates the fluctuating climatic conditions.

The next session was based on palaeoclimatic reconstruction. In the keynote lecture, Torsten Utescher (Senckenberg Research Institute and Natural History Museum, Germany) presented an outline of the Coenozoic climate change in Eurasia. He also threw light on the work being carried out by the NECLIME team which comprises 138 members around 36

countries. He enumerated the contributions being made by the members, whereby they provide their published climatic and vegetational data for more than 1000 sites to build up the collective database. Poonam Verma (BSIP, Lucknow) presented her study based on palynological findings from the amber of Vastan lignite. She spoke about the evidence of extremely wet and humid conditions that prevailed in the post ETM2 (Eocene Thermal Maxima) during the Eocene with a dry phase of 3–4 months. Vandana Prasad (BSIP, Lucknow) talked about the equatorial climate from the Northeast India during the PETM based on palynological studies. She also emphasized on the fact that the main determining factors for the rainforest type of vegetation in the equatorial regions are the seasonal rainfall patterns and dry season rather than the mean annual rainfall.

The fourth session consisted of lectures based on Quaternary and Neogene records. A. D. Singh (Banaras Hindu University, Varanasi) delivered the keynote talk entitled 'Neogene–Quaternary low–mid latitude climate variability and its linkages to the evolution of ocean gateways'. He mentioned that the major palaeoceanographic changes and restricted equatorial current system were a result of changing plate boundaries. Anjum Farooqui (BSIP, Lucknow) talked about the diversification and extinction of *Nypa* in India during the Quaternary period based on mangrove pollen records. She spoke about the trend in diversity of *Nypa* over time, which can be linked to the anthropogenic activities and climatic adversity along the coastal region. Amit K. Ghosh (BSIP, Lucknow) discussed his study based on the benthic/planktic ratio of the diatoms, whereby the diatom abundance is an indicator of nutrient-rich conditions and indicates active monsoonal conditions during the late-Miocene. He also illustrated the fact that diversity of calcareous algae is determined by the hydrodynamic conditions, moderate environmental interference and substrate availability. M. R. Rao (BSIP, Lucknow) presented an overview on the possible applications of palynology in deciphering the palaeoenvironment

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and palynostratigraphy. He also enlisted the sites in India known for their Neogene deposits, namely Assam–Meghalaya, Arunachal Pradesh, Mizoram and Tripura in NE India; Gujarat in western India, Himachal Pradesh, Haryana, Punjab and Uttarakhand in North India, and Tamil Nadu, Kerala, Maharashtra and Karnataka in South India.

In the concluding session on Quaternary climate and vegetation dynamics, Santosh K. Shah (BSIP, Lucknow) presented the modern pollen–climate calibration model from the temperate–alpine belt of north Sikkim to develop a transfer function. He also pointed out the need for quantitative study of the past climate from the Himalaya.

There were 28 poster presentations focusing on the prescribed themes of the meeting. The work by Runcie P. Mathews (BSIP, Lucknow) was adjudged to be the best. His study on Miocene–Pliocene onshore Warakalli sedimentary sequence showed that it is organically rich with high bacterial activity. Thus it reflected its potential to generate gaseous hydrocarbon. The presentation by M. F. Quamar (BSIP, Lucknow) focused on the Holocene climate variation based on pollen evidences from Khedla Quila Lake in Betul district, Madhya Pradesh. The

study suggested the occurrence of warm and humid climate under tropical forest cover during 1416–506 cal yrs BP followed by Little Ice Age. Jyoti Srivastava (BSIP, Lucknow) presented an overview of estuarine ecosystem dynamics as a response to the Holocene climate and sea-level changes based on pollen studies. Her study well illustrated the fluctuation of the wetland from open land without trees before 7 ka to the establishment of mangroves since 0.8 ka, but with loss in diversity. Binita Parthiyal (BSIP, Lucknow) focused on Late Quaternary climatic records from Ladakh region of western Tibet, using multi-proxy approach. The study was based on palaeo-lake sediment deposit of Ladakh region to understand the Indian summer monsoon westerlies dynamics during the late Quaternary period. Anupam Sharma (BSIP, Lucknow) presented the mineralogical and geochemical characterization of aeolian sediments from mainland Gujarat, focusing on the provenance of those sediments. Based on grain size and thin-section studies, he interpreted that the source of these sediments was Deccan basalt. Parminder S. Ranhotra (BSIP, Lucknow) gave an overview of mid to late Holocene climate based on palynological study from the Dokriani glacial

valley of Garhwal Himalaya, India, which demarcates the dominance of aboreal pollen taxa over non-aboreal pollen in the area and also indicates tree-line shift to higher altitude during late Holocene. Syed Azharuddin (BSIP, Lucknow) presented the productivity variation pattern in the NE Arabian Sea during the Holocene. Based on foraminiferal studies, he mentioned that the early Holocene can be considered as oligotrophic, whereas middle and late Holocene as mesotrophic and Eutrophic respectively.

The meeting provided an opportunity to the scientists, young researchers and students to interact with a galaxy of experts from India and abroad.

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**Ipsita Roy\*, Shazi Farooqui and Syed Azharuddin**, Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow 226 007, India.

\*e-mail: ipsita.roy@bsip.res.in