Annual Report 2024-25

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Birbal Sahni Institute of Palaeosciences

53 University Road, Lucknow 226 007, U.P., India
An Autonomous Institute under Department of Science and Technology
Government of India, New Delhi

BSIP *at a glance*

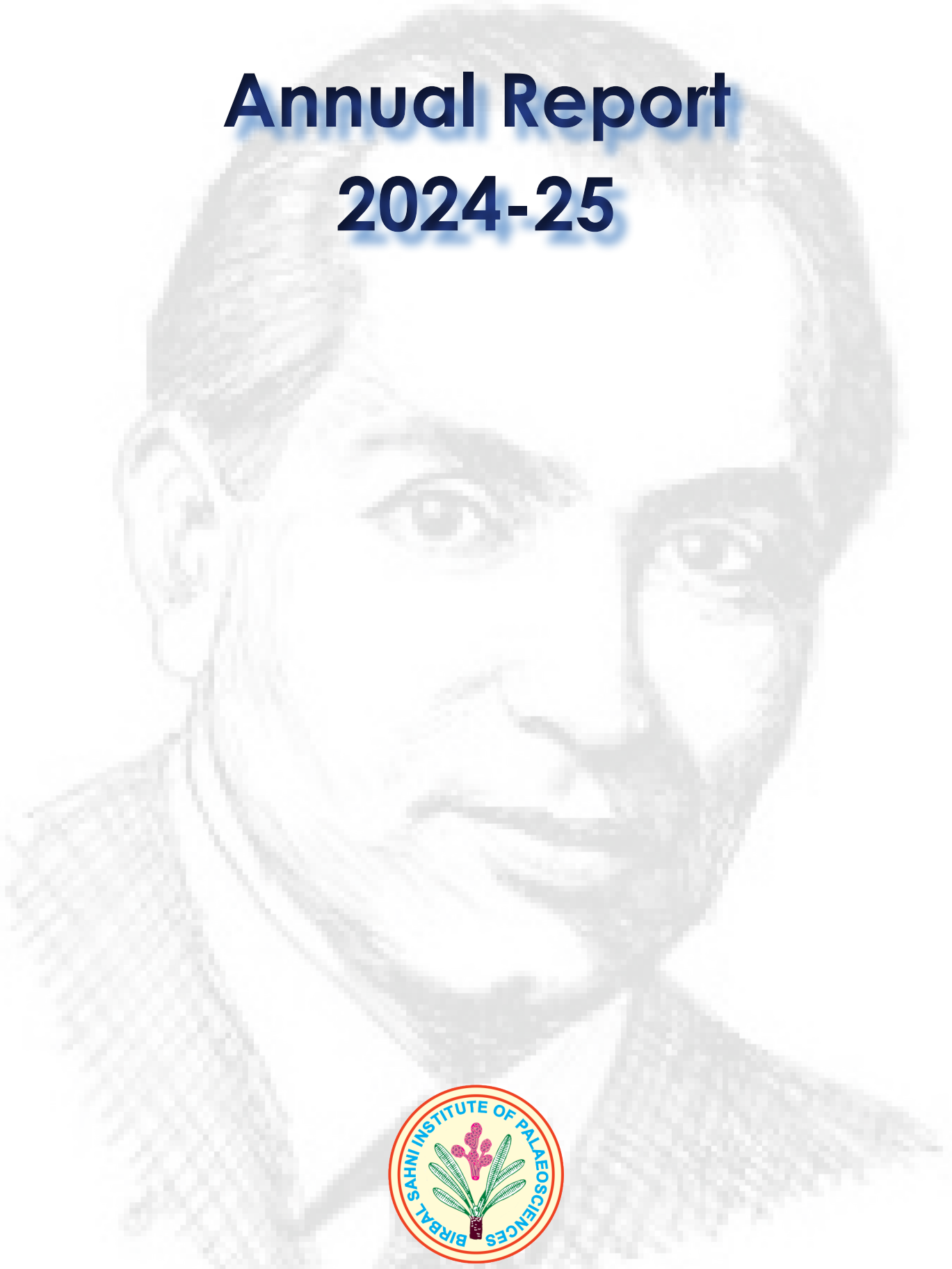
The Birbal Sahni Institute of Palaeosciences (the erstwhile Birbal Sahni Institute of Palaeobotany) was founded in 1946 and is currently an autonomous research institute under the Department of Science and Technology, Government of India. At its inception, the institute had laid emphasis on the pursuit of basic knowledge in Palaeobotany and its applications thereof in Geology and allied sciences. Further, evolving the scope from fundamental aspects of palaeobotany to a multidisciplinary approach including biotic and abiotic proxies, for a holistic understanding of the evolution of floras, faunas, climate, ecosystems at different temporal and spatial scales through time, the BSIP is today known for its excellence in Palaeosciences R&D. Over the years, since its establishment, BSIP has become the premier institute for advanced Palaeoscience research in India.

With a long and rich legacy of 78 years, the BSIP continues to push the boundaries of scientific research, achieving ground breaking advancements in the field of Palaeoscience research through cutting-edge technologies, thus actualizing the vision of its founder Late Prof. Birbal Sahni to greater heights. The Institute has taken several initiatives in promoting emerging and interdisciplinary areas such as, Industrial Micropalaeontology, Amber Analysis and Palaeoentomology, Vertebrate and Invertebrate Palaeontology, Archaeobotany and Ancient DNA Studies, Dendrochronology, Sedimentology, Oceanography, Geochemistry, Advanced Coal Petrology, Radiocarbon Dating, Luminescence Dating, Palaeomagnetism, Astrobiology and Astrochemistry, etc. Thus research at BSIP covers the entire geological time scale. To augment the above multidisciplinary approaches in research, BSIP continues to pursue advances in instrumentation with the state-of-the-art facilities such as TL/OSL dating system, IRMS, ICP-MS, GC-MS, XRF, FTIR instruments and Clumped Isotope Laboratory for geochemical analyses, Palaeomagnetic Laboratory, Vertebrate Palaeontology and Preparation Laboratory, Ancient DNA Laboratory, FE-SEM Laboratory, Confocal Laser and Raman Spectroscopy (CLSM) Laboratory, Amber Research Laboratory, Advanced Coal Petro- Geochemical Laboratory and Industrial Micropalaeontology Laboratory.

BSIP Museum is a repository of scientific resources comprising of collection of fossil plants made by Professor Sahni from India and abroad, including those received by him as gift or in exchange, which structured the beginning of the Institute's Museum. The repository of the museum is continuously being enriched through collections made by scientists of the institute during their fieldwork all over the country, and also by the receipt in exchange of material from foreign countries. There are thousands of samples, holotype specimens, slides and figured specimens that are systematically stored by the museum that is readily available for the investigation to the research workers. The museum also houses the stratotype speleothem section from the Mawmluh Cave, which is the Global Boundary Stratotype Section and Point (GSSP) for the Meghalayan Stage (~4200 BP). BSIP aims towards modernising the museum through technology and improved visitor experience in the upcoming new building.

Recognising the increasingly rapid evolution in science systems and to transcend the confines of the traditional academic sphere, BSIP continues to develop active and close collaborations with national and international research institutions, adopt a trans disciplinary research approach and engage in technology transfer and industry relations. It is also expanding its role in Science Communication and Public Awareness in order to bridge the gap between science and society and to foster a culture of impactful science communication. Under the directives of the Department of Science and Technology (DST), BSIP is proactively engaged with the DST Media Cell to share significant scientific findings for dissemination via the Press Information Bureau (PIB). It also publishes an in-house journal 'Journal of Palaeosciences' (formerly published as The Palaeobotanist) of international repute besides publishing catalogues, atlas and special issues. In its ongoing commitment to support the advancement of usage of Hindi as Official Language, the BSIP Rajbhasha Implementation Committee actively promotes Rajbhasha through regular reviews and creative initiatives. BSIP shows active participation in national and international conferences, workshops, symposia, seminars and expeditions to the poles. BSIP is focused on expanding its research into new arenas and address other challenges of specific issues through innovative solutions for sustainable development.

Annual Report
2024-25



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Produced by : Research Development and Coordination Cell (RDCC) & Publication Unit

Issued: September 2025

Description of the cover photo: A view of a conspicuous P/T (Permian–Triassic) boundary seen ~3 km from Rangdum village of Zanskar Himalaya. The dark colored Panjal Volcanics (to the right side of the photo) are overlain by buff colored folded Triassic limestones and quartzites. Two large rock debris fans are seen in the middle, while gazing ground in the forefront is glacial wash deposits indicating the post LGM topography. Photo Courtesy: Prof. Mahesh G. Thakkar, BSIP

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From the Director's desk

It is a privilege to present the BSIP Annual Report for the year 2024–25, highlighting our key accomplishments, academic contributions, and significant milestones. This report reflects the steadfast dedication and collaborative efforts of our committed team in advancing the frontiers of palaeoscience research. With a distinguished legacy spanning 78 years, BSIP continues to uphold and elevate the visionary ideals of its founder, the late Prof. Birbal Sahni, by embracing cutting-edge technologies and pioneering innovations that propel the Institute toward new heights in scientific discovery.

The year witnessed a significant elevation in BSIP's national and global profile, as reflected in its increased academic impact, prestigious recognitions, and expanded collaborative engagements. Our scientists published 135 high-impact research papers in leading journals, alongside several other scholarly contributions. The Institute secured multiple research grants and established new partnerships with numerous national and international institutions and universities. BSIP faculty undertook a wide range of research projects supported by key funding agencies such as the Department of Science and Technology (DST), Ministry of Earth Sciences (MoES), Anusandhan National Research Foundation (ANRF, formerly SERB), Tribhuvan University (Nepal) under its Excellent Research Grant, CSIR, INQUA, MANDU, OIL, and DST-SERB-SUPRA, among others, spanning both public and private sectors. The Institute also proudly hosted the 40th Convention of the Indian Association of Sedimentologists (IAS-2024), and actively participated in the 15th Indian Summer Arctic Expedition as well as the 44th Indian Scientific Expedition to Antarctica (ISEA). Further details of these accomplishments are provided within this report.

In an effort to extend beyond the traditional boundaries of academic research, BSIP actively forged strategic collaborations with institutions from both the university and private sectors. During the year, the Institute formalized Memoranda of Understanding (MoUs) with several esteemed organisations, including KSKV Kachchh University, Kachchh (Gujarat), Uttar Pradesh Ecotourism Development Board (UPEDB), Directorate of Archaeology (Guwahati), Banasthali Vidyapith (Rajasthan), Anthropological Survey of India (Kolkata), Geological Survey of India (Kolkata), Department of Ancient History, Culture & Archaeology (University of Allahabad), University of Ladakh (Leh). These partnerships are designed to foster interdisciplinary collaboration, leverage shared expertise, and utilize advanced technologies and resources.

On the international front, BSIP continues to strengthen its global engagement through joint research initiatives with institutions such as the Khakass Technical Institute, Siberian Federal University (Abakan, Russia), the Institute of Earth Surface Dynamics at the University of Lausanne (Switzerland), and the INDO-UK collaborative program

(MoES/UKRI). These regional and international linkages aim to cultivate a vibrant ecosystem of scientific innovation that transcends disciplinary and geographic boundaries.

Recognising the rapid evolution of scientific systems, BSIP has adopted a transdisciplinary research approach that integrates diverse knowledge domains. This strategy aims to bridge the gap between palaeosciences, the natural and social sciences, and non-academic stakeholders such as the Uttar Pradesh Ecotourism Development Board (UPEDB), Patanjali Research Foundation Trust (Haridwar), and others.

To facilitate technology transfer and strengthen industry engagement, BSIP leverages its expertise in research, consultancy, and training, positioning itself as an ideal partner for collaborative technological initiatives. In the fiscal year 2024–25, the Institute provided consultancy services to several esteemed organisations including IIT Roorkee; IIT (ISM), Dhanbad; CIMFR, Dhanbad; CPGIDMS, Lucknow; University of Lucknow; AMPRI, Bhopal; Isabella Thoburn College, Lucknow; Saraswati Dental College, Lucknow; Career PG Institute of Dental Sciences and Hospital, Lucknow; CSIR-NBRI, Lucknow; Guru Ghasidas Central University, Bilaspur; Integral University, Lucknow; and Babasaheb Bhimrao Ambedkar University, Lucknow, among others. Furthermore, the Birbal Sahni Training Program and the Biannual Master's Dissertation Program continued to offer valuable opportunities for graduate and postgraduate students, research scholars, and postdoctoral fellows to explore careers in research and development.

Bridging science and society remains one of the Institute's core objectives. In recent years, BSIP has initiated several new avenues for public knowledge dissemination. The Centre for Promotion of Geoheritage and Geotourism (CPGG), established in 2023, continues its mission to educate the public about the significance of palaeosciences. Outreach programs conducted under the banner of *Jan Bhagidari* commemorated World Environment Day, World Wetland Day, National Science Day, and Earth Science Week. Throughout the year, BSIP also welcomed school and college students to its museum and laboratories, underscoring its broader commitment to public engagement and fostering a scientifically informed society.

Encouraging dialogue between science and civil society is essential for promoting scientific literacy and public engagement. In this spirit, BSIP launched the ASPIRE (Artful Science Communication to Popularise Impactful Research) initiative, aimed at cultivating a culture of effective science communication. This program empowers researchers to communicate their work more meaningfully to the general public, thereby promoting a stronger scientific temper within society.

As part of its continued commitment to promoting Hindi as an Official Language, the BSIP Rajbhasha Implementation Committee remained active through regular assessments and creative initiatives. A notable achievement in 2024 was the successful publication of the third issue of the Annual Hindi Magazine *Puravigyan Smarika*, which featured both scientific and general articles contributed by BSIP staff and other distinguished authors. The magazine received widespread appreciation and was honoured with a prestigious award from the Town Official Language Implementation Committee (TOLIC-3) for its exemplary contribution to the promotion of Hindi.

The significant achievements detailed in this report are the result of the intellectual contributions of our faculty and students, the unwavering support of our technical and administrative staff, and the generous financial assistance from various funding agencies. We gratefully acknowledge the Department of Science and Technology (DST), Government of India, for its consistent support toward both recurring and research-related expenditures.

Looking ahead, BSIP remains committed to exploring emerging research frontiers and addressing complex scientific challenges through innovative solutions. I extend my heartfelt gratitude to the Chairman and members of the Governing Body and the Research Advisory Council, for their invaluable guidance and continued support. I look forward to their ongoing cooperation as we pursue our collective mission of scientific excellence.

Mahesh G. Thakkar

(Director)

Organizational Highlights

- The year was marked by a notable increase in the BSIP's profile, reflected in its enhanced global impact through publications, awards, collaborations with members and partners. Our team published 135 high-impact research papers in leading journals with a cumulative impact factor of 330.54, in addition to other scholarly publications.
- A total of 18 extramural projects sponsored by various national and international agencies such as Department of Science and Technology (DST); Ministry of Earth Sciences (MoES); Anusandhan National Research Foundation (ANRF) (Formerly SERB); Excellent Research Grant Sponsored by Tribhuvan University, Nepal; CSIR, INQUA, MANDU, OIL, DST-SERB-SUPRA have been implemented/ongoing by BSIP scientists.
- In terms of research manpower trained, BSIP scientists provided training to 96 graduate/post-graduate students and 10 Ph.Ds were awarded during the F.Y. 2024-2025.
- BSIP actively pursued collaborations with the private and university sectors and signed official MoU's with KSKV Kachchh University, Gujarat, Uttar Pradesh Ecotourism Development Board (UPEDB); Directorate of Archaeology, Guwahati; Banasthali Vidyapith, Rajasthan, Anthropological Survey of India, Kolkata, GSI, Kolkata, Dept. of Ancient History, Culture & Archaeology, University of Allahabad, University of Ladakh, Leh.
- International collaborations have been established with the Khakass Technical Institute, Siberian Federal University, Abakan, Russia; Institute of Earth Surface Dynamics, University of Lausanne, Switzerland; INDO-UK Collaboration (MoES/UKRI), etc.
- BSIP rendered consultancy services to IIT Roorkee; IIT, ISM Dhanbad; CIMFR, Dhanbad; CPGIDMS Lucknow; University of Lucknow; AMPRI, Bhopal; IT College, Lucknow; Saraswati Dental College, Lucknow; Career PG Institute of Dental Sciences and Hospital, Lucknow; CSIR-NBRI, lucknow; Guru Ghasi Das Central University, Bilaspur; Integral University, Lucknow; Baba Bhimrao Ambedkar University, Lucknow, etc.
- BSIP hosted the 40th Convention of Indian Association of Sedimentologists and National Conference on Sedimentology and Environmental Research from 11–13 Dec 2024 with 250 delegates including senior scientists, professors, and scholars from various universities and institutes nationwide. Dr Arvind K Singh and Santosh K Pandey were Convener and Co-convener respectively.
- BSIP participated in the 15th Indian Summer Arctic Expedition (29 July – 1 September, 2024) wherein Dr. Srinivas Bikkina, Scientist F was deputed under Project RiS ID: 12410: Tracing Aeolian dust and footprints of forest fires over the Arctic: observation from Svalbard.
- BSIP also participated in the 44th Indian Scientific Expedition to Antarctica (ISEA) during November 2024 –March 2025 wherein Dr. Srinivas Bikkina and Dr. Manoj MC were deputed to investigate the sources and transport mechanisms of black carbon (BC) and organic lipids in the Antarctic environment and its impact on climate change in Polar regions.
- The first proceeding of the newly formed Governing Body was held on 22 Oct 2024, where the Director BSIP welcomed the Chairman Prof. H.B. Srivastava and members.
- The Chairman, Governing Body of BSIP in consultation with Secretary, DST reconstituted the Research Advisory Council (RAC) of BSIP for a period of three years w.e.f. March 2025, following which the 61st RAC meeting was held on March 27 and 28, 2025 at BSIP.
- 10 Birbal Sahni Research Scholars and 10 Birbal Sahni Research Associates were selected through written test and interview held in the month of February, 2025.
- BSIP Lucknow acquired a state-of-the-art, first-in-India unmanned surface vehicle (USV) dedicated to the bathymetry to estimate lake volume and glacial lake outburst flood (GLOF) risks in Himalaya.
- Dr. Veeru Kant Singh, Scientist-E has been elected as a Voting Member of the International Subcommission on Ediacaran Stratigraphy (ISCS), a subsidiary of the International Commission on Stratigraphy (ICS) of the International Union of Geological Sciences (IUGS) for a period of four years from 2024-2028.
- BSIP welcomed the delegates of INQUA consisting of Professor Laura Sadori, President INQUA, Sapienza University of Rome, Italy; Professor Francesco Chiocci, Sapienza University of Rome, Italy (President of

INQUA 2023); Professor Alessandro Maria Michetti, Dipartimento di Scienza e Alta Tecnologia, Università degli Studi dell'Insubria, Como; Dr. Ilaria Mazzini, Institute of Environmental Geology and Geoengineering, National Research Council of Italy. The delegation held several meetings in the presence of Prof. Mahesh G. Thakkar, Director BSIP, to oversee and contribute towards preparation for International Conference of INQUA-2027 at Lucknow.

- Professor Laura Sadori, President INQUA, Sapienza University of Rome, Italy delivered an enlightening talk on the topic 'Southern European Holocene Lacustrine Pollen records: climate forcing vs. human impact' on 17th February 2025. The delegation along with BSIP Scientists also attended a field session in the Ganga-Yamuna Interfluve region near Kalpi, UP.
- Under the directives of the Department of Science and Technology (DST), BSIP has proactively engaged with the DST Media Cell to share significant scientific findings for dissemination via the Press Information Bureau (PIB). Over the past year, 9–10 high-impact research stories from the Institute have been featured in PIB releases and received widespread coverage across leading national newspapers and media platforms.
- BSIP celebrated National Space Day with a keynote lecture by Prof. A.K. Singh on "Sun-Earth Interactions and Climate Variability," followed by essay and quiz competitions for school students. The event also marked the launch of the 'Earth and Planetary Exploration Group' (EPEG-BSIP) to carry out dedicated Astrobiological research in the Institute. Among many aspects under study, the identification of false biosignatures in the geological materials, help us to explore the spatio-temporal variations which are relevant to the detection of life on Mars, as well as the early Earth and other planetary bodies.
- The Hindi Fortnight was celebrated with great enthusiasm at BSIP from 14th to 26th September 2024. During the Inaugural Ceremony, Prof. Abhishek Kumar Singh, Senior Technical Officer (Official Language Cell), Indian Sugarcane Research Institute, Lucknow delivered a lecture on "Hindi Policy and Guidelines." Various competitions such as Typing, Noting, Translation, Debate, Essay writing, Spelling, and Poster-making were organised, witnessing active participation from employees and research scholars. As part of the celebration, Dr. Sadhan Basumatari delivered a special lecture on "Alternative Basis for Palaeoecology and Palaeovegetation Analysis."
- The official language magazine of Birbal Sahni Institute of Palaeosciences. "Puravigyaan Smarika" 2024 was awarded the first prize by The Nagar Rajbhasha Sansthan Samiti (3), Lucknow, Department of Official Language, Ministry of Home Affairs, Government of India. The award distribution ceremony was held on 28 November 2024 at ICAR-Indian Sugarcane Research Institute, Lucknow.
- BSIP staff including scientific, administrative and technical staff observed National Learning Week (कर्मयोगी सप्ताह) from 19 – 25 October, 2024 and learned through various courses provided on iGOT Karmayogi Portal.
- BSIP observed Swachhata Pakhwada-2024 with cleaning, plantation, community outreach, and honoured sanitation staff for maintaining campus cleanliness. Under Special Campaign 4.0, BSIP organised several events including Swachhata Outreach program at Kalicharan College, under the scheme Swachhata special campaign 4.0 on 16-10-2024, to spread the awareness about cleanliness drive with the message of "Cleanliness is service". A Health Campaign was also organised within BSIP for health awareness. A talk on "Health & Hygiene was delivered by Dr Pankaj Bharti for a Successful and Productive Life".
- As part of the Geoconservation efforts by BSIP, a Memorandum of Understanding (MoU) was signed on the 26th of June, 2024 between the BSIP and the Uttar Pradesh Ecotourism Development Board (UPEDB) in the auspicious presence of Shri Yogi Adityanath (Hon. Chief Minister, Uttar Pradesh) to promote and develop 'Salkhan Fossil Park' (Sonbhadra District, Uttar Pradesh) to develop it for gaining a UNESCO World Heritage Site status.
- BSIP organised and celebrated 10th International Yoga Day on June 21, 2024 with a yoga session conducted in BSIP premises for the staff members which included Gentle Yoga flow, Surya Namaskar, Pain and stress reliving asanas and Pranayama asanas.
- BSIP celebrated its 78th Foundation Day on 10th September 2024 with a floral tribute to Late Prof. Birbal Sahni by Director Prof. Mahesh G. Thakkar and staff. The Chief Guest Dr. S. Sundar Manoharan and Guest of Honour Dr. Bhaskar Narayan graced the event. Prof. D.K. Pandey delivered the Foundation Day Lecture on "Corals, Civilization and Geological Significance." The third issue of BSIP's Hindi magazine *"Puravigyaan Smarika Patrika"* was also released.
- BSIP celebrated Founders' Day on 14th November 2024, marking the 133rd Birth Anniversary of Prof. Birbal Sahni. Prof. Thijs van Kolfschoten delivered the 54th Prof. Birbal Sahni Memorial Lecture, and Prof.

Anindya Sarkar presented the 66th Sir Albert Charles Seward Memorial Lecture on this occasion.

- BSIP observed Vigilance Awareness Week from 28 Oct to 3 Nov 2024 on the theme "Culture of Integrity for Nation's Prosperity." Director and staff took an oath led by CVO Dr. Shilpa Pandey, followed by a speech competition on "Anti-corruption: Challenges & Its Impact on Society" to promote integrity and transparency.
- BSIP held a One-Day Workshop on "Anti-Corruption and Vigilance Matters" on 13 Jan 2025, featuring Keynote Speaker Shri Rajiv Verma. The workshop promoted transparency, accountability, and integrity within organisations.
- Under the Nasha Mukt Bharat Abhiyan campaign, BSIP Director and its scientific, administrative and student staff took a pledge on 12th August 2024 to make BSIP campus, city and India Nasha Mukt under the theme "Viksit Bharat ka Mantra, Bharat ho Nasha se Swatantra".
- BSIP organised curtain raiser event of IISF 2024 at its campus on 08 Nov 2024. The Chief Guest of the function was Dr. Bhaskar Narayan, Director CSIR-IITR, Lucknow and Shri Ashutosh Singh, Prant Mantri, Vigyan Bharti, graced the occasion as Guest of honour.
- Brainstorming sessions were organised between BSIP-OIL India Ltd for forging academic-industry collaboration on ongoing and future projects in the presence of heads of both the organisations during 27th -31st May 2024.
- Research scholars from BSIP presented their research work at the International Geological Congress (IGC), 2024 at Busan, South Korea in the Busan Exhibition Centre and Convention Hall, BEXCO.
- BSIP held a Brainstorming Workshop on Museum from 28–29 August 2024 to discuss modernising the BSIP Museum through technology and improved visitor experience. The event featured lectures by museum experts and national museum directors.
- BSIP conducted a One-Day Workshop on "Patenting Your Innovations" featuring Prof. Mohan Patel as the Chief Guest. Keynote lectures were delivered by Prof. Harikesh Bahadur Singh on Intellectual Property Rights and Prof. Mrugesh H. Trivedi on NABL's role in quality assurance for a developed India by 2047.
- BSIP celebrated the Earth Day with theme "Plant vs Plastics" on 22nd April 2024 by conducting a plantation drive in the Institute Campus which was participated by institute scientists and research scholars.
- BSIP celebrated the World Environment Day under the theme "Land restoration, Desertification and Drought resilience" on 05th June 2024 by conducting a plantation drive on the Institute Campus as well as around Lucknow City.
- Director BSIP, Prof. Mahesh Thakkar gave an interview on 'Career Prospects in Palaeosciences' in a program 'Vigyan Jagat' conducted by Shri Praveen Kumar at NEWS ON AIR, 'Akash Vani' Lucknow.
- BSIP organised fire safety training for its entire staff including scientific, technical and administrative on 06 Dec 2024 at institute campus. All the staff members actively participated this training.
- BSIP celebrated World Hindi Day 2025 by organising an invited lecture at its institute campus on 10 Jan 2025 which was delivered by Prof. Hemanshu Sen, Department of Hindi and Modern Languages, Lucknow University on the topic "वैश्विक भाषा के रूप में हिंदी: स्तिथि एवं संभावनाएं".
- BSIP celebrated the 92nd Birth Anniversary of Dr. B.S. Venkatachala, Former Director BSIP by organising 11th B.S. Venkatachala Memorial Lecture on 06th Jan 2025 at its campus. The prestigious memorial lecture was delivered by renowned former BSIP scientist, Dr Chandra Mohan Nautiyal on the topic "Isotopes, Planets and Life".
- The 8th Dr. K.R. Surange Memorial Lecture was delivered on 6th February, 2025. Prof. Ajit Shasany, Director, CSIR-NBRI, Lucknow, by an enlightening talk on "Internal Immunity: Learnings from Plants," exploring nature's insights into immune resilience.
- Prof. Sourendra Kumar Bhattacharyya (Retired Senior Professor and Dean, PRL) delivered 9th M. N. Bose Memorial Lecture on the topic "Triple Oxygen Isotopes in Silicified Woods from Deccan Intertrappeans provide evidence of high tropical rainfall in Late Cretaceous India" on 10th April 2024.
- BSIP celebrated National Science Day on 28th February, 2025 at its campus. Theme of this year- "Empowering Indian Youth for Global Leadership in Science and Innovation for Viksit Bharat," emphasises the vital role that the youth play in shaping the future of science and innovation in our nation. Dr. Anil Kumar Rastogi, Former Dy. Director and Chief Scientist, CSIR-CDRI and Sr. Bollywood actor and Theatre Personality, was the Chief Guest of the occasion.

Research Highlights

As defined in the mandate of the institute, the major aspects of the research include origin and evolution of life, both flora and fauna throughout the geological history, climate and response including adaptation and extinction of different life forms in time and space, evolution of monsoon and its importance in current scenario of climate change, migration of fauna and flora including humans' – their evolution and diversification, response to environmental conditions and archives of various depositional environments including the role of digenetic processes, earth's intrinsic processes and their role in biogeochemical cycling of elements including their interaction and mobility in different spheres of earth and formation of natural resources.

The following are some of our research highlights in the year 2024-25:

- Investigations based on plant proxies revealed the impact of carbon emissions on hydrological cycle in equatorial regions during the Eocene Thermal Maximum 2 (ETM-2), a past hyperthermal event. Studies show that during ETM-2, when atmospheric CO_2 exceeded 1000 ppmv near the paleo-equator, rainfall significantly declined. This reduction in precipitation led to the expansion of deciduous forests, replacing evergreen rainforests. The study highlights potential threats to modern equatorial rainforests and biodiversity under ongoing anthropogenic climate change. (Fig. 1, 2)
- Whole genome data from modern Ahoms and ancient DNA from royal burial sites (Maidams) revealed that modern Ahoms show substantial genetic admixture with local Tibeto-Burman, Khasi, and Kusunda populations. In contrast, ancient royal samples were genetically closer to present-day Thai populations, supporting historical accounts of the Ahoms' Southeast Asian origins. The study highlights significant genetic divergence over time due to assimilation with diverse regional groups following their migration.

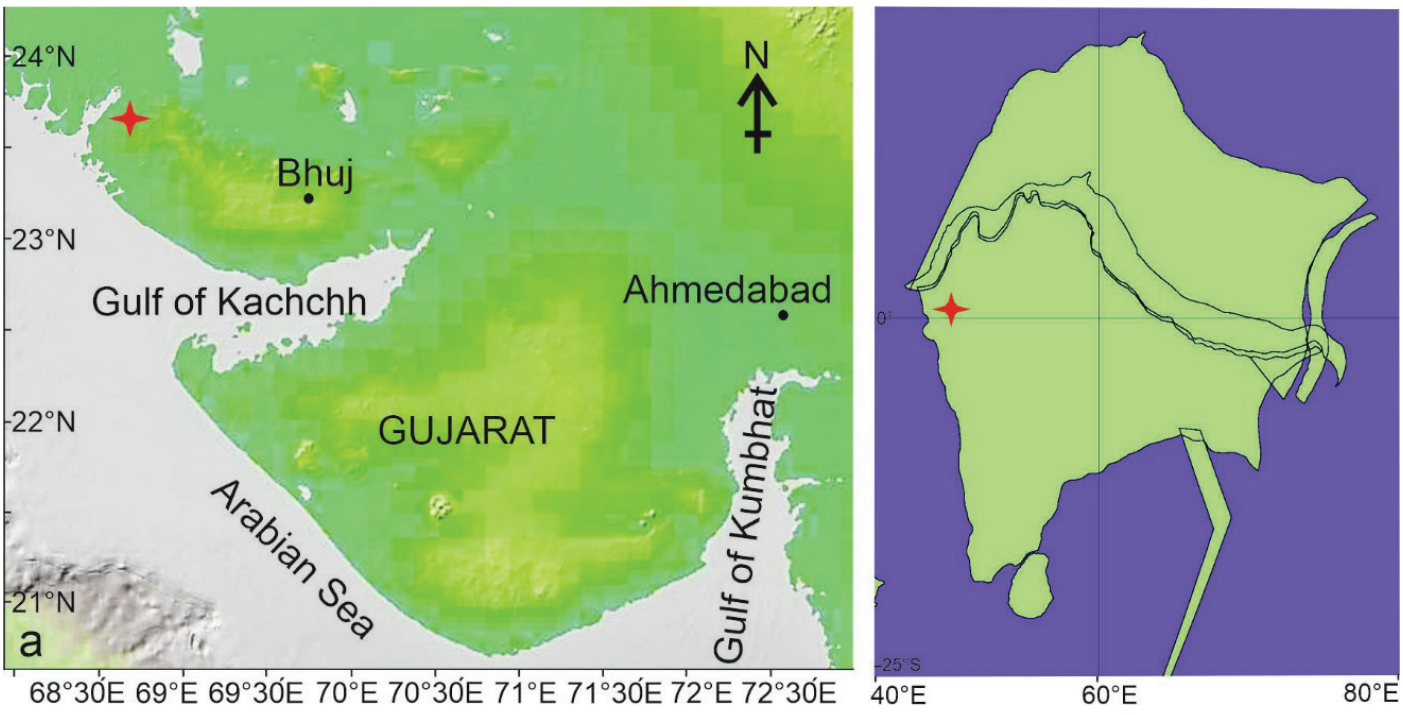


Fig 1. Modern map of western India showing the fossil locality (red solid star) and its palaeo-position (~0.6° N) at ~53 Million year ago.

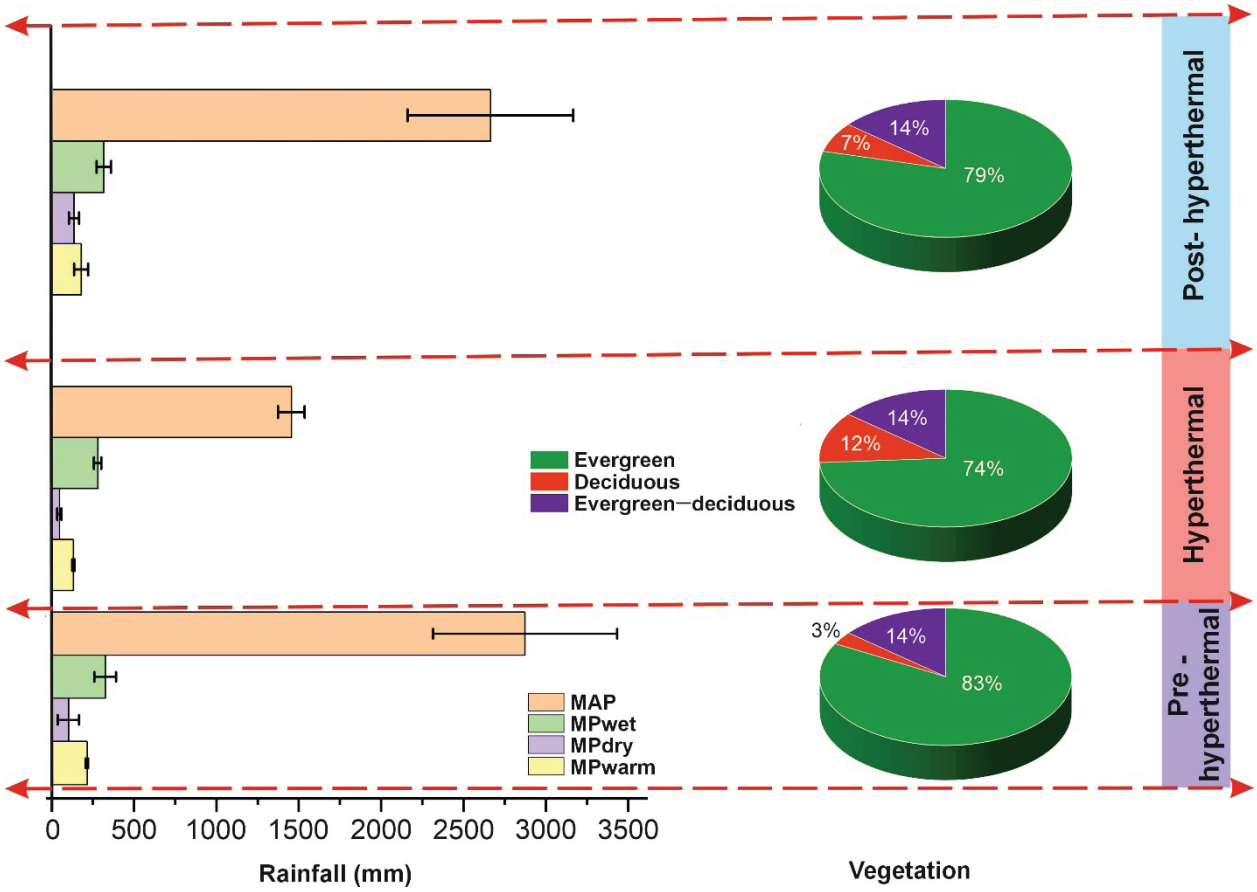


Fig 2. Diagram showing decreased rainfall and expansion of deciduous forests during the ~53 Million year ago hyperthermal event, when CO_2 concentrations exceeded 1000 ppm and global temperatures were 5–8°C higher than present.

- A high-resolution study from Kanwar Lake in the Central Ganga Plain presents the first detailed terrestrial record of monsoon variability over the past 15,000 years. Mineral magnetic and textural analyses reveal several dry events and weaker monsoon phases that align with known North Atlantic climatic events and solar cycles. Notably, fluctuations in the Indian Summer Monsoon (ISM) correlate with Bond Events and upwelling patterns in the Arabian Sea, suggesting a combined influence of solar forcing and internal climate systems like the AMOC. The study highlights millennial- and centennial-scale monsoon cycles, providing key insights into past climate dynamics in the Indian subcontinent.
- Studies based on distribution models of key NTFP species in India under past, present, and future climate scenarios reveal that *Aegle marmelos* and *Terminalia bellirica* may expand or remain stable, while *Buchanania lanzan*, *Madhuca longifolia*, and *Phyllanthus emblica* are likely to lose habitat due to climate sensitivity. These results aid in planning conservation strategies under climate change.
- Biases in interpreting past vegetation through pollen analysis is revealed by analysing modern pollen assemblages from central India wherein, a poor representation of regional forest vegetation with many trees and shrubs are under-represented or absent due to low pollen production, insect pollination, and poor preservation. Even high pollen producers like *Shorea robusta* and *Tectona grandis* were not detected, likely due to low dispersal efficiency and preservation issues. In contrast, pollen from crops, weeds, and dung fungi such as *Cerealia*, *Cannabis sativa*, and *Sporormiella* indicate strong agricultural and pastoral activity in the region.

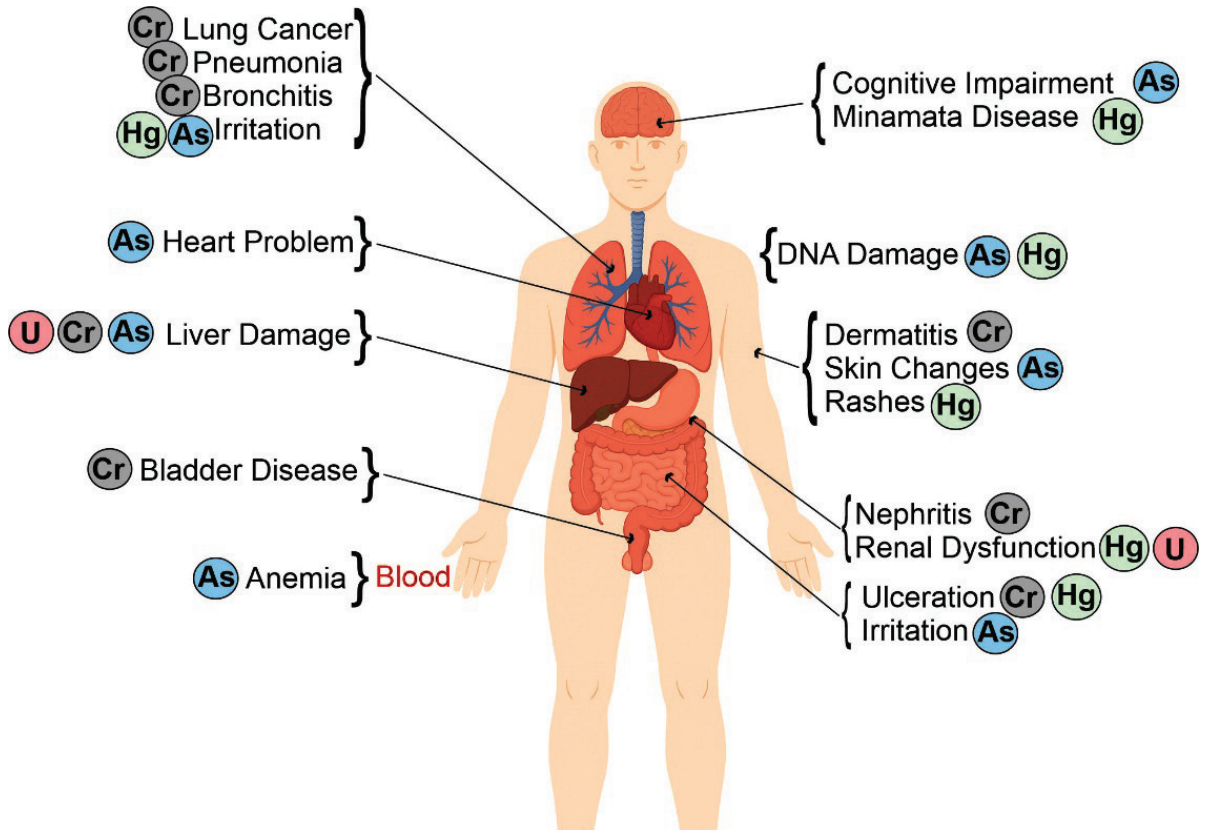


Fig 3. Schematic diagram illustrating the potential health effects of chromium (Cr), arsenic (As), mercury (Hg), and uranium (U) on the human body, when ingested in amounts exceeding safe limits.

- Analysis of groundwater in Ladakh revealed that 46–96% of groundwater samples contain harmful levels of chromium, arsenic, mercury, and uranium, with 46–76% exceeding safe limits for chromium and arsenic. Prolonged exposure to these contaminants poses carcinogenic risks, particularly gastrointestinal cancer, while uranium and mercury contribute to additional non-carcinogenic health hazards. (Fig. 3)

- The study of Lameta and intertrappean deposits in central India reveals that Deccan Volcanism during the late Maastrichtian triggered episodic changes in regional vegetation. Palynological data from the C29R magnetochron section show rapid recovery of lowland tropical rainforest flora during volcanic quiescence. The region experienced a warm, humid, and seasonally wet climate, with both volcanism and plate tectonics playing key roles in shaping vegetation, climate, and floristic diversity during this period. (Fig. 4)

- New studies on the Glossopteridales, a distinctive group of gymnosperms common in the Permian of Gondwana, which were previously thought to have survived into the Triassic based on Indian fossil records, reveal that the floras from peninsular India, including the Panchet Formation, are actually late Permian in age. There is no clear evidence that Glossopteridales survived the Permian-Triassic extinction in India, with only China showing unequivocal Triassic survival. (Fig. 5)

- A new species and genus *Satpuraphyllum furcatum,* belonging to the plant order Peltaspermales has been reported for the first time from the Barakar Formation of Satpura Gondwana Basin, India. Its distinctive cuticular features and its association with shield-shaped bracts with marginal seed scars provide strong evidence for attribution to Peltaspermales, making this the oldest representative of this order to penetrate the core regions of the Gondwanan glossopterid biome prior to the end-Permian extinction event.

- Studies on the distribution of the endangered dryland tree *Tecomella undulata* revealed its decrease since the Last Glacial Maximum emphasizing the need for expanded regional conservation efforts. While future climate conditions may favor the species, studies show non-climatic threats like human activities and pests could limit its spread.

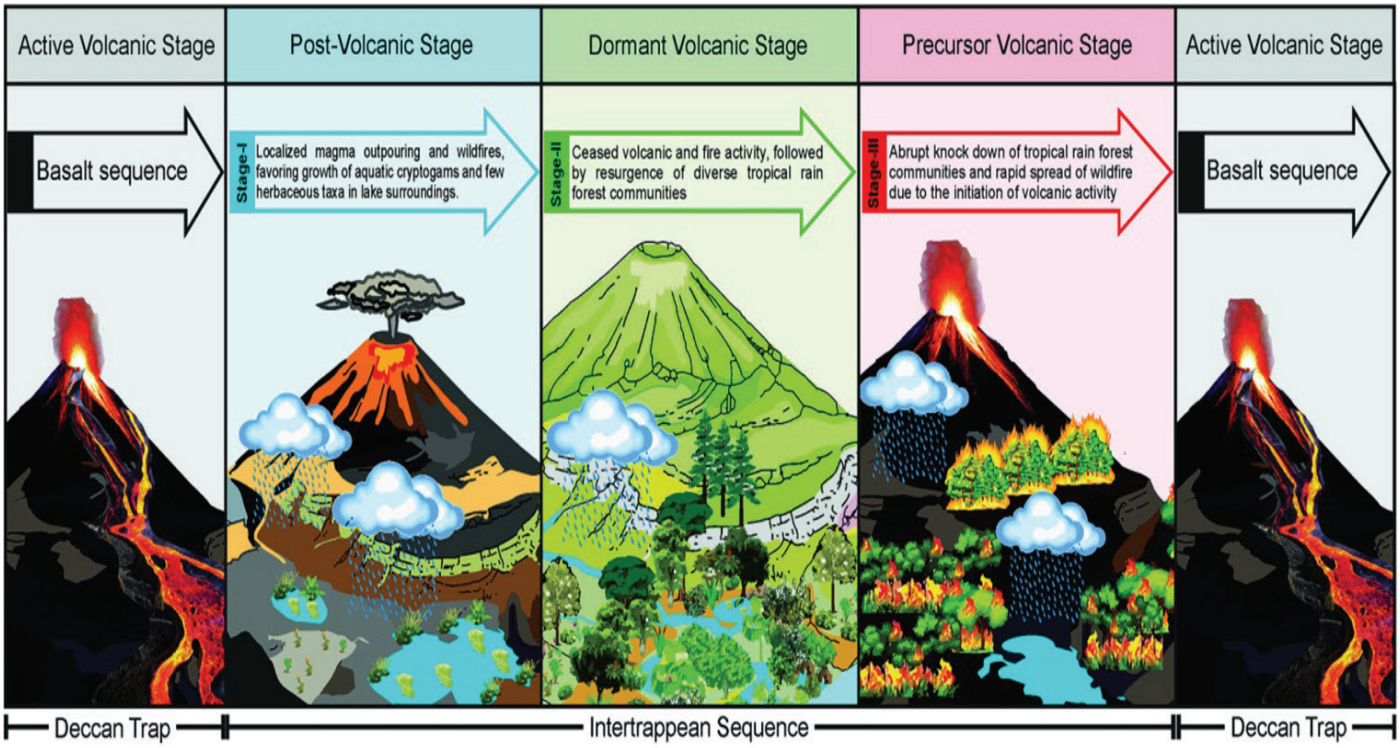


Fig 4. Illustration showing the episodic shifts in diversity and composition of Maastrichtian flora during the active and dormant phases of the Deccan Volcanism. The active volcanic phases destroyed existing flora via magmatic outpouring and forest wildfires. While, flora rapidly revived due to conducive tropical climates during the dormant volcanic stages. Image Credit: Mishra et al., 2024

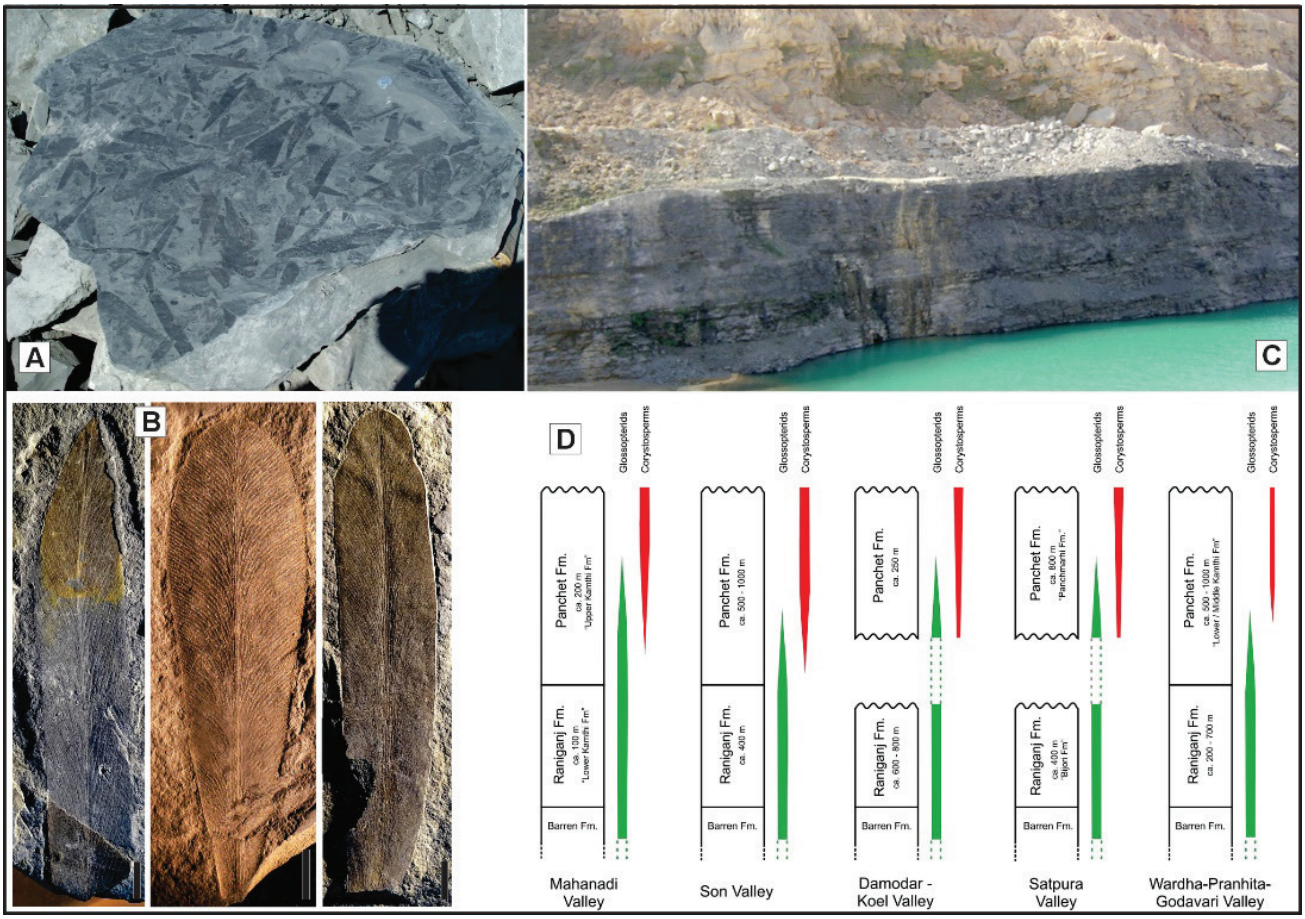


Fig 5. Glimpse of the evolution and extinction of coal forming flora. A) A shale slab containing numerous fossil leaves of '*Glossopteris* Flora'. B) Different fossil leaves of genus *Glossopteris*. C) A picture of coal seam formed by the plant remains of *Glossopteris* Flora. D) A schematic representation showing the radiation and extinction of floral elements of Glossopterids and Corystosperms in the different Gondwana Basins of India.

Fig 6. Fossil of thorny bamboo (*Chimonobambusa*), showing thorns (black arrows) and buds (sky-blue arrows)

- A newly discovered thorny bamboo fossil, *Chimonobambusa manipurensis* sp. nov., from the late Pleistocene of eastern India provides the first Asian record of spinescent bamboo and insights into bamboo nodal morphology. This fossil, sharing traits with modern *Chimonobambusa*, indicates that bamboo spinescence likely evolved during the Neogene and continued adapting through the Pleistocene, possibly in response to climate change and herbivory. The finding also suggests that Quaternary bamboos in Asia grew in warm, humid conditions, filling a significant gap in bamboo evolutionary and paleoclimatic knowledge. (Fig. 6, 7).

- A high-resolution fine-grained genetic study- allele-frequency-based analysis of the Sinhalese population revealed a tight cluster of Sinhalese and Tamil populations, suggesting strong gene flow beyond the boundary of ethnicity and language. Interestingly, the haplotype-based analysis preserved a trace of the North Indian affiliation to the Sinhalese population.

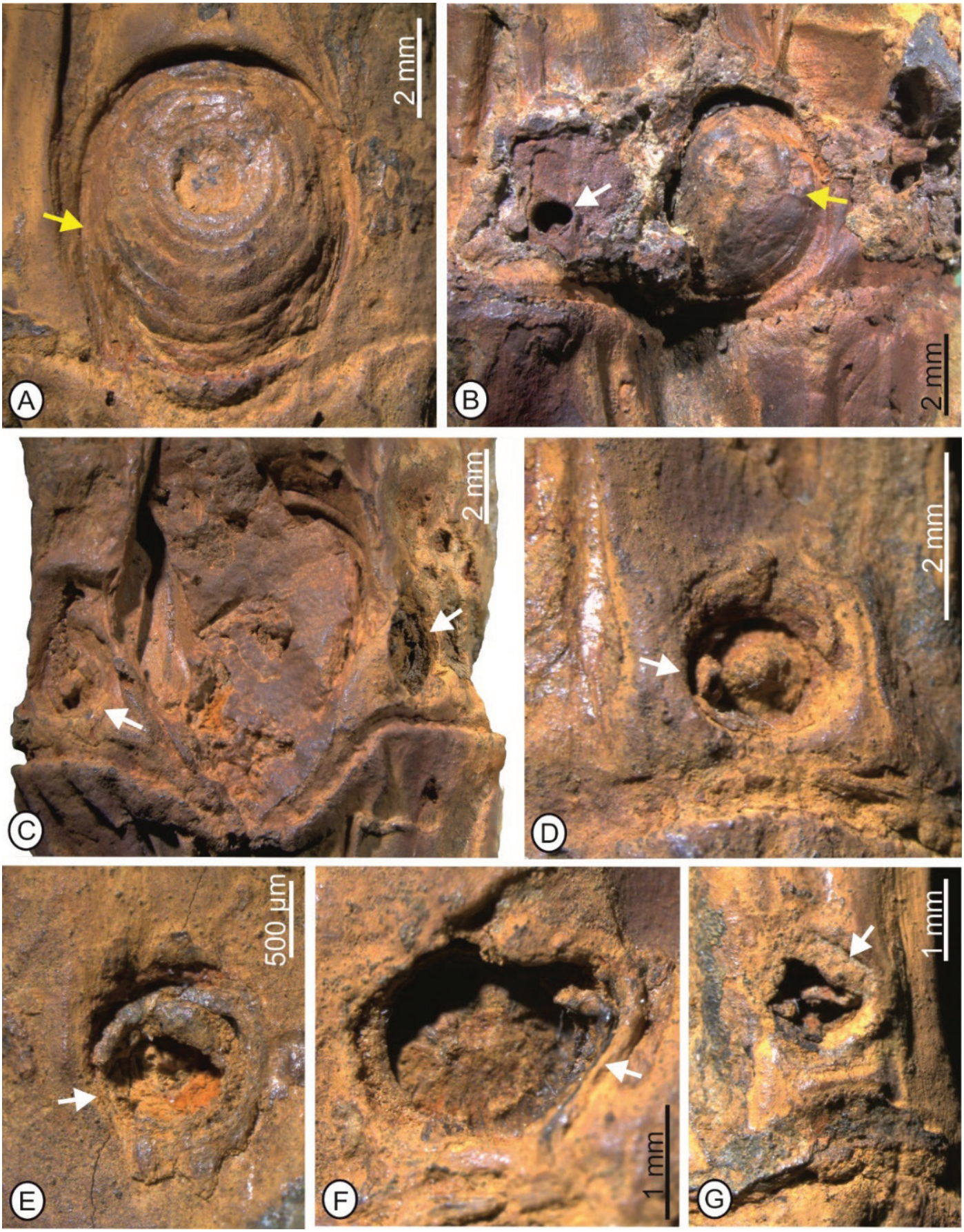


Fig 7. Microscopic images showing preserved thorns (white arrows) and buds (yellow arrows) on the fossil bamboo

- Palynological and geochemical analysis of the Late Artinskian-Kungurian sediments of Sirka colliery showed a greater potential for hydrocarbon generation than Giddi colliery in the South Karanpura coalfield due to immature kerogen ($T_{max.}$ 429°C) and palaeodepositional setting dominated by flooded palaeomires.

- Studies on the monsoon variations in the CMZ and its comparison with the other regional and global records reveal significant asynchronous and inconsistent variations between the CMZ and other regional records since the LGM. The peripheral CMZ region demonstrated strengthened North East Monsoon during the LGM. The Holocene Climate Optimum was observed as asynchronous in the central Indian CMZ. The climate of the CMZ showed teleconnection with global climate forcings and climatic variables. (Fig. 8)

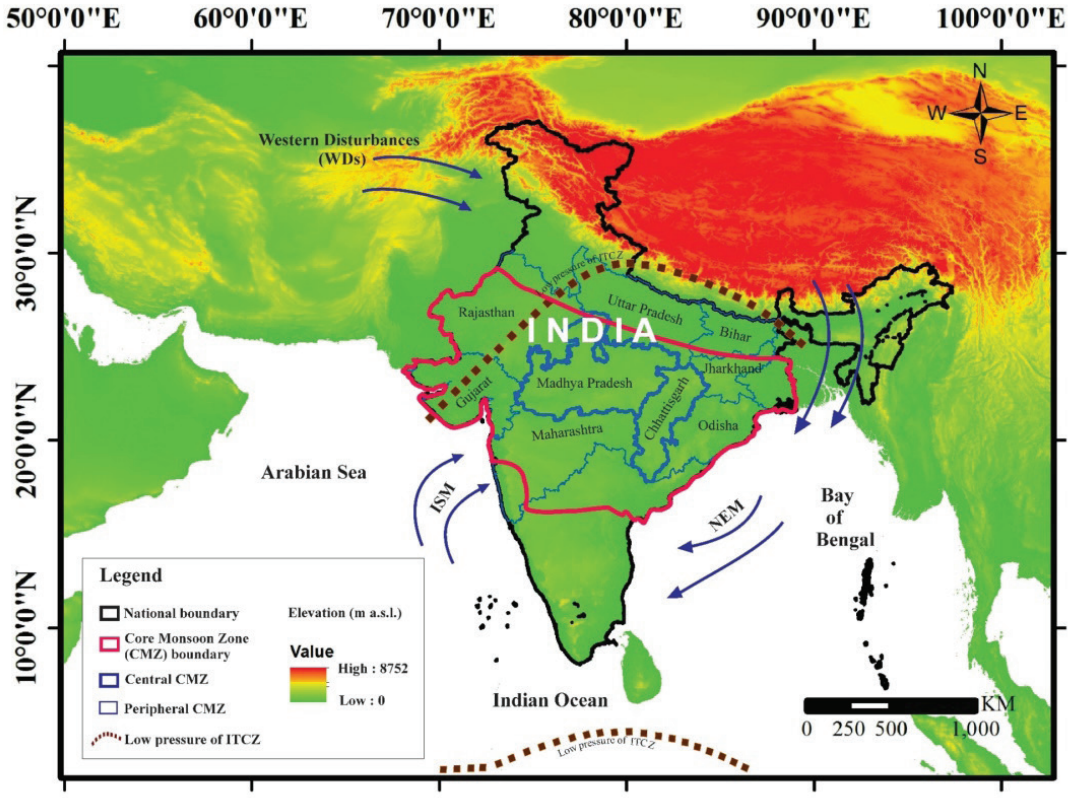


Fig 8. Shuttle Radar Topographic Mission (SRTM) Digital Elevation Map (DEM) of India, showing the Core Monsoon Zone (CMZ: thick red lines: 18°N–28°N; 65°E–88°E). Also, showing central CMZ (Madhya Pradesh and Chhattisgarh), as well as peripheral CMZ (Uttar Pradesh, Bihar, Jharkhand, Odisha, Maharashtra, Gujarat and Rajasthan, as well as some parts of Andhra Pradesh and Telangana). Indian Summer Monsoon (ISM) and Northeast Monsoon (NEM), as well as Western Disturbances (WDs) are also seen. The position of the Inter Tropical Convergence Zone (ITCZ) also looks in.

- Studies on the role of climate and tectonics in sedimentation in the Ganga plain revealed that intra-basinal tectonics play a significant role in sedimentation through the cratonic region, specifically involving the Deccan basalt and Vindhyan sediments negating the previous concept wherein it was believed that the Himalayas were the primary source of sediments for the Ganga plain, and the contribution of sediments from the higher and lesser Himalayas depended on the region's climate.

- Studies revealed that Ladakh's rock varnish can act as a potential geomaterial for Mars analogue studies in extreme settings due to the presence of putative magnetofossil-like entities in the varnish layer reported for the first time. Higher levels of oxidized Mn^{4+} and carboxylic acids on the varnish surface revealed organic signatures through XPS analysis. Comprehensive magnetic characterization of rock varnish unveils magnetite as the dominant magnetic mineral. (Fig. 9)

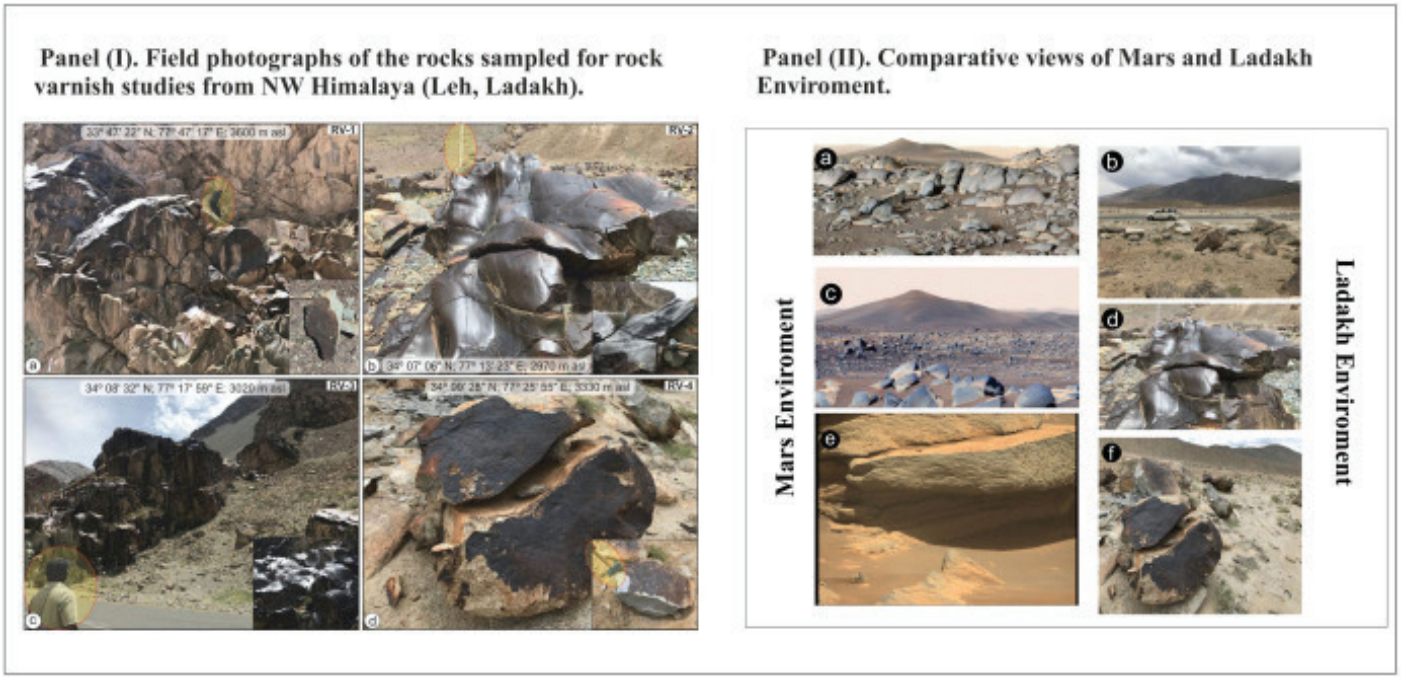
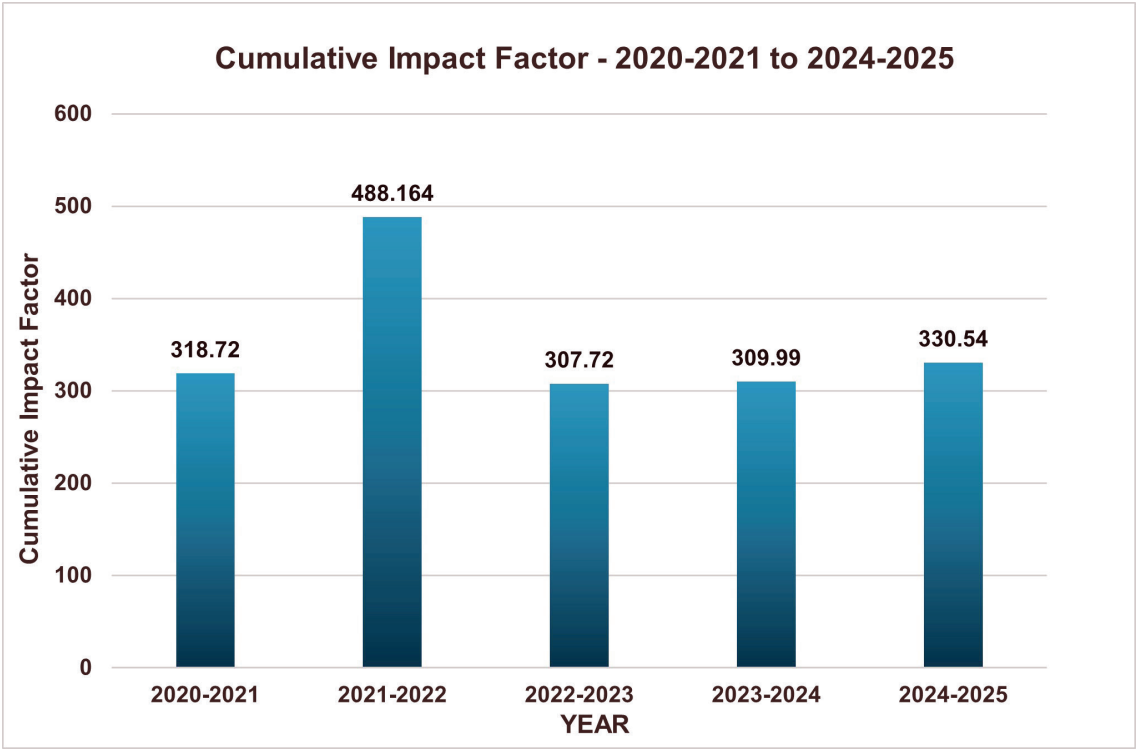


Fig 9. (a–d) Panel I; Field photographs of the rocks sampled for rock varnish studies from NW Himalaya (Leh, Ladakh). Panel II; (a) View from the NASA›s Mars rover showing a boulder field in front of a location named as "Santa Cruz"; (b) synoptic view of barren landscape from Ladakh with varnish coated boulders; (c) NASA›s Perseverance Mars rover obtained this image of "Santa Cruz" hill in Jezero Crater by stitching together 24 separate photographs from the rover's Mastcam-Z camera system, the rover crew called the boulders in the foreground "Ch'al" rocks; (d) Thick glazed shining brown varnish coating on Ladakh rocks; (e) The Perseverance rover obtained this image using its left Mastcam-Z camera on oct 25, 2021; (f) Rich dark reddish-brown coating on Ladakh batholith boulders. Image Credit (a, c): NASA/JPL-Caltech; (e) NASA/JPL-Caltech/ASU.



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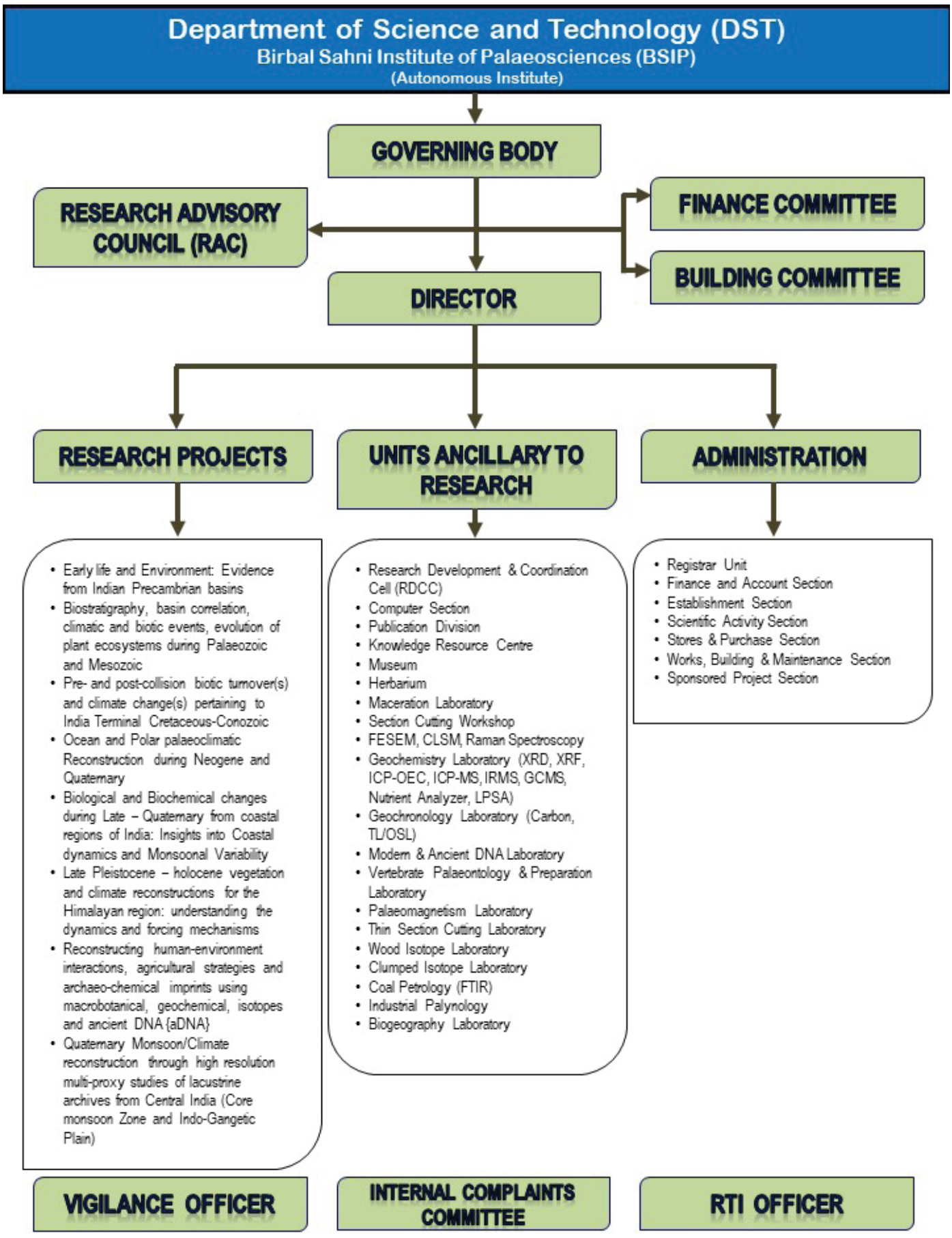

Arumberia banksi, a typical late Ediacaran fossil. Locality: Maihar, Satna district, MP. Stratigraphic horizon: Maihar Sandstone, Vindhyan Supergroup.
Photo Courtesy: Dr. Santosh K. Pandey, BSIP

RESEARCH

Project 1: Early life and environment: Evidence from Indian Precambrian basins

Coordinator: Veeru Kant Singh (Scientist E)
Co-coordinator: Santosh Kumar Pandey (Scientist D)

OBJECTIVES

- *Tracing the antiquity of various life forms.*
- *To trace the emergence of photosynthetic oxygenation and subsequent changes in ocean redox structure.*
- *To understand the role of sedimentological processes and depositional environment in the associated sedimentary formations.*
- *Study of life forms and associated biogeochemical processes in the extreme environment from the Archaean and Modern analogues.*

PREAMBLE

The Precambrian Eon encompasses major evolutionary events of the Earth's history with regards to the co-evolution of life and environment. India is one of the countries having several Precambrian sedimentary basins which make it a best archive to investigate the origins and evolution of early life, emergence of eukaryotes, or multicellular organisms, and their progression into complex metaphytes and metazoan forms along with associated depositional environment and atmosphere. Stromatolites from the Dharwar Craton in India date back to the Archaean Period (4000–2500 million years), stromatolitic and non-stromatolitic layers of the Palaeoproterozoic Bajna Dolomite, Bijawar Group are studied to establish

1st Row (L-R): Archana Sonker, Divya Singh, Yogmaya Shukla, Arif Husain Ansari, Veeru Kant Singh, Santosh Kumar Pandey, Arvind Kumar Singh, Shamim Ahmad; 2nd Row (L-R): Md. Arif Ansari, Arunaditya Das, Faizan Ahmad Khan, Kumail Ahmad, Gurumurthy G.P.

the syngenecity of preserved organic remains in terms of biogenicity. Microscopic and megascopic fossil remnants from the Bhander Group of the Vindhyan Supergroup in central India and the Raipur Group of Chhattisgarh are examined to determine their age, antiquity, and affinity. New Ediacaran fossil assemblage recovered from the Sonia Sandstone of the Marwar Supergroup, mark this horizon as best archive of Ediacaran ecosystem on global platform. Sediments of the Cuddappah and Vindhyan Supergroup are investigated to understand how oxygen evolved during the Proterozoic and its involvement in eukaryotic evolution. Additionally, discovery of *Dictyosphaera macroreticulata* from the >1.65 Ga Chitrakoot Formation, Vindhyan Supergroup marks yet another evidence of one of the oldest eukaryotes recovered from the Earth's history.

PERSONNEL

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Research Scholars: Yogesh Kumar, Divya Singh, Kumail Ahmad, Faizan Ahmad Khan, Md. Arif Ansari, Arunaditya Das

SIGNIFICANT FINDINGS

The latest Palaeoproterozoic (>1.65 Ga) Eukaryotic fossils from the Chitrakoot Formation (Semri Group), Vindhyan Basin

Palaeobiological studies were carried out on the different stratigraphic units of the Vindhyan and Chhattisgarh Supergroup to understand the origin, evolution and diversity of early eukaryotes in the Proterozoic (2500-538 Ma) biosphere. Compression-preserved acid-resistant organic-walled microfossils entombed in fine-grained siliciclastic rocks provide an essential tool for biostratigraphical correlation, predominantly when alternative methods of stratigraphical correlation are scarce. These fossils offer vibrant insights into the evolution and diversification of the Proterozoic history of eukaryotes. In order to understand the antiquity of early life forms, four distinct morphologically complex organic-walled microfossils (OWMs) (acritarchs), viz. *Dictyosphaera macroreticulata*, *Shuiyousphaeridium echinulatum*, *Cymatiosphaeroides kullingii* and smooth walled sphaeromorphs *Leiosphaeridia* spp. recorded from the latest Palaeoproterozoic Chitrakut Formation of the Semri Group exposed in the Son Valley, India were studied (Fig. 1). These fossils were also investigated under TLM, CLSM and LRS to understand the chemical composition and cell wall anatomy. The study represents an evolutionary innovation in the advent of early eukaryotes in the Proterozoic biosphere.

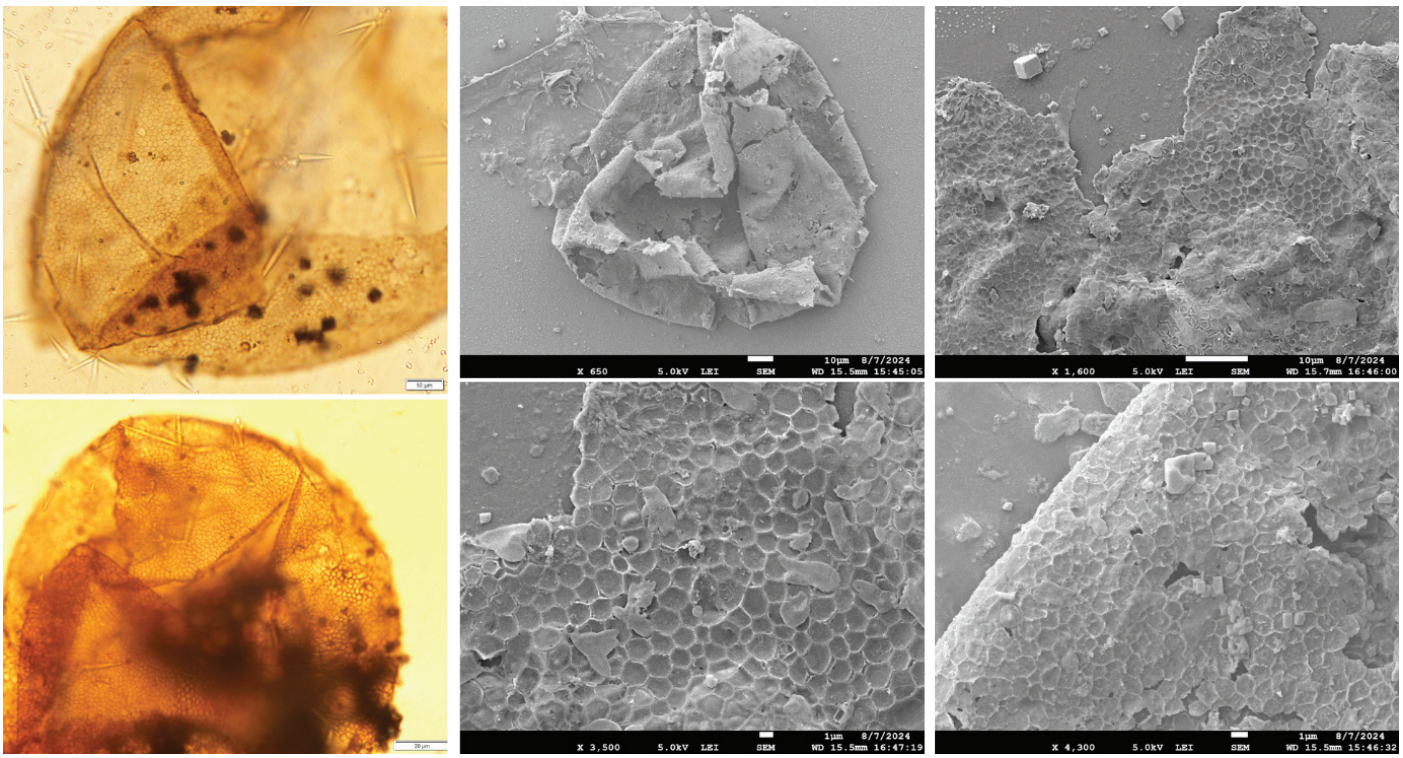


Fig. 1 - TLM and SEM based microphotographs of taxonomically recognised Eukaryotic fossil *Dictyosphaera macroreticulata* from the >1.65 Ga Chitrakoot Formation, Vindhyan Supergroup. Scale bar = 25 µm each.

Tonian (100-720 Ma) age-restricted tubular organic-walled microfossils from Neoproterozoic Raipur Group, Chhattisgarh Supergroup.

Carbonaceous black shale and silicified black cherts from the carbonate sequence of the Neoproterozoic Raipur Group, Chhattisgarh Supergroup were processed and distinct Tonian age organic-walled microbiota *Trachyhystrichosphaera* Timofeev & Hermann were recovered. Two species of *Trachyhystrichosphaera,* viz. *T. aimika* and *T. botula* are recorded as organic-walled microfossils. In the global context, recovered species of *Trachyhystrichosphaera* are widely distributed in latest Mesoproterozoic and early Neoproterozoic organic-walled microfossil assemblages and are considered potential index fossils of Tonian age (1000- 720 Ma, early Neoproterozoic). Present study from the Saradih Limestone of Raipur Group collectively adds to the growing diversity of the Tonian fossils, which was earlier constrained to older than 1000 Ma, i.e. Mesoproterozoic.

Geochemical studies on the stromatolites from the Joldhal Formation, Chitradurga Group, Dharwar Craton.

The REE and trace metal analysis have been performed on the carbonate stromatolites from the Joldhal Formation, Chitradurga Group, Dharwar Craton. The chondrite normalised REE plot of the Kumsi stromatolitic carbonate samples shows an enrichment of LREE relative to HREE (Fig. 2). The Chondritic Y/Ho vale < 28, which is typically considered an indicator for a non-marine, restricted basinal condition. In several of the lower layers of Kumsi stromatolite europium anomalies (Eu/Eu*) are > 1.2 strongly suggesting possible inputs from local hydrothermal sources. Most of the REE patterns show a true positive Ce/Ce* may indicate a pH lower than 5. This pattern of REE + Y distribution of the stromatolitic carbonate has been interpreted as carbonate/sediment precipitation in a restricted basin with more terrigenous or freshwater influx than seawater. The lower pH in the depositional environment must have been caused by the volcanic acidic gases and hydrogen ions supplied from hydrothermal sources.

Advance microscopic investigations of Early Precambrian Stromatolites from the Bajna Dolomite, Bijawar Group.

The study employed an innovative multi-disciplinary methodology integrating petrography, FESEM-EDX, Raman spectroscopy, and stable carbon isotope analysis to investigate early Precambrian stromatolites from the Palaeoproterozoic Bajna Dolomite in India (Fig. 3). A key

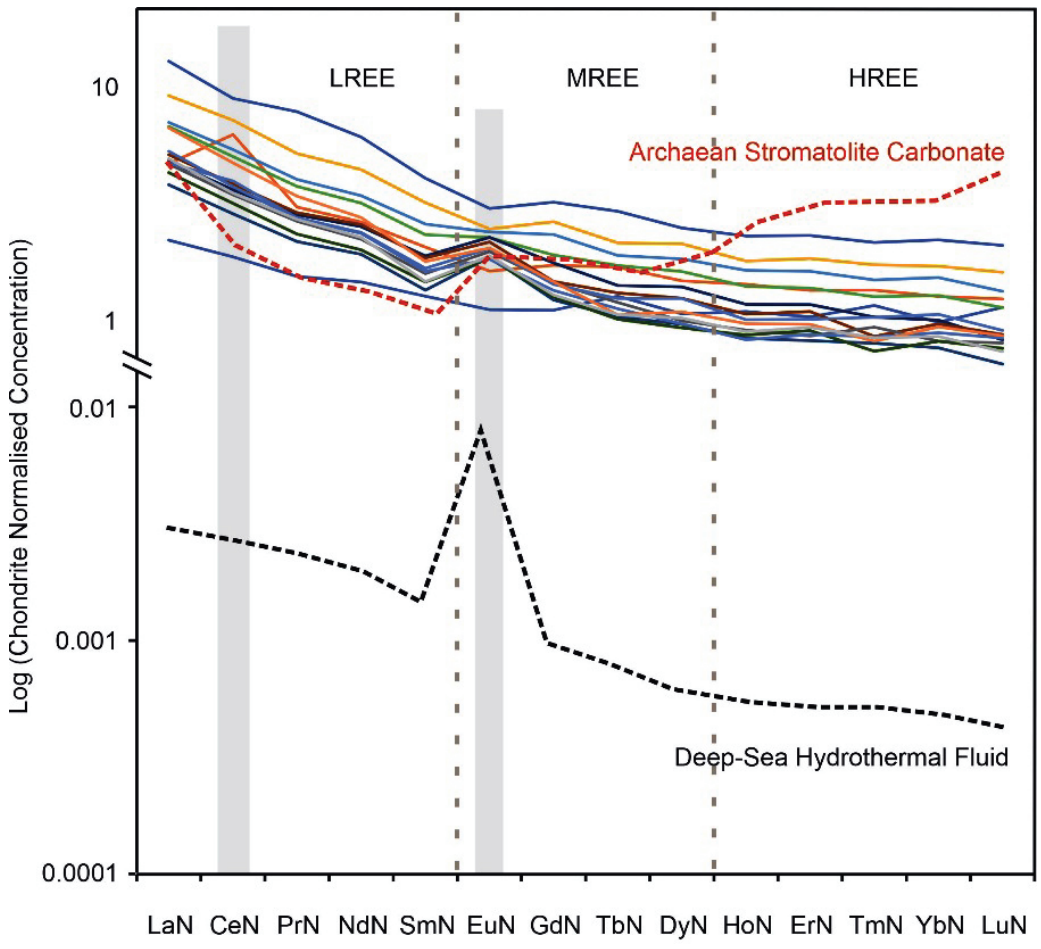


Fig. 2 - The chondrite normalised REE plot of the Kumsi stromatolitic carbonate samples.

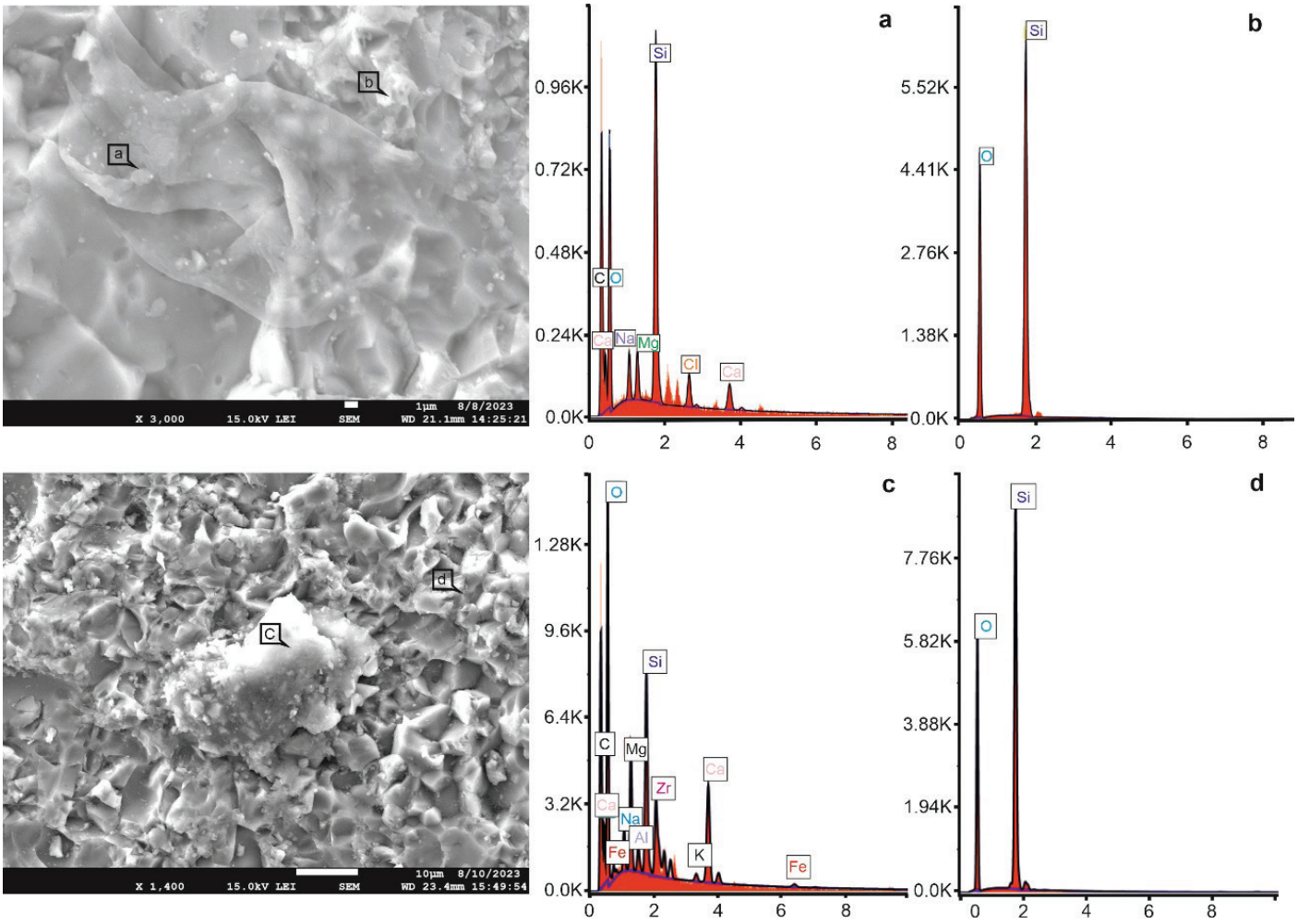


Fig. 3 - Photographs of hemispheroidal stromatolites: (a) A cluster of hemispheroidal stromatolites, with a 28 cm long hammer placed for scale, (b) A horizontal close-up view of the stromatolites, with a 6 cm diameter camera lens cap for scale, (c) A vertical section of the stromatolites displaying laminae, (d) A magnified view of the stromatolite shown in image c, (e) A vertical polished section of a hemispheroidal, cabbage-shaped stromatolite. This image also indicates the sampling spots—core (S) and S1 to S6—used for SEM-EDX and Raman spectroscopy analyses.

innovation lies in the application of Raman spectroscopy to assess the thermal maturity of organic carbon, providing novel insights into the biogenic origin of carbonaceous matter while effectively ruling out contamination by younger organics. The detection of significant cation concentrations (Ca, Mg, Fe) further confirmed microbial activity, strengthening evidence for cyanobacteria and methanogenic bacteria in stromatolite formation. This approach advances the field of biogenic studies by offering robust geochemical and palaeontological data.

Ediacaran biotic diversity and their significance in Sonia Sandstone, Marwar Supergroup.

The Sonia Sandstone of the Jodhpur Group, Marwar Supergroup in western Rajasthan has unveiled a remarkable array of fossil assemblages, significantly advancing our comprehension of the Ediacaran biotic diversity and palaeoecological dynamics. Recent discoveries within the Sonia Sandstone include a diverse suite of Ediacaran fossil assemblages such as *Tirasiana qingzhenensis*, *Hiemalora stellaris*, *Pteridinium* sp., *Finkoella ukrainica*, *Finkoella oblonga*, *Arumberia banski*, coiled form, bizarre form A, *Quaestio simpsonorum,* and jelly fish-like impressions. These fossils preserved predominantly as positive epirelief on the bedding plane, exhibit an extraordinary range of morphological intricacies, suggesting a multifaceted and dynamic Ediacaran ecosystem. This unprecedented palaeontological record sheds light on the ecological complexity and evolutionary trajectories during the Ediacaran Period, contributing to the broader understanding of early metazoan diversification and sedimentary biogenic processes.

Sedimentary processes, provenance, and palaeoclimatic evolution of Palaeoproterozoic Papaghni sub-basin.

Tectonic inferences for sedimentary basins are challenging due to the complexities associated with the geochemical composition of sediments, which are influenced by provenance, weathering, recycling, and hydrodynamic sorting during fluvial transportation and deposition. While

siliciclastic sediment geochemistry is conventionally used for tectonic interpretations, significant limitations persist. An evaluation of traditional and advanced geochemical discrimination approaches, highlighting the challenges in reconstructing tectonic settings have been carried out. The siliciclastic sediments of the Palaeoproterozoic Papaghni sub-basin within the Cuddapah Basin, India, were analysed for bulk mineralogy and major, trace, and rare earth element (REE) geochemistry to understand provenance, sedimentary processes, and palaeoclimatic evolution. Forward modelling based on chondrite-normalised REE patterns indicate dominant contributions from felsic-intermediate basement lithologies (72%) and mafic sources (28%). Fine-grained shales, deposited in low-energy shallow marine settings, show minimal quartz dilution but exhibit K-enrichment from diagenetic fluids, whereas coarse-grained quartzites, deposited in high-energy near-shore environments, are significantly affected by tidal reworking and quartz dilution. Traditional tectonic discrimination diagrams often yield inconclusive results due to quartz dilution, sedimentary reworking, and post-depositional alterations. Advanced approaches, such as discriminant function analysis, adjusted for major oxides and trace elements, also remain sensitive to provenance and diagenetic changes, particularly in the Precambrian basins. Biases from chemical weathering, sediment recycling and provenance complicate tectonic interpretations, emphasizing the need to account for basin-specific sedimentary and depositional processes. Achieving robust tectonic discrimination in sedimentary basins necessitates an integrated multidisciplinary approach, highlighting an important avenue for further investigation and advancement.

Shelf Palaeogeographic reconstruction of the Lower Cuddapah Basin

The Cuddapah Basin sediments belonging to the Palaeoproterozoic to Neoproterozoic are important archives to understand the early Earth sedimentary processes, sedimentation pattern, formation and evolution of extensive carbonate platforms and several irreversible changes. In this study, the sedimentary record from Vempalle and Tadpatri formations, along with available data, have been examined for process-based analysis of facies and facies associations in the lower Cuddapah Basin, especially in carbonate successions. The process-based facies analysis of Vempalle Formation exposed near Parnapalle and Goothy regions shows carbonate lithofacies which are clubbed under 14 facies association. The sedimentological attributes from Tadpatri Formation exposed near Somyajupalle and Animela villages shows 9 facies associations. The facies and facies association analysis in spatio-temporal framework suggests both Vempalle and Tadpatri carbonate platforms initiated largely as a carbonate ramp, which is in connotation with global phenomenon. However, profuse development of biostromal and biohermal stromatolites in Vempalle Formation along with alternation of dolomite-micrite rhythmite suggest formation of reef barrier thus imposing a rimmed profile to Vempalle carbonate platform in its late stage of development. The development of rimmed profile to the Vempalle carbonate platform draws its significance owing to high organic productivity and scope for hydrocarbon exploration in the restricted part of Vempalle platform which can be represented under four different palaeo-depositional settings namely (i) intertidal to shallow subtidal, (ii) shallow to deep subtidal, (iii) peritidal reef setting, and (iv) back reef lagoon setting. The sedimentation in Tadpatri Formation further reveals three palaeogeographic settings, namely (a) Supra tidal, (b) intertidal and (c) shallow subtidal, thereby forming a relatively stable carbonate ramp platform setting post-deposition of Vempalle sediments in the Lower Cuddapah Basin (Fig 4).

SPONSORED PROJECT (SP)

SP 1.1 **Ediacaran Complex Acanthomorph Palynoflora (ECAP) based biostratigraphy of the Krol Belt of the Lesser Himalaya, Northern India: Significance for global correlation** (Sponsored by SERB-DST EEQ/2021/000787 w.e.f. 09.03.2022)

Project Investigator: Veeru Kant Singh

The project aims to establish the Ediacaran Complex Acanthomorph Palynoflora (ECAP) based biostratigraphy of the Krol Belt exposed in Lesser Himalaya to understand the origin, antiquity, affinity, evolution, diversification, and potential refinement of biostratigraphic zonation during the Ediacaran Period. An index fossil, *Shaanxilithes ningqiangensis*, has been documented from the Rajana section of the terminal Ediacaran-aged Krol-E Formation of the Nigalidhar Syncline, Lesser Himalaya, India. These are carbonaceous in nature and preserved as compression and are characterised by serially arranged discoidal, lensoidal, or crescentic-shaped nested units found preserved on the top of the bedding planes. In this study, we described four types of taphonomic variants of Shaanxilithes ningqiangensis, having different morphological artifacts preserved on different bedding planes of the micritic earthy dolomite unit. These fossils have been considered a potential biostratigraphic marker of the terminal Ediacaran age. Laser Raman Spectroscopic (LRS) analyses of all these four taphonomic variants have also been carried out to understand their biogenic origin.

SP 1.2 **Biomolecule preservation in modern and relict Ladakh hotspring deposits, with implications for finding life on**

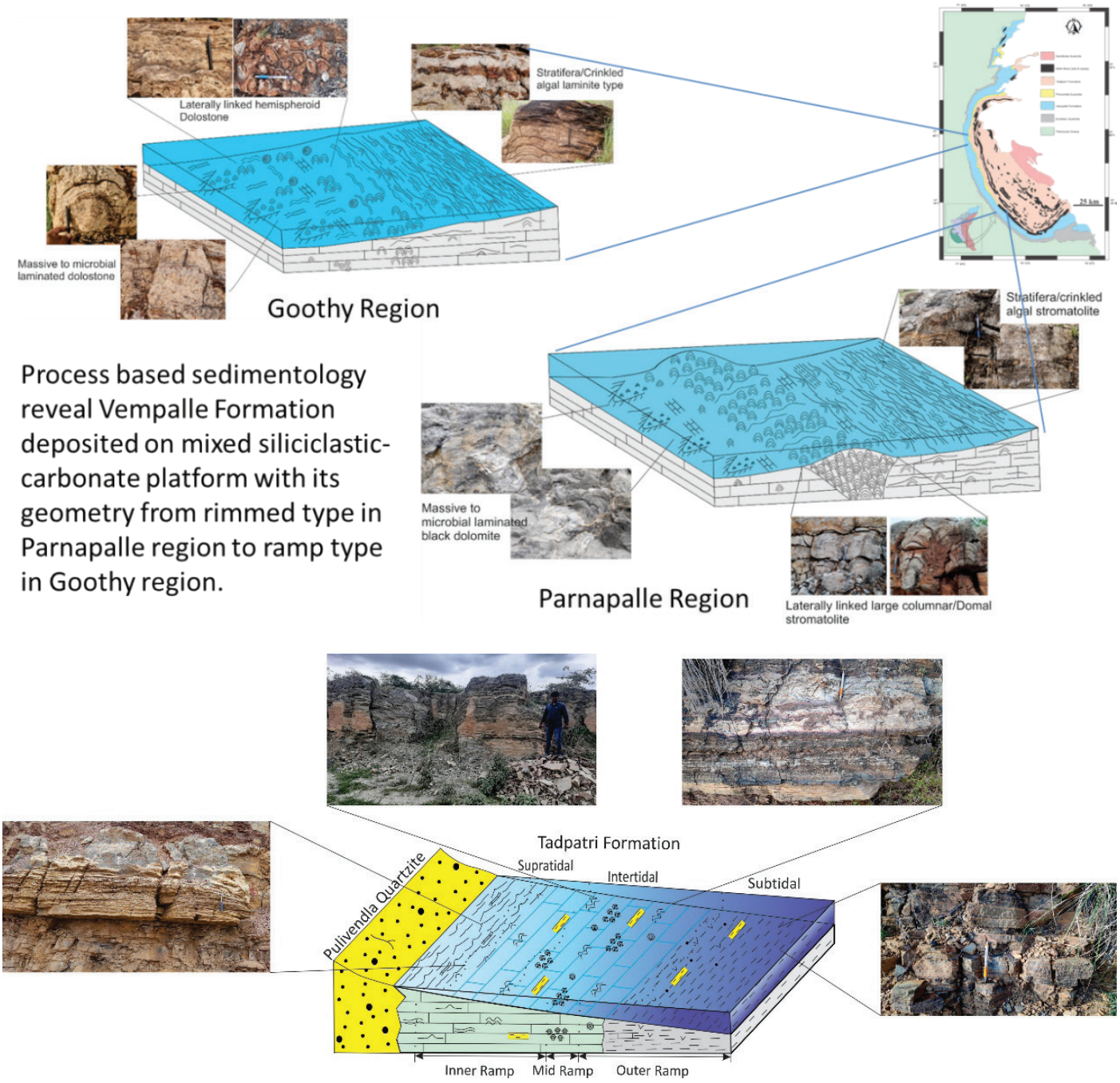


Fig. 4 - Block diagram showing shelf palaeogeographic reconstruction of Palaeoproterozoic Vempalle and Tadpatri carbonate platform. Note the development of rimmed cum ramp combined carbonate platform in Vempalle shelf.

Mars (Sponsored by SERB-DST Core Research Grant (CRG/2022/000460, w.e.f. 23.02.2023)).

Investigator: Arif Husain Ansari

The study of Ladakh's high-altitude hotspring waters as analogs for Mars' ancient hydrothermal environments represents a novel application in astrobiology, advancing our understanding of extra-terrestrial habitability. By identifying unique organic biomarkers such as n-alkanes, esters, and alcohols—produced by bacterial communities—the research demonstrated that high-altitude hot springs preserve a more diverse and stable suite of bioactive compounds compared to their low-altitude counterparts. These findings have significant astrobiological relevance, as they provide a framework for detecting potential biomarkers in Martian hydrothermal deposits, strengthening the search for past or present microbial life beyond Earth.

SP 1.3 Chemical weathering and sediment provenance in the northern part of Bay of Bengal during the late Quaternary: decoupling the role of climate-tectonics in

Bay of Bengal sedimentation (Sponsored by CRG project No. is CRG/2023/007765, May 08, 2024)

Project Investigator: GP Gurumurthy (PI) and Anupam Sharma (Co-PI)

In this study the late Quaternary sedimentary record from the Bay of Bengal and Brahmaputra River Basin has been characterized for provenance and chemical weathering characteristics to infer the climate-tectonic history of the northeastern Himalaya. The sediment core samples from northwestern and northeastern Bay of Bengal is studied for sediment texture, clay mineralogy, elemental geochemistry (major, trace and rare earth elements) and radiogenic isotopes (87Sr/86Sr and εNd) to infer the weathering and provenance characteristics in the source region. The weathering and provenance record will be compared with the continental records to decouple the climate-tectonic role in Bay of Bengal sedimentation.

COLLABORATIVE PROJECTS (CP)

CP1.1 Differential chemical weathering responses of Gondwana Basins in peninsular India to climate change during the late Palaeozoic.

Gurumuthy, G.P. [& K. Pauline Sabina, BSIP]

The glacial to greenhouse climate transition during the late Carboniferous to early Permian occurred in an episodic manner; however, the signatures are sporadic and remain enigmatic. In the current study, climate transition and subsequent environmental change in the high latitudinal regions of the Gondwana during the late Carboniferous - early Permian have been studied through chemical weathering intensity and sediment provenance characteristics of the Wardha Basin, Peninsular India using elemental geochemistry (major, trace and rare earth elements (REEs) and bulk mineralogy. The sediment provenance in the Talchir Formation is dominantly granitic source, however, there is an increase in mafic-mineral enriched detritus in the Barakar and Motur formations, possibly derived from metamorphic (granite gneissic) source. These sediments exhibit consistent low to moderate chemical weathering, which implies relatively drier climate conditions in the source area. The stratigraphic comparison with the lower Gondwana succession suggests that the Wardha Basin sediments experienced a relatively cold and drier climate than the Satpura Basin sediments. The sediments in these basins have distinct characteristics, which can be explained by basin tectonics, topography and associated climate differences in the source region. Both local and global forcing factors control the climate during the late Palaeozoic. The transition from glacial to greenhouse climate during the late Carboniferous and early Permian was gradual, and cold climate persisted in high latitude regions of the Gondwana, which was influenced by glaciers/ice caps radiating from local upland topography highlighting the differential responses of Gondwana Basins to the global climate during the late Palaeozoic.

CP 1.2 Geochemistry of sediments in the Laccadive Sea, western continental margin of India.

Gurumurthy G.P. [& Tripti M, National Institute of Hydrology, Roorkee, India]

A sediment core (No. SK-362-AE-2) from the Laccadive Sea has been studied for sediment texture, bulk mineralogy, clay mineralogy, and elemental geochemistry (major, trace and rare earth elements (REEs)) to infer the chemical weathering pattern and sediment provenance in the late Quaternary. The study aims to provide quantitative sediment provenance constraints to Lakshadweep Sea. The sediments in the core site are very poorly sorted and are texturally and compositionally immature. The sediments have undergone low to moderate chemical weathering (avg. CIA value of 50 (range 37-50)). The composition shows substantial depletion of Nb-Ta-Ti and enrichment of Zr, Hf, Th, and light rare earth elements (LREEs). The sediments exhibit enriched incompatible element patterns that resemble continental rift basalts (CRB), the Deccan Basalts. The textural and compositional immature characteristics of the Laccadive Sea sediments at core site are inconsistent with the potential source area sedimentary and weathering characteristics (the western flank of the Western Ghats and the Western Himalayas) suggesting weathering of *in-situ* submerged volcanic intrusive rocks. The study reveals geochemically similar (Deccan Basalts) relic volcanic intrusives as an important contributor to the sedimentary budget of the Lakshadweep Sea. The provenance determination along the western continental margin of India needs to consider the contribution of volcanic sources in the western margin of India, which needs to be carefully assessed for accurate reconstruction of palaeoclimate and palaeogeography of Peninsular India.

CP 1.3 Geochemistry of sediments from the Central Ganga Basin.

Gurumurthy G.P. [& Dr Anupam Sharma, BSIP]

Sedimentological, geochemical, and clay mineralogy study of sediments flood plains of the central Ganga Basin (CGB) is studied to understand the operative fluvial processes in the Ganga Basin. The aim of the study is to provide a comprehensive depositional model by evaluating the sedimentary source, the role of climate and basin tectonics in the CGB sedimentation during the late Quaternary.

CP 1.4 Effect of Expansion of Oxygen Minimum Zones (OMZs) on modern ocean basins.

Arvind K. Singh [& Aditya Abha Singh, Botany Department, University of Lucknow]

Oxygen Minimum Zones (OMZ) are represented by starkly depleted oxygen concentrations in the modern ocean basins whose expansions are documented since 1960. They are expanding globally in the world oceans with profound implications for marine ecosystems and biogeochemical cycles. Under this study, we have explored the interplay of physical, chemical, and biological factors controlling the OMZ formation, intensification and expansion. The study highlights the role of ocean circulation patterns, nutrient enrichment from anthropogenic activities & augmenting influence of climate change. It also discusses the biogeochemical significance of OMZs and their contribution to greenhouse gas emissions particularly in the context of nitrogen and other nutrient cycles. It emphasizes the complex feedback loops between OMZ expansion and climate change, underlining the urgent need for mitigation and adaptation strategies.

CP 1.5 Sedimentology & Clay Mineralogy of Gujri-Dugni Composite Intertrappean Deposits.

Arvind K. Singh [& Md. Arif, BSIP]

The Composite Deccan Volcano Sedimentary Succession comprising three intervening Intertrappean beds within four basaltic lava flows exposed at Gujri-Dugni Village near Dhamnod, MP was investigated for sedimentary attributes. Out of three Intertrappean units, eight microfacies have been identified, namely (a) fossiliferous argillaceous limestone, (b) Marly limestone, (c) Calcareous Mud, (d) Silty calcareous mud with fossils, (e) Greyish Limy fossiliferous shale, (f) Nodular calcrete layer, (g) Fossiliferous silty limy shale and (h) Massive carbonaceous mud. The lowermost microfacies has yielded fossils and bioclasts of bivalve and Mollusca whereas limy fossiliferous shale exhibits presence of ostracods and charophytes under microscopic observation. Clay mineral investigation of calcareous mud, limy shale, argillaceous limestone and calcrete nodules of the Gujri Intertrappean section shows the presence of smectite, illite/smectite interlayer phase, mica and quartz in the fine clay fraction of the sediments. Smectite is a secondary clay mineral formed by the chemical weathering of basic rocks, such as basalts, in a mainly arid to semi-arid climate with alternating wet and dry seasons. Considering the sedimentary attributes, clay mineralogy and palynological data of lithounits, it is suggested that these sediments were deposited in a palustrine/lacustrine environment with semi-arid to humid climatic conditions seasonal precipitation.

CP 1.6 Sequence development of Mehadbani Intertrappean Deposits.

Arvind K. Singh [& Md. Arif, BSIP]

Sedimentological investigation and lithofacies development of Mehadwani Intertrappean deposit reveal its deposition largely in a small, shallow palustrine or lacustrine type depositional setup with low to moderate energy conditions under warm and humid climate. These kinds of lacustrine setup were extensively developed either by clogging of stream channels or by pooling in lava flows during quiescence period of volcanism in Deccan Large Igneous Province. Diffusive and micritic nature along with shell fragments within fossiliferous argillaceous limestone suggest quiet as well as calm, shallow water conditions with little wave activity which resulted from carbonate precipitation processes under well-defined pH and Eh conditions prevailing in shallow water body. The chert formation owes its origin to the interaction of silica enriched fluids on marl and argillaceous limestone during early stages of diagenesis. The higher silica content in meteoric waters would have resulted from continental chemical weathering processes. The compact and iron cement coatings on chert pods, indicate burial diagenesis at shallow to intermediate depth where, either leaching of basaltic trap has generated iron during chemical weathering or by the action of iron-rich circulating diagenetic fluid.

CP 1.7 Influence of sedimentary processes on tectonics of Precambrian Sedimentary Basin.

Arvind K Singh [& Gurumurthy GP, BSIP]

Tectonic inferences for sedimentary basins are challenging due to the complexities associated with the geochemical composition of sediments, which are influenced by provenance, weathering, recycling, and hydrodynamic sorting during fluvial transportation and deposition. Petrographic analyses of the Gulcheru, Pulivendla, and Gandikota formations reveal that they are primarily composed of fine to medium-grained, well-rounded to sub-rounded, and well-sorted monocrystalline quartz grains, with some polycrystalline quartz varieties, including recrystallized and stretched metamorphic types. These formations also contain K-feldspar (orthoclase and microcline), plagioclase, finer platy minerals such as micas (muscovite and biotite), and heavy minerals like zircon and apatite. The primary cementing material is silica, often appearing as overgrowth around the monocrystalline quartz grains. In the Gandikota quartzites, K-feldspar grains show sericitization, and chlorite is also observed in the matrix, and these rocks are classified as arkose, sublitharenite, and quartz-arenite (T. Khan *et al.*, 2019). In contrast, shale samples from the Vempalle and Tadpatri formations exhibit significant variability, ranging from

dark-grey shales with ferruginous laminae to massive grey-greenish shales composed of clay minerals, micas, quartz, and ferruginous materials. Furthermore, the presence of calcareous shale is also observed from both Vempalle and Tadpatri formations.

CP 1.8 Terrestrialization of Wetlands.

Arvind K. Singh [& Aditya Abha Singh, Department of Botany, University of Lucknow]

The interdisciplinary collaboration focuses on climate change and its effect on wetlands and its terrestrialization. This collaborative study concentrated on understanding changes in area of Sikandarpur riverine wetland and vegetation due to increasing urbanization of Muzaffarpur City, deforestation, siltation of sand and influx of domestic/industrial waste. The study incorporates the use of multi-temporal time-services by analysing the previous 44 years of Landsat data using different Landsat images (Landset-3, Landset-5, Landset-8 and latest Landset-9) at regular intervals years extending 1980, 1998, 2004, 2008, 2011, 2018 and 2024.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Shukla Yogmaya, Sharma Mukund, Ansari AH & Singh VK - "Evidence of microbial textures in the Neoarchaean aged Donimalai Formation, Sandur Schist Belt, Dharwar Craton, India". 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contribution in Environmental Climatic and Energy Research held at BSIP, Lucknow, (11th-13th December 2024), Page No. 4.

2. Ahmad Shamim & Pandey SK - "The Suite of new Ediacaran fossil record from the Jodhpur Group, western Rajasthan and their inferences". 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contribution in Environmental Climatic and Energy Research held at BSIP, Lucknow, (11th-13th December 2024), Page No. 5.

3. Singh Divya, Sharma Mukund, Pandey SK, Pandey Bindhyachal, Dubey Nageshwar - "On the genesis of carbonate concretion in the Rohtasgarh Limestone, Vindhyan Supergroup, India". 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contribution in Environmental Climatic and Energy Research held at BSIP, Lucknow, (11th-13th December 2024). Page No. 6.

4. Ahmad Kumail, Singh AK, Pandey SK, Singh VK, Gurumurthy GP - "Decoding Molar Tooth Structures from the Rohtasgarh Limestone, Son Valley, Vindhyan Basin, India: Implications for its genesis and palaeoenvironment". 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contribution in Environmental Climatic and Energy Research held at BSIP, Lucknow, (11th-13th December 2024), Page No. 45.

5. Singh VK & Sharma Mukund - "Laser Raman micro-spectroscopy based kerogenous categorisation of chert hosted permineralised microbiota of the Chhattisgarh Supergroup, India". 29th Indian Colloquium on Micropalaeontology and Stratigraphy, University of Delhi, Delhi, (17th-19th October 2024), Page No. 208.

6. Kumar Yogesh, Sharma Mukund, Goswami Sreeroop & Singh VK - "Advantage of Confocal Laser Scanning Microscopy in deciphering new morphological characters: A case study based on the Neoproterozoic Kurnool microfossils". 29th Indian Colloquium on Micropalaeontology and Stratigraphy, at University of Delhi, Delhi, (17th-19th October 2024), Page No. 213.

7. Singh VK & Sharma Mukund - "The status of the Singhora Group, the Chhattisgarh Supergroup: Insights from micropalaeontological scrutiny". 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contribution in Environmental Climatic and Energy Research held at BSIP, Lucknow (11th-13th December 2024), Page No. 70.

8. Singh VK - "Boring Billion and Early Evolution of Complex Life: Insights from Proterozoic Vindhyan Basin, central India". International Conference on "Earth: From Archaean to Proterozoic (ICEAP-2024), held at Mohan Lal Sukhadia University, Udaipur, Rajasthan, (December 19th-21st, 2024), Page No. 9.

9. Pandey SK, Sharma M & Ahmad S - Co-evolution of life and environment and the role of large seaweeds for the Emergence of Ediacara biota. 29th Indian Colloquium on Micropalaeontology and Stratigraphy, University of Delhi, Delhi (17-19 October 2024), Page No. 160.

10. Ahmad S & Pandey K - Insight into *Bergaueria* trace fossils from the Nagaur Group, Marwar Supergroup, India. 29th Indian Colloquium on Micropalaeontology and Stratigraphy, Delhi University, Delhi (17-19 October 2024), Page No. 170.

11. Gurumurthy GP, Kavali PS, Faizan AK, Alam M, Sharma A, Singh AK & Bajpai A 2024 - Differential chemical weathering responses of Gondwana basins in Peninsular India to climate change during the late Palaeozoic. 40th Convention of Indian Association of Sedimentologists & National Conference on an Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research (11tth – 13th December 2024), Page No. 111.

12. Gurumurthy GP 2024 - Tracing the sediment provenance in the Lakshadweep Sea: Insights into chemical weathering and Quaternary climate. Climate change and geosciences to be held at Department of Geology, Bangalore University during February 5-6, 2024.

13. Faizan AK, Gurumurthy GP, Ahmad K, Singh AK, Alam M & Sharma A - "Unravelling Sediment Provenances in Precambrian Sedimentary Rocks: Insights from the Papaghni Sub-basin, Cuddapah Supergroup, India" at the Conference on Integrated Earth (CITE) during 1st -2nd September 2024, Indian Institute of Science Education and Research, Pune, India, Page No. 100.

14. Ahmad K, Singh AK, Gurumurthy GP, Ahmad F, Alam Mahboob & Arif M - 2024. Sedimentation pattern and nature of Paleaoproterozoic carbonate platform: Insights from lower Cuddapah Basin, India. Conference for Integrated Earth (CITE), IISER Pune 1st -2nd September 2024, Page No. 175.

15. Faizan AK, Gurumurthy GP, Ahmad K, Singh AK, Alam M, Arif M & Sharma A - "Exploring Palaeoproterozoic Ocean Redox Variability: Insights from the Vempalle carbonates of the Cuddapah Basin, India" 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research (11th – 13th December 2024), Page No. 9.

16. Pandey SK - The sustenance for large body plan of Ediacara biota. Conference for Integrated Earth (CITE), IISER Pune (1st -2nd September 2024), Page No. 155.

17. Singh D, Sharma M, Pandey SK & Pandey B - Understanding the effect of secondary alterations on the preserved microfossils: A case study from the Palaeoproterozoic chert of the Salkhan Limestone, Vindhyan Supergroup, India. Conference for Integrated Earth (CITE), IISER Pune (1st -2nd September 2024), Page No. 178.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Yogmaya Shukla

- Symposium on "Women in Science, Technology and Innovations: As Role models in transforming Challenges into Innovative Solutions held at BSIP, October 04, 2024 (online).

Veeru Kant Singh, Arvind K Singh, Santosh K Singh, Arif H Ansari, Yogmaya Shukla, Shamim Ahmad, Divya Singh, Yogesh Kumar, Kumail Ahmad & Faizan Ahmad Khan

- 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contribution in Environmental Climatic and Energy Research held at BSIP, Lucknow, December 11-13, 2024).

Veeru Kant Singh, S.K. Pandey & Shamim Ahmad

- 29th Indian Colloquium on Micropalaeontology and Stratigraphy, at University of Delhi, Delhi, India, October 18-20, 2024.

Yogmaya Shukla & Arif H. Ansari

- International Conference on Palaeodown under 3" organized by The Geological Society of Australia, specialist group Australasian Palaeontologists from July 10-14, 2023 (online).

Veeru Kant Singh

- International Conference on "Earth: From Archaean to Proterozoic (ICEAP-2024), at

Mohan Lal Sukhadia University, Udaipur, Rajasthan, India, December 19-23, 2024.

Gurumurthy GP

- Conference on Chemical, Biological, Radiological, Nuclear and Industrial (CBRNI) Disaster Management held on March 07, 2024, organised by Rashtriya Raksha University, Lucknow.

Santosh Kumar Pandey, Divya Singh, Arif Mohammad Ansari, Kumail Ahmad & Faizan Ahmad Khan

- Conference for Integrated Earth (CITE), IISER Pune, September 01-02, 2024.

PH.D. PROGRAMMES

	**Divya Singh (2019)**. Palaeobiology and geochemistry of chemically precipitated rocks of the Semri Group, Vindhyan Supergroup in understanding the evolution of life, under the supervision of **Mukund Sharma (BSIP)**, **S.K. Pandey (BSIP)** & Bindhyachal Pandey (BHU), Banaras Hindu University, Varanasi. Status: Awarded
	**Mahboob Alam (2018).** Palaeoclimatic and Palaeoceanographic reconstruction of the eastern Arabian Sea since the late Miocene through geochemical and isotopic approach under the supervision of **Gurumurthy GP (BSIP) &** Komal Verma (BHU, Varanasi), registered with Banaras Hindu University (BHU), Varanasi. Status: Awarded (February 2024).
	**Mohammad Arif Ansari (2019).** Multiproxy study of palaeoproductivity-denitrification changes in the Eastern Arabian Sea during the late Quaternary under supervision of **Arif H. Ansari (BSIP)**, registered with Academy of Scientific and Innovative Research, Ghaziabad (AcSIR). Status: In Progress.
	**Arunaditya Das (2023).** Organic biomarker preservation potential in high-altitude hot spring deposits of Ladakh: an astrobiological implication under supervision of **Arif H. Ansari (BSIP)**, registered with Academy of Scientific and Innovative Research, Ghaziabad (AcSIR). Status: In Progress.
	**Archana Sonker (2023).** Characterisation of the microbiome and physicochemical conditions of high-altitude hot springs of Ladakh, Trans-Himalaya under supervision of **Arif H. Ansari (BSIP)**, registered with Academy of Scientific and Innovative Research, Ghaziabad (AcSIR). Status: In Progress.
	**Faizan Ahmed Khan (2022).** Geochemical evolution of Earth's hydrospheric environment during the Neoarchaean and Paleoproterozoic Era: Evidences from Dharwar Craton, under the Supervision of **Gurumurthy GP (BSIP) & Arvind K Singh (BSIP)**, Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In Progress.
	**Kumail Ahmad (2022).** Sedimentological and geochemical evolution of argillaceous and carbonate successions from Cuddapah Basin, under the supervision of **Dr Arvind K Singh (BSIP) & Gurumurthy GP (BSIP)** registered with Academy of Scientific and Innovative Research (AcSIR). Status: In Progress.
	**Ms. Aditi Bajpai (2024).** Late Quaternary climate and tectonic processes in the eastern Himalaya and its role in basin sedimentation and carbon cycle under the Supervision of **Gurumurthy GP (BSIP)**, registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In Progress.

TRAINING/STUDY VISITS

Veeru Kant Singh

- Imparted training to Ms. Akriti Dimri, M.Sc., Geology, Baba Sahab Bhim Rao Ambedkar University, Lucknow on topic 'Low-Manipulation acid maceration techniques and their implication on Proterozoic microfossils recovery', during July-August 2024.
- Imparted training to Mr. Aman Pundir, M.Sc., Geology, Baba Saheb Bhim Rao Ambedkar University, Lucknow on topic 'Techniques on recovery of Proterozoic microfossil embedded in shale and chert through Petrographic thin section", during July-August 2024.
- Imparted training to Ms. Sweta Rani Maharana, M.Sc., Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research (IISER), Bhopal on topic 'Different methods of sample preparation to view the Precambrian microfossils under the microscope' during December 2024- January 2025.
- Imparted training to the M.Sc. (Geology) students of Mohan Lal Sukhadia University to recognise different stromatolites morphology in field during ICEAP-2024 conference December 22-23, 2024.

LECTURES DELIVERED

Arif Husain Ansari

- "Biomolecules preservation in modern and relict Ladakh hot spring deposits, with implications for finding life on Mars" at the SETI Goa Workshop, Goa, December 13-15, 2024.
- "Investigating the origin of amorphous carbonaceous matters in a Palaeoproterozoic hemispheroidal stromatolite" at the 40th IAS Convention and National Conference, BSIP, Lucknow, December 11-13, 2024.
- "A study of the origin and distribution of dissolved organics in high-altitude hotsprings of Ladakh" at the MetMeSS-2024, PRL Ahmedabad, November 20-22, 2024.

CONSULTANCY/TECHNICAL SUPPORT RENDERED

Gurumurthy GP

- Inductively Coupled Plasma Mass Spectrometry and Inductively Coupled Plasma Optical Emission Spectrometer (ICPOES) – Consultancy for various university departments, institutes and industries.

ACCOLADES RECEIVED

Veeru Kant Singh

- Chaired a Technical Session in the 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research at Birbal Sahni Institute of Palaeoscience, Lucknow, India. 11 – 13 December 2024.

Arif Husain Ansari

- Co-chaired a Technical Session in the 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research at Birbal Sahni Institute of Palaeoscience, Lucknow, India. 11 – 13 December 2024.

Gurumurthy GP

- Received fund of Capacity Building Grants from the Geochemical Society, USA to conduct Workshop Training Program on Mass Spectrometry Analytical Techniques for Geological Research. Investigators: PI- Dr Gurumurthy GP., Co-PI: Dr Anupam Sharma; Funding: USD2500.

Arvind Kumar Singh (Convenor) and Santosh Kumar Pandey (Co-convenor)

- Organized 40th Convention of Indian Association of Sedimentologists and National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant Contributions in Environmental, Climatic, and Energy Research" at BSIP from December 11-13, 2024.

REPRESENTATION IN COMMITTEES/ BOARD

Veeru Kant Singh

- Voting Member, Sub-commission on Ediacaran Stratigraphy (Second Stage) International Commission of Stratigraphy
- Life Member**,** The Micropalaeontological Society (TMS)**,** International (TMS)
- Member**,** Scientific Advisory Committee, 40th IAS Convention and National Conference, 2024 BSIP, Lucknow, India
- Life Member, The Palaeontological Society of India, Lucknow (PSI)
- Fellow and Member, Executive Council, The Palaeobotanical Society, Lucknow
- Life Member, The Society of Earth Scientists, India (SES)
- Life Member, The Geological Society of India, India (SGI)
- Life Member, Indian Association of Sedimentologists, India (IAS)

Santosh Kumar Pandey

- Life Membership of the Indian Science Congress Associations (ISCA)
- Life Membership of The Palaeontological Society of India, Lucknow (PSI)
- Member, Doctoral Advisory Committee, AcSIR, Ghaziabad, India.
- Reviewer of Gondwana Research, Journal of Palaeonrtological Society of India.

Yogmaya Shukla

- Voting Member, The Sub-commission on Pre-Cryogenian Stratigraphy –International Commission of Stratigraphy (ICS-Pre-Cryogenian).
- Life Member, Indian Science Congress Associations (ISCA) (Since 2012).
- Life Member, Palaeontological Society of India (PSI).

Arif Husain Ansari

- Life Member, Indian Association of Sedimentologists.
- Member, Doctoral Advisory Committee, AcSIR, BSIP.
- Consortium Member of Sedimentary Geochemistry and Palaeoenvironments Project.
- Field Workshop Committee Member for 40th IAS Convention and National Conference, 2024 BSIP, Lucknow, India.

Gurumurthy GP

- AcSIR Director's Nominee for Physical Sciences.
- AcSIR DAC Member for Physical Sciences.
- Associate Editor, Arabian Journal of Geosciences, Sprinter Verlag.
- Reviewed manuscripts for Mineral, Palaeo-3, Journal of Palaeosciences, etc.

Arvind Kumar Singh

- Invited Governing Council Member, Indian Association of Sedimentologists, Aligarh, India.
- Member, Doctoral Advisory Committee, AcSIR, Ghaziabad, India.
- Co-coordinator, Sedimentology and Stratigraphy PhD Course Work, AcSIR, Ghaziabad, India.
- Life Member, Himalayan Geology, Wadia Institute of Himalayan Geology, Dehradun.
- Life Member, Indian Science Congress Association, Kolkata.
- Life Member, Indian Association of Sedimentologists, Aligarh Muslim University, Aligarh.
- Sponsored Member, International Association of Sedimentologists.
- Reviewer, Plos one, Journal of Palaeogeography, Arabian Journal of Geosciences, Journal of Earth System Science and Himalayan Geology.

Shamim Ahmad

- Academic Editor of PLOS ONE Journal.

Project 2: Biostratigraphy, Basin Correlation, Climatic and Biotic events during Palaeozoic and Mesozoic

Coordinator: Srikanta Murthy (Scientist E)
Co-coordinator: Anju Saxena (Scientist E)

OBJECTIVES

- *To resolve the age constraints of the Talchir Formation based on palynological correlations with radiometrically constrained assemblages across Gondwana and associated palaeoclimate changes across the glacial and postglacial sequences.*
- *To comprehend pathways and timings of marine incursions and sequence biostratigraphic framework across Gondwana deposits during the late Palaeozoic-Mesozoic sequences.*
- *To assess and delineate the events of biotic crisis-recovery and subsequent radiation of biota and extreme climatic events (OAEs) across the Permian-Triassic and Jurassic-Early Cretaceous sequences.*
- *Evolution of plant ecosystem with special emphasis on radiation of seed plants and phylogenetic studies to trace the early Angiosperms evolution in Indian context.*

PREAMBLE

The research work of Gondwana Palaeobiology Group covers a large time slice of deep time sediments encompassing Cambrian to Early Cretaceous time period (~100 to 545 Ma old). One aspect of the research work mainly focuses on understanding the explosion of life during the Cambrian and evolution and subsequent radiation of terrestrial plants, evidences for which are stored in the early Palaeozoic rocks of Tethyan realm particularly in Himachal Pradesh. Another major focus is on the study of 'Gondwana' successions (300-100 Ma) of peninsular India which are the major store house of coal deposits of country and are exclusively distributed in Damodar, Rajmahal, Son-Mahanadi, Satpura and Wardha-Godavari basins along with some parts of extra peninsular region. Gondwana Basins of India account for nearly 99% of coal resource of the country and hold a premier position in India for having a considerable share of reserve of

1st Row (L to R): Ayushi Mishra, Shivalee Srivastava, Stuti Saxena, Deepa Agnihotri, Anju Saxena, Srikanta Murthy, Suyash Gupta, K. Pauline Sabina, Neelam; 2nd Row (L to R): Divya K. Mishra, Abha Singh; 3rd Row (L to R): Shubham Pandey, Neha Aggarwal, S. Suresh K. Pillai, Deveshwar Prakash Mishra, Ranveer Singh Negi

thermal grades non-coking coal for catering to the demand of coal in various parts of the country. Contemporaneous sequences are known from most of the Southern Hemisphere continents suggesting former amalgamation of these landmasses. The research activities mainly aim to resolve issues related to biostratigraphy, palaeoclimate and hydrocarbon exploration with integration of microfossils and macrofossil assemblages, along with sedimentological and geochemical parameters. Emphasis is also being made to understand the evolution of flowering plants. The research findings contribute towards the understanding of the geochronological framework of Gondwana regions, origin and evolution of land plants during the Palaeozoic and Mesozoic times and the potential influence of latitudinal controls on the flora and fauna through time. It also provides insights into the vegetation, palaeoclimate and associated tectonics that contributed to the formation of coal.

PERSONNEL INVOLVED

Team Members: K. Pauline Sabina (Scientist E), S. Suresh K. Pillai (Scientist E), Deepa Agnihotri (Scientist E), Neha Aggarwal (Scientist E), Neelam Das (Scientist E), Abha Singh (Scientist D), Divya Kumari Mishra (Scientist C), Sabyasachi Mandal (Scientist C), Ranveer S. Negi (Scientist C)

Associate Member: Runcie Paul Mathews (Scientist D)

Technical Support Member: Ms. Shivalee Srivastava

Research Scholars: Raj Kumar, Suyash Gupta, Alok Mishra, Deveshwar P. Mishra, Nazim Deori, Suraj Kumar, Sabera Khatoon, Ayushi Mishra.

SIGNIFICANT FINDINGS

Palaeozoic record of the Kinnaur region, Tethyan Himalaya: Trace fossils, MISS, and Early marine fauna:

The Kinnaur region exposes a well-preserved Tethyan sedimentary sequence ranging from the late Proterozoic to the Cretaceous (Bassi *et al.,* 1983; Bhargava & Bassi, 1998; Negi *et al.,* 2023). The Palaeozoic succession is widely accessible in the Baspa, Tidong, Gyamthiang and Hojis Valleys. After a 40-year gap, new investigations in the Hojis Valley identified the *Psammichnites gigas gigas* sub-ichnozone within the Cambrian Kunzam La Formation, assigning a Cambrian Series 2–Stage 4 age

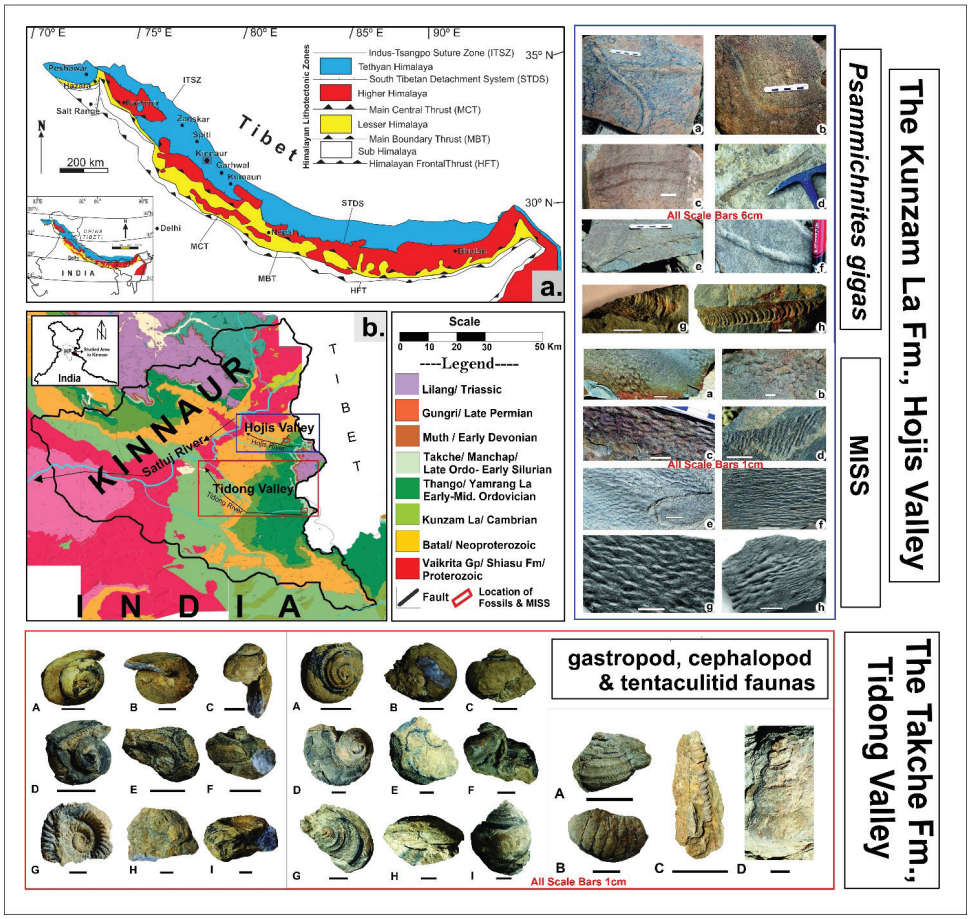


Fig. 1- The Palaeozoic record from Kinnaur region showing– *Psammichnites gigas gigas*, and microbially induced sedimentary structures (MISS) (Cambrian, Kunzam La Formation); gastropod, cephalopod and tentaculitid fauna (Ordovician-Silurian, Takche Formation).

(Negi *et al.,* 2025). Eight microbially induced sedimentary structures (MISS), including 'elephant skin', *Kinneyia*, and mat slumps, were also documented, indicating a shallow, sediment-starved nearshore environment. In the Tidong Valley, Late Ordovician gastropods (*Holopea?*, *Hormotoma*, *Poleumita?*, *Gyronemarupestre*), cephalopods (*Discoceras*, nautiloids), and *Tentaculites* from the Takche Formation were reported (Negi *et al.,* 2024). The gastropods resemble those from Baltica, suggesting a possible oceanic connection, while *Tentaculites* shows stronger affinities with Gondwanan rather than Laurussian forms (Fig. 1).

The Permian–Triassic boundary in Peninsular India and the extinction of the Glossopteridales:

Glossopteridales were in many ways the quintessential Palaeozoic Gondwana plants, whose remains are widespread and abundant in Permian terrestrial deposits of India, Australia, southern Africa, Antarctica and South America. Some studies have suggested that the Glossopterids may also have occurred in the Triassic Period and so had survived the catastrophic Permian–Triassic extinction event. This suggestion was mainly based on records from Peninsular India such as from the Panchet Formation, which traditionally was regarded as Triassic in age. In view of the importance of this issue for understanding the evolution of Palaeozoic Gondwana vegetation, as well as the wider impact of the Permian/Triassic biotic crisis on plant evolution, this study reviewed the evidence for a Triassic age for these floras and it is argued that they are in fact late Permian. The study envisaged that lower part of the Panchet Formation could be Lopingian in age. There is no clear evidence that the Glossopteridales survived the P/T biotic crisis in India, which is akin to the coeval records of Glossopterids across the globe, and only unequivocal evidence is in China that they survived into the Triassic (Fig. 2).

First report of Peltasperm from the Middle Permian of Gondwana:

A new species and genus *Satpuraphyllum furcatum,* belonging to the plant order Peltaspermales has been reported from the Barakar Formation of Satpura Gondwana Basin, India. Its distinctive cuticular features and its association with shield-shaped bracts with marginal seed scars provide strong evidence for attribution to Peltaspermales, making this the oldest representative of this order to penetrate the core regions of the Gondwanan glossopterid biome prior to the end-Permian extinction event. Given that late Palaeozoic Peltaspermales predominantly characterised warm and seasonally dry conditions, their occurrence in the Satpura Basin suggests that the Tethyan fringe of Gondwana experienced a warm interglacial phase in the latter part of the Cisuralian that might represent an expression of the Artinskian (–Kungurian) Warming Event in the Southern Hemisphere. Although known from only one plant assemblage, *S. furcatum* was clearly targeted by multiple arthropods as a food source, indicating that rarity in the vegetation did not necessarily facilitate avoidance of herbivory pressure in the Gondwanan forest-mire communities (Fig. 3).

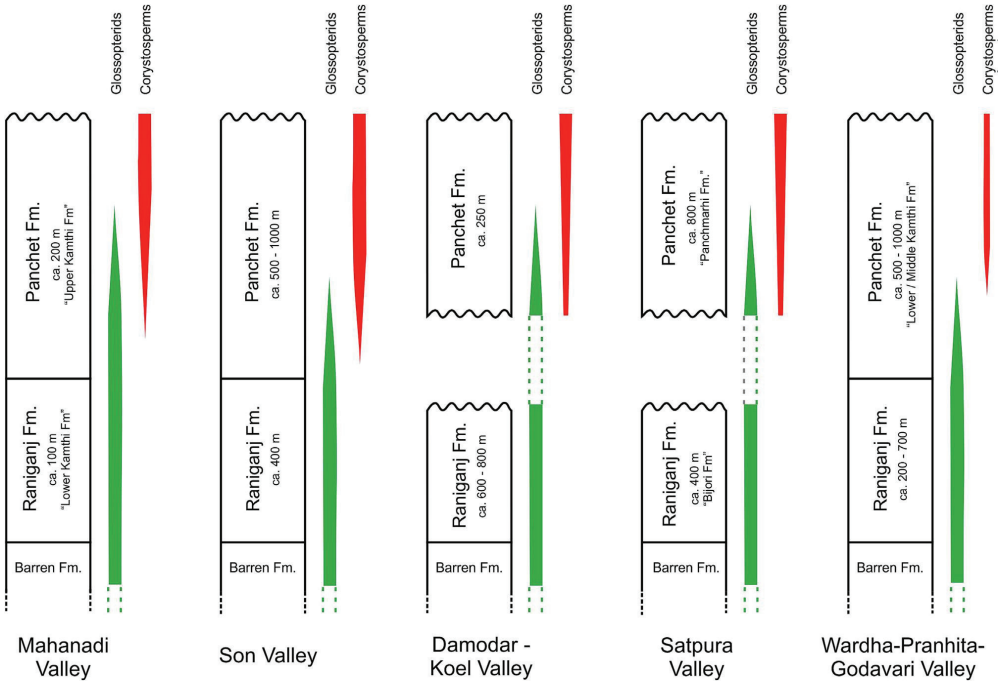


Fig. 2- Diagrammatic representation of relative stratigraphical distribution of the glossopterids and corystosperms through the Raniganj Formation and Permian part of the Panchet Formation in the five major Gondwana sedimentary basins of India.

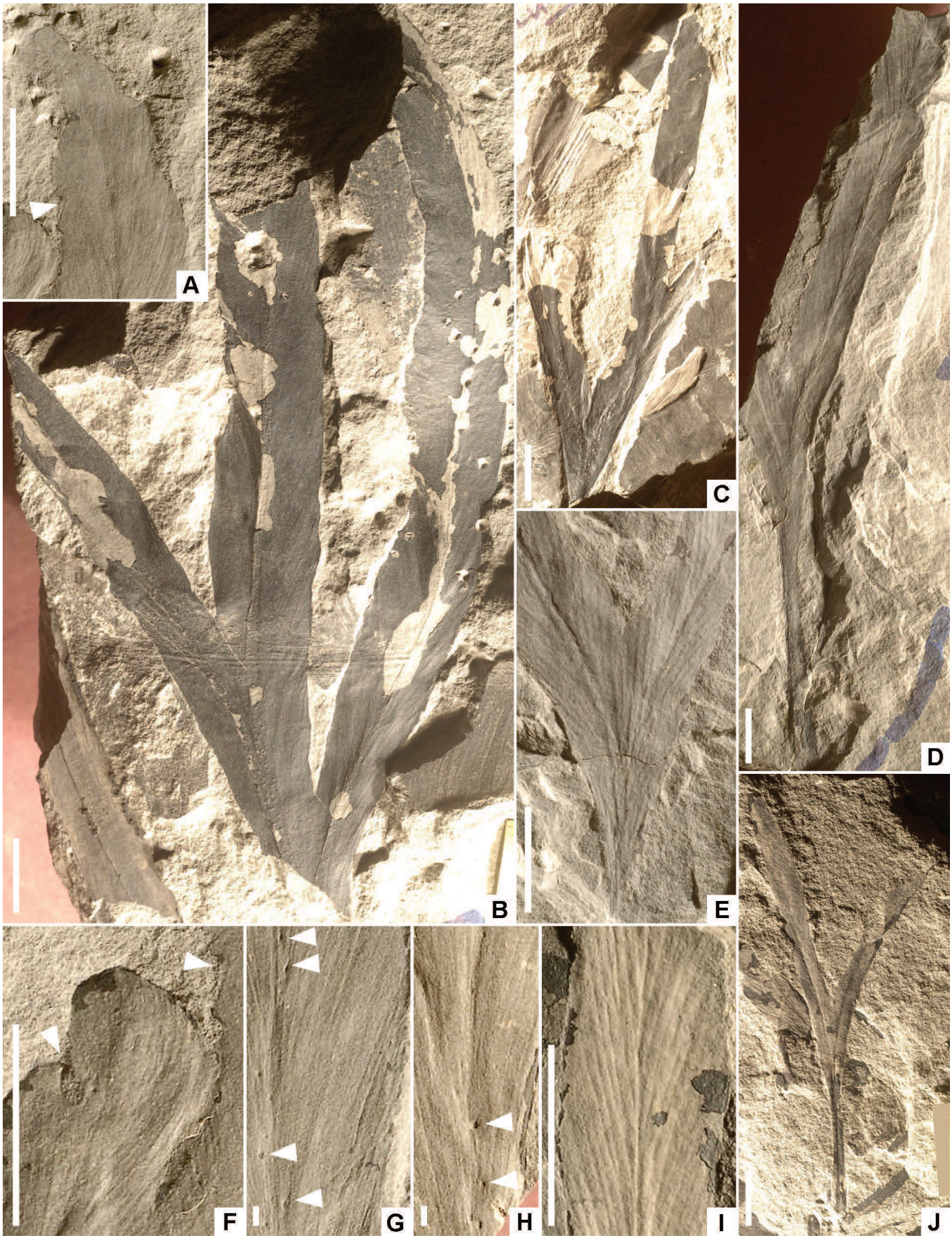


Fig. 3 - *Satpuraphyllum furcatum* gen. et sp. nov. leaves from the Barakar Formation of New Sethia Open Cast Mine, Madhya Pradesh, India.

Reconstruction of palaeoenvironment and vegetation dynamics during Late Permian: Evidences from Raniganj Coalfield, India:

Raniganj Coalfield is located in the easternmost part of the Damodar Valley Coalfield. The fossils were preserved on the shale rock and revealed diversified *Glossopteris* flora. The *Glossopteris* floral assemblages include -24 different species. The megafloral assemblage with dominance of broad mesh forms *Glossopteris* leaves with associated pteridophytes, dispersed seeds and fructile bracts and the absence of typical Triassic flora signifies that the sediments belong to the Raniganj Formation of the Late Permian Period of the Lopingian Series. The morphology of the leaves indicates a warm temperate environment with adequate water availability and sunlight during the Raniganj Formation. The palynoflora shows the presence of the *Densipollenites magnicorpus* assemblage having a dominance of striate bisaccates (*Striatopodocarpites* spp. and *Faunipollenites* spp.) along with the presence of stratigraphically significant taxa, namely, *Densipollenites, Crescentipollenites, Lunatisporites* and *Gondisporites*, which confirms the Lopingian Series affinity. The geochemical study of coal reveals bimodal distribution, suggesting multiple organic matter inputs, while the shale sample shows unimodal distribution, suggesting increased microbially derived organic matter input. The different environmental conditions during the Triassic were constrained for the *Glossopteris* flora lineage. The *Glossopteris* flora during the Raniganj Formation is considered an acme of Permian flora in peninsular India. The higher CH_2/CH_3 ratio and vitrinite reflectance further suggest the lower thermal maturity of the studied coal. The vitrinite reflectance analysis shows a medium rank of the coal, signifying the 'high volatile bituminous' rank (Fig. 4).

Permian coal-bearing sequences in Korba Basin, central India: Implications on age and their palaeoecology:

The coal-bearing deposits associated with the Barakar Formation of the Korba Basin were examined. The palynological studies revealed the presence of one palynoassemblage in the entire borehole succession which corresponds to *Scheuringipollenites barakarensis* assemblage and it reveals the Artinskian age. The studied palynoassemblage is largely dominated by bisaccate pollen

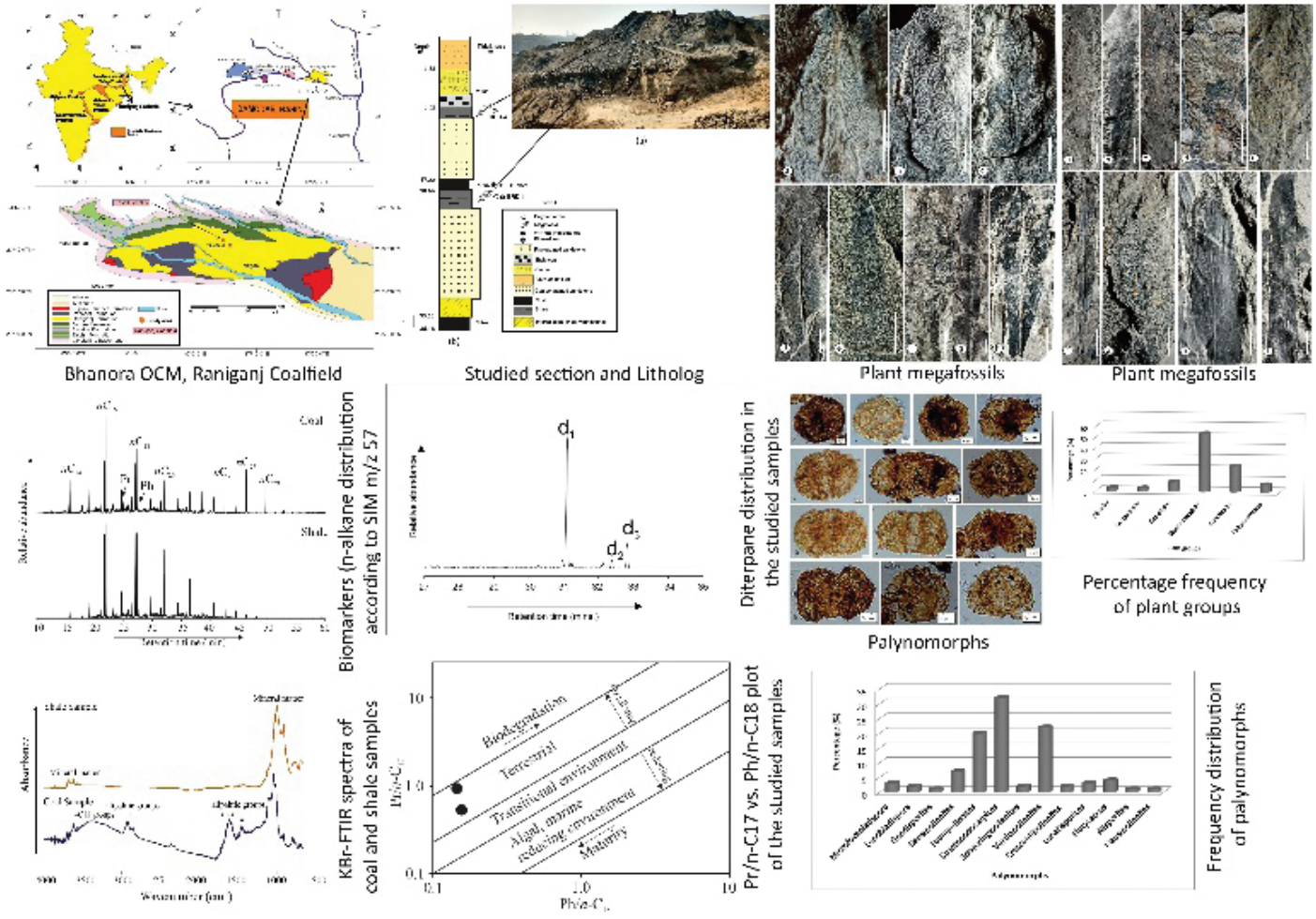


Fig. 4 - Early Permian floral diversity, palaeoenvironment, palaeoclimate and depositional setting using a multiproxy approach that includes morphotaxonomy, palynology and organic geochemistry of Karo OCM (Open Cast Mine), East Bokaro Coalfield, Damodar Gondwana Basin.

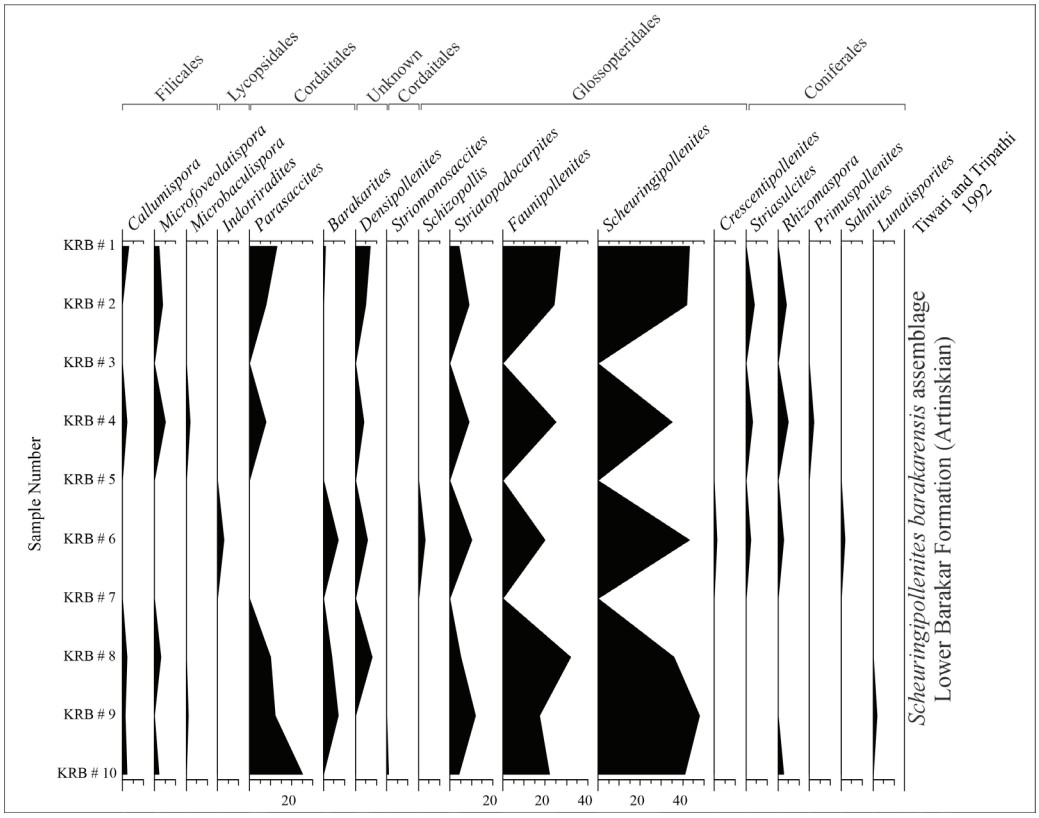


Fig. 5 - Frequency chart showing the vertical distribution of different palynomorphs in the core PKK-2B sequence. Frequency: dominant (> 20%); subdominant (10%– 20%); common (5%–9%); fair (2%–4%); poor (< 2%).

represented by *Scheuringipollenites, Faunipollenites, Striatopodocarpites, Striasulcites,* etc. The studied palynoassemblage is Artinskian in age based on inter, intra and Gondwanan palynological correlation. Further, the affinity of palynoassemblage reflects Glossopterid-dominated forest along with lower proportions of Coniferales (avg. 2.3%) and Peltaspermales (avg. 1.8%) in relatively warm and humid climatic conditions. The appreciated presence of Cordaites (avg. 12.3%), indicated by the monosaccate pollen of *Parasaccites* and *Barakarites,* suggests high terrigenous input into the mire. However, the occurrence of the spores of filicopsids and lycopsids indicates a significant contribution from herbaceous vegetation (Fig. 5).

Integrated palynofacies and geochemical characterisation of organic matter in Godavari Basin Shales: Insights into palaeofire history and thermal maturity:

This study employs integrated palynofacies and geochemical analyses to characterise organic matter (OM) in Godavari Basin shales. Three OM types—TrOM, palaeofire-induced charcoal (PAL-CH), and oxidized charcoal (OX-CH)—were identified. Raman spectroscopy, Rock-Eval, and FTIR confirm microcharcoal presence and reveal thermal maturity (411–609 °C) marked by hydrogen loss and aromatic–aliphatic deformation. The findings offer key insights into the palaeofire history and structural evolution of OM (Figs 6 & 7).

Integrated palynofacies, palaeobotanical, and geochemical evidence for a Late Permian terrestrial–marine transition in the Raniganj sediments of the Ib-River Coalfield, India:

The investigation of Raniganj sediments in the Kendudihi section, Ib-River Coalfield, unveils a rich assemblage of megaflora and microflora. Palynofacies analysis reveals deposition in low-energy, swampy, oxic–dysoxic environments. Strikingly, the presence of phosphorite nodules, biogenic structures, fluorapatite (XRD), and marine-influenced REE anomalies (La: 1.02, Gd: 1.05) at the Raniganj–Barren Measures boundary marks a significant marine incursion. These integrated palaeobotanical, palynological, and geochemical signatures provide persuasive evidence of a Late Permian terrestrial–marine transition, enhancing our understanding of palaeoenvironmental dynamics during the Gondwana sedimentation.

Integrated geochemical analysis and palynofacies study for hydrocarbon generation potential of South Karanpura Coalfield:

This study evaluates the hydrocarbon generation potential

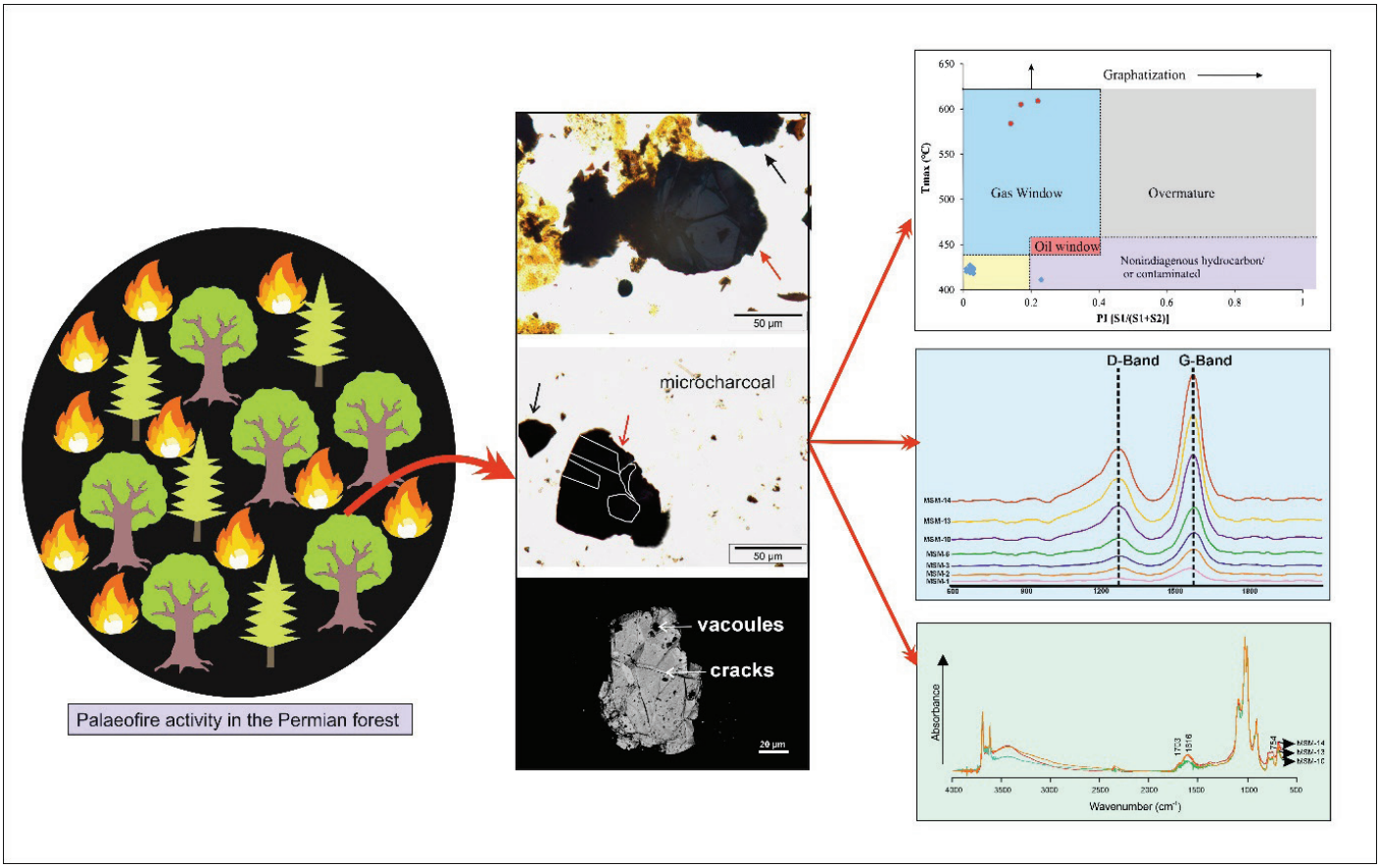


Fig. 6 - Graphical abstract representing the integrated approach to resolve palaeofire activity during the Permian in Godavari Basin.

of late Artinskian-Kungurian sediments in the South Karanpura Coalfield through megaflora, palynological and geochemical analysis. The findings indicate fluctuating water levels with anoxic to oxic depositional conditions influenced by terrestrial inputs. The Sirka Colliery is identified as the most favourable for hydrocarbon generation due to its flooded palaeomire setting, rich in type II/III to type III kerogen. Thermal maturity analysis shows that while the Sirka area contains immature kerogen, the Giddi Colliery has a slightly higher maturity level but poor hydrocarbon potential due to oxidation. These insights aid in assessing the oil and gas storage capacity of Permian coal formations.

Palaeofloristics of South Rewa Gondwana Basin and its palaeoclimatic significance:

Plant fossil assemblages recovered from Barhambaba Village are predominantly preserved as impressions in carbonaceous shale and are chiefly composed of conifers (e.g., *Araucarites, Elatocladus, Pagiophyllum, Brachyphyllum, Desmiophyllum),* pteridophytes *(Cladophlebis, Gleichenia),* pteridosperms *(Pachypteris, Sphenopteris*) and bennettitales (*Otozamites*). The assemblage is notably dominated by coniferous and pteridophytic taxa. The Barhambaba flora shows strong compositional affinities with palaeofloral assemblages from the Bhuj, Dhrangadhra and Himmatnagar formations of the western India Basin, which similarly exhibit a dominance of conifers and pteridophytes. However, it differs in the absence of *Weichselia* and *Matonidium*, which are commonly reported from younger formations.

Review of Rajmahal Flora:

The flora of the Rajmahal Formation, typically referred to as the "Early Cretaceous (Barremian to Aptian) Rajmahal Flora," represents one of the most significant and diverse Mesozoic floral assemblages in India. This floral succession is characterised by a prolific array of plant groups, many of which have been the subject of ongoing taxonomic reassessment – particularly enigmatic macro remains attributed to angiosperms. The discovery of definitive angiospermous pollen grains within the Rajmahal Formation strongly suggests the potential presence of corresponding megafossils. Consequently, various researchers have made claims regarding the identification of angiosperm megafossils within this formation.

The present study offers an updated synthesis and critical evaluation of the palaeofloristic composition of the Rajmahal Formation and the underlying Dubrajpur Formation. This analysis holds significant implications for

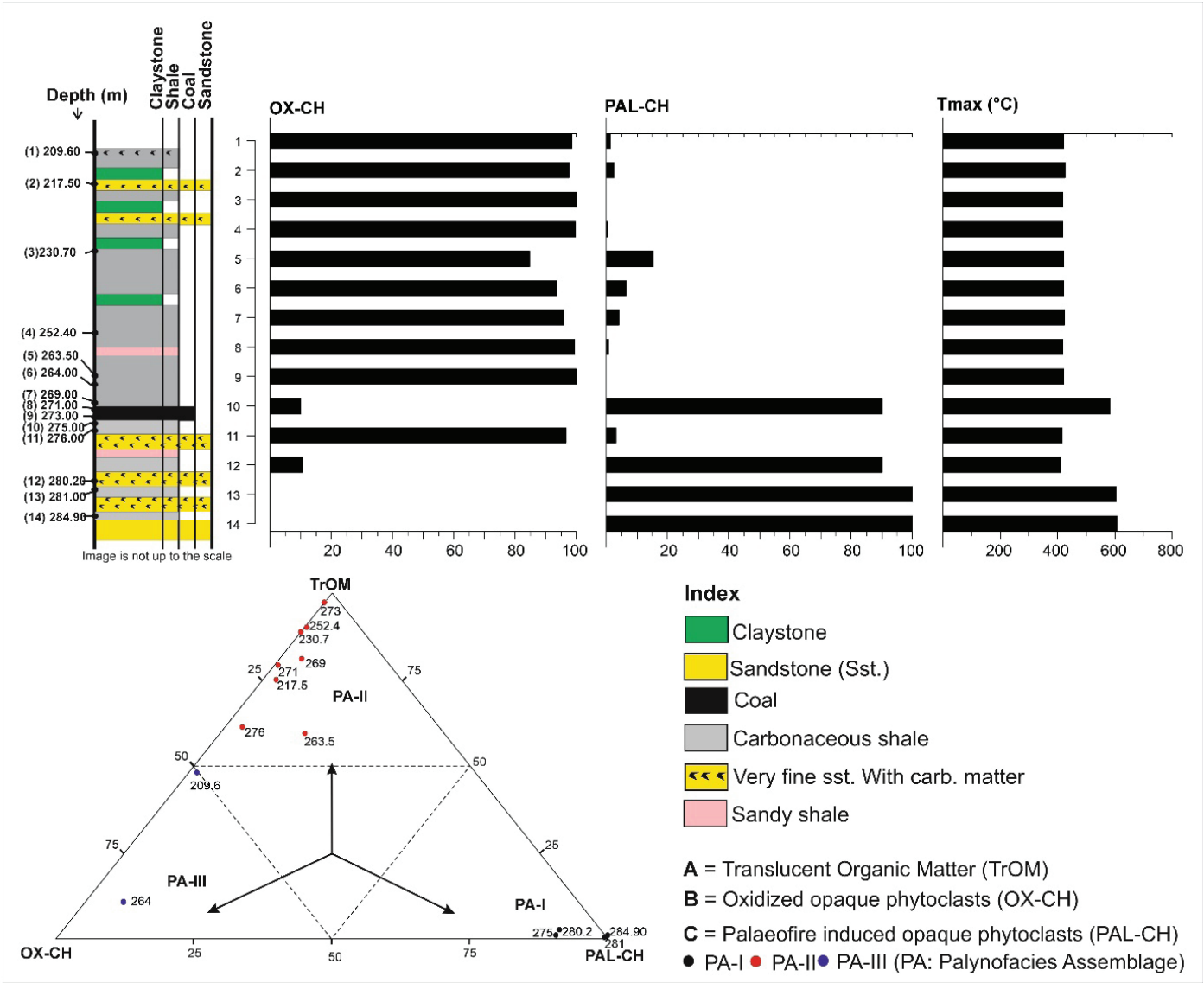


Fig. 7 - The distribution of the palynofacies assemblages with lithological details and a ternary diagram.

understanding the early evolution and diversification of angiosperms in the Indian subcontinent during the Early Cretaceous.

Revision of the stratigraphic age of the Spiti Formation, Spiti Himalaya:

Pliensbachian to Toarcian age calcareous nannofossils have been recorded from the lower part of the 15 m thick black shale succession of Spiti Formation exposed near Langza Village, Spiti Valley. The nannofossil assemblage is represented by *Ansulasphaera helvetica*, *Discorhabdus criotus*, *Lotharingius frodoi*, *L. hauffii*, *L. umbriensis, L. velatus, Watznaueria britannica, W. contracta* and *W. ovata*. The recorded assemblage suggests an approximate 15 million year older age of the base of the Spiti Formation than previous records (Fig. 8).

SPONSORED PROJECT (SP) AND COLLABORATIVE PROJECT (CP)

SPONSORED PROJECTS

SP 2.1: **Re-evaluation of late Palaeozoic spores and pollen from Indian Gondwana sequences to resolve gaps in global correlation and palaeobiogeography** [Sponsored by MoES, Project No: MoES/P.O. (Geo)/211/2019, w.e.f. October 2022]

Investigators: Pauline Sabina Kavali (PI) & Runcie Paul Mathews (Co-PI)

Despite re-emphasis of the taxonomic status of the late Palaeozoic cordaitalean morphogenus *Parasaccites* as junior synonym of *Cannanoropollis* by several workers,

we notice the usage of *Parasaccites* is still in practice, especially in India. Therefore to resolve this discrepancy and re-affirm if *Parasaccites* merits a generic status or not, or should it be considered as junior synonym of *Cannanoropollis* as claimed, we took up this work for a detailed study comprising of an extensive review of the older systematic works, re-examination of illustrated specimens and slides of available holotypes/paratypes of both the genera under transmitted light microscope, confocal laser scanning microscope and scanning electron microscope. They were also compared with the fresh palynological material collected from the Damodar Basin and the Wardha Basin and with those from South American basins (Bolivia, Argentina, Brazil and Uruguay) and were analysed at every stage of acid treatment to observe their effect on the morphology of the grains. The morphological features re-examined are- amb, corpus, nature of saccus and diameter, all of which revealed no apparent differences between the two genera (Fig. SP 2.1.1). Albeit, the nature of zone of attachment which was the main distinguishing character, although difficult to determine based on preservation of the specimens, was not mentioned in the original diagnosis of *Cannanoropollis* but was mentioned in later works and also observed in our present study, wherein well preserved specimens displayed different zones of saccus attachment ranging from subequatorial proximal and distal attachment, to proximally equatorial–subequatorial to distally subequatorial attachment, sometimes diffused (Fig. SP. 2.1.2). Therefore we emended the original diagnosis of *Cannanoropollis* incorporating the possible zones of attachment. The rest of the features of *Parasaccites* overlap with *Cannanoropollis* and therefore do not warranty a generic status to it. Thus this work re-affirms that *Parasaccites* is junior synonym of *Canannoropollis* and by nomenclatural rule of priority its further usage is to be avoided. Among the remaining species erected under *Parasaccites*, they have been synonymized under the convalidated species of *Cannanoropollis* based on their original/emended diagnoses, viz. *C. janakii, C. diffusus, C. densus, C. triangularis* while some have been transferred to genera such as *Caheniasaccites* and *Potonieisporites* as they differ from *Cannanoropollis.*

COLLABORATIVE PROJECT

CP 2.1: Neelam Das (Srikanta Murthy)

The Bhadasar Formation in the Jaisalmer Basin, has been investigated through detailed palynological and palynofacies analyses. The recovered palynoassemblage comprises 10 genera and 24 species, belonging to the plant group Coniferales, which constitutes approximately 89.4% of the total assemblage. The conifer-derived palynomorphs are mainly represented by *Callialasporites* (1.33–22.67%), *Araucariacites* (4–20%), *Cupressacites* (0–4%), *Microcachryidites* (1.33%), *Classopollis* (2.67%), *Podocarpidites* (1.33%) and *Pityosporites* (0–2.67%). Other plant groups recorded include Ginkgoales (*Ginkgo retectina*, 1.33–4.00%) and Ephedrales (*Monosulcites*, 0–1.33%). Pteridophytes are represented by a sparse occurrence of *Todisporites crassus* (0–4%), attributed to

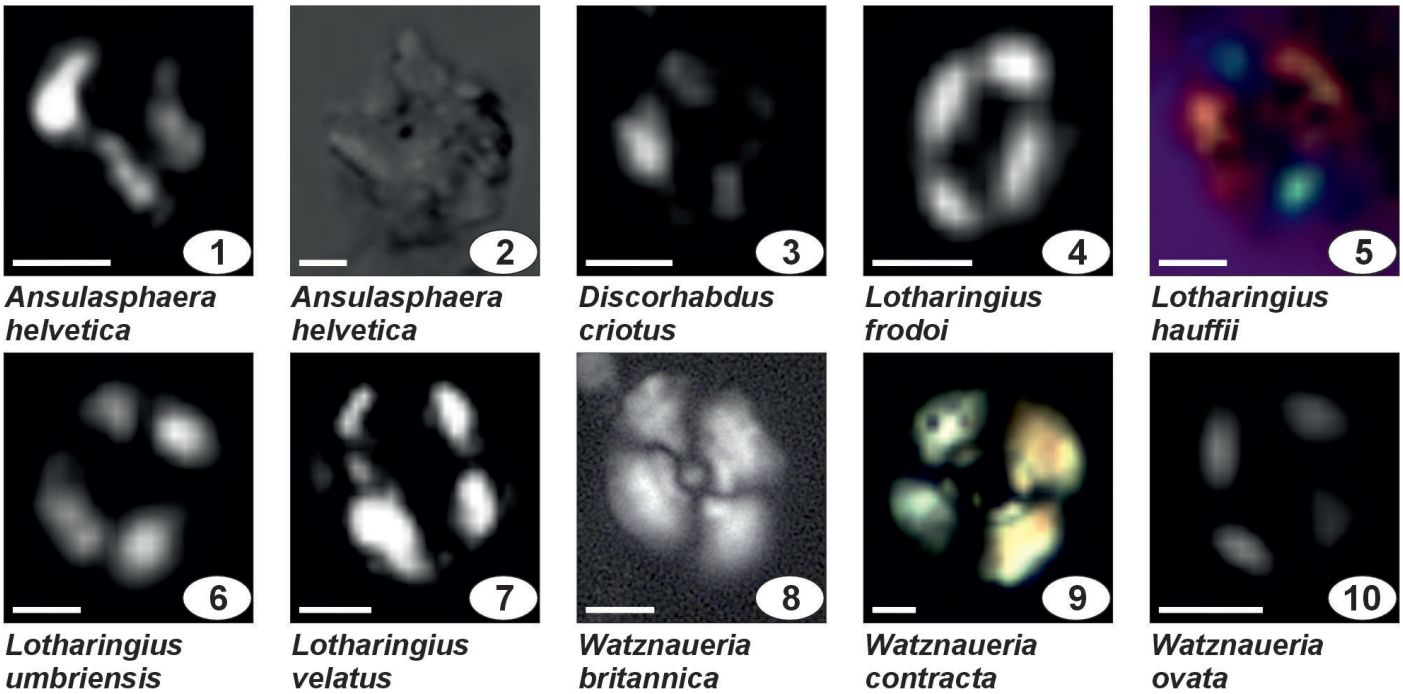


Fig. 8 - Nannofossil assemblage recorded from the Spiti Formation, near Langza Village, Spiti Valley (Scale bar represents 2 µm in each photomicrograph).

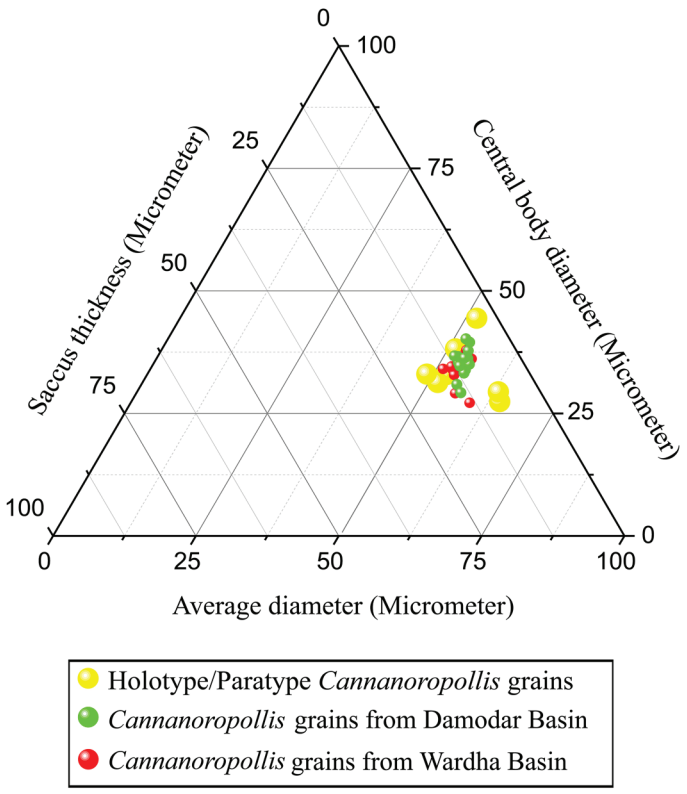


Fig. SP 2.1.1: Plot showing the similarities in the morphological features of *Cannanoropollis* grains of re-examined holotypes and freshly prepared material.

the order Filicales. Although the palynomorphs recovered from this section are largely composed of long-ranging forms and thus lack precise stratigraphic resolution, the presence of *Callialasporites* species such as *C. monoalasporus, C. trilobatus, C. dampieri, C. rimalis, C. discoidalis,* and *C. segmentatus* suggests a wide temporal distribution spanning the Jurassic to Cretaceous periods.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Aggarwal N - Palaeoenvironmental settings of Artinskian sediments in the Sattupalli area of the Chintalapudi sub-basin, Godavari Valley Coalfield, south India. Indian Colloquium on Micropalaeontology and Stratigraphy, New Delhi, 17th-19th October, 2024:103.
2. Aggarwal N - Study on sequence stratigraphy in the Permian sediments of terrestrial sequences within the Chintalapudi sub-basin, Godavari Coalfield, Southern India: Insight from palynology and geochemistry. Annual Convention of the International Association for Gondwana Research (IAGR) and 21st International Symposium on Gondwana to Asia". Curtin University, Kuching, Malaysia, 18th – 22nd November, 2024 :76.
3. Aggarwal N - Palaeoenvironmental and depositional reconstruction of Permian coal-bearing deposits in the Godavari Valley Coalfield, Southern India: An integrated approach. Indian Association of Sedimentologists held at BSIP during 11-13th December, 2024: 58.
4. Negi RS – Integrated ichnological, sedimentological and geochemical studies of the Cambrian Kunzam La Formation from Tidong Valley (Kinnaur), Himachal Himalaya: reconstructing the northern margin of the Indian Plate. The 37th International Geological Congress (IGC) 2024: The Great Travellers: Voyages to the Unifying Earth. BEXCO, BUSAN, Republic of Korea, 25–31st August 2024. : 183.
5. Negi RS–Gastropod, cephalopod and rare tentaculitid fauna from Takche Formation (Ordovician-Silurian), Kinnaur, Tethyan Himalaya: palaeobiogeographic connections to Gondwana and beyond. National Conference by Indian Association of Sedimentologists (IAS) 2024: An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in environmental climatic and energy research. Birbal Sahni Institute of Palaeosciences, Lucknow, 11–13th December, 2024. IAS2024/ BSIP/056: 52–53.
6. Agnihotri D–An evaluation of palaeovegetation of the Permian coal-bearing sequence of Arunachal Pradesh, and its biostratigraphic and palaeoenvironmental implications. 40th Convention of the Indian Association of Sedimentologists and National Conference on "An Odyssey to sedimentology from Precambrian to Anthropocene: Significant contributions in environmental, climatic and energy research held at Birbal Sahni Institute of Palaeosciences, Lucknow, 11−13th December, 2024 : 74.
7. Das N- Floral diversity and palaeoenvironment during Early Cretaceous of Motayaksh, Bhuj Formation, Kachchh, India. 40th Convention of the Indian Association of Sedimentologists and National Conference on "An Odyssey to sedimentology from Precambrian to Anthropocene: Significant contributions in environmental, climatic and energy research. Birbal Sahni Institute of Palaeosciences, Lucknow, 11−13th December, 2024: 62.
8. Das N- Palaeofloristic studies from Motayaksh, Bhuj Formation of Kutch Basin, India. 40th Convention of the Indian Association of Sedimentologists and National Conference on "An Odyssey to sedimentology from Precambrian to Anthropocene: Significant contributions in environmental, climatic and energy research. Birbal Sahni Institute of Palaeosciences, Lucknow, 11−13th December, 2024: 75.

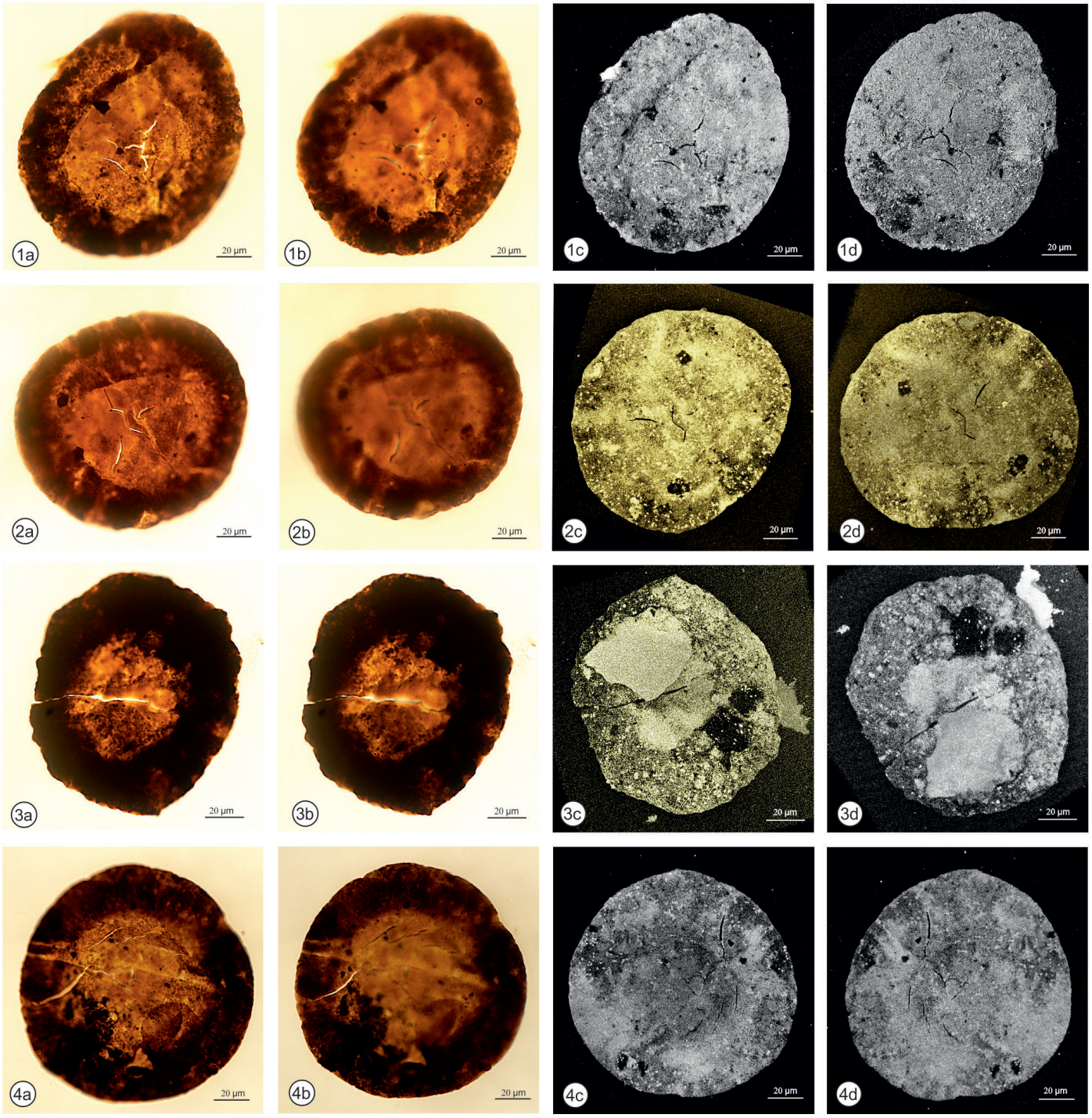


Fig. SP 2.1.2: *Cannanoropollis* specimens retrieved from the type slides of Potonié and Sah 1960: 1a,1b,1c and 1d-*Cannanoropollis* specimen displaying Para condition of zone of attachment, St no.155, slide no. 1, EF-Q 42.1. 2a, 2b, 2c and 2d- *Cannanoropollis* specimen displaying diffused zone of attachment, St no.155, slide no 1, EF-F 40.3. 3a, 3b, 3c and 3d -*Cannanoropollis* specimen displaying Para condition of zone of attachment, St no.155, slide no 1, EF-G 44.4. 4a ,4b, 4c and 4d- *Cannanoropollis* specimen displaying Para condition of zone of attachment, St no.155, slide no. 1, EF-P 48.1.

9. Mishra D- A comprehensive geochemical and petrographic analysis of the Mata-no-Madh Lignite Mine in the Kutch Basin: Insights into source rock characteristics and palaeodepositional environment. 40th Convention of Indian Association of Sedimentologists & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in environmental climatic and energy research". Birbal Sahni Institute of Palaeosciences, Lucknow, 11–13th Dec. 2024, Abstract No: IAS2024/BSIP/111: 104.
10. Kavali PS- Revision of the age of the oldest palynozone of the Talchir Formation based on guide palynomorphs present in radiometrically dated palynozonations in coeval pan Gondwana basins. 29th Indian Colloquium on Micropaleontology and Stratigraphy, Department of Geology. University of Delhi, Delhi, 17–19 October, 2024. Abstract No.125: 128.
11. Mishra A- Resolution of the long pending debate on the taxonomic status of the Late Palaeozoic morphogenus *Callumispora* Bharadwaj and Srivastava 1969 and *Punctatisporites* Ibrahim 1933 emend. Potonié and Kremp 1954. 29th Indian Colloquium on Micropaleontology and Stratigraphy, Department of Geology. University of Delhi, Delhi, 17-19th October, 2024. Abstract No. 38: 39.
12. Mishra A- Late Palaeozoic climatic changes: Evidence from the Lower Gondwana succession of West Bokaro Coalfield, Damodar Basin. 40th Convention of the Indian Association of Sedimentologists and National Conference on "An Odyssey to sedimentology from Precambrian to Anthropocene: Significant contributions in environmental, climatic and energy research. Birbal Sahni Institute of Palaeosciences, Lucknow, 11–13th December, 2024. Abstract no. 11: 10.
13. Saxena A - Palynofloristics and evidence for wildfire from Permian deposits of the Satpura Gondwana Basin, India: A multiproxy approach. Annual Convention of the International Association for Gondwana Research (IAGR) and 21st International Symposium on Gondwana to Asia". Curtin University, Kuching, Malaysia, 18–22nd November, 2024.Abstract No. 87.
14. Pillai SSK- Floristic diversity of Gondwana Supergroup and its implications from Nayabazar-Legship Road Section of South Sikkim, India: A multiproxy approach. Annual Convention of the International Association for Gondwana Research (IAGR) and 21st International Symposium on Gondwana to Asia". Curtin University, Kuching, Malaysia, 18-22nd November, 2024. Abstract No. 82.
15. Murthy S- Palaeobotanical and geochemical evidences for Permian- Triassic Transition from Talcher Coalfield, Son-Mahanadi Basin, India: Insights into the age, palaeovegetation and palaeoclimate. Annual Convention of the International Association for Gondwana Research (IAGR) and 21st International Symposium on Gondwana to Asia". Curtin University, Kuching, Malaysia. 18-22nd November, 2024. Abstract No. 80.
16. Singh A- Calcareous nannofossil biostratigraphy of Khuiala Formation, Jaisalmer Basin, Rajasthan and its palaeoenvironmental implications. 40th Convention of the Indian Association of Sedimentologists and National Conference on "An Odyssey to sedimentology from Precambrian to Anthropocene: Significant contributions in environmental, climatic and energy research. Birbal Sahni Institute of Palaeosciences, Lucknow, 11–13th December, 2024: 77.
17. Singh A- Nannofossil biostratigraphy of the Jurassic succession from the Langza area, Spiti Valley, Southern Tethys Basin, India. IAGR 2024 Annual Convention and 21st International Conference on Gondwana to Asia. Curtin University, Kuching, Malaysia, 18-22nd November, 2024: 77–78.
18. Singh A- Middle Eocene nannofossil biostratigraphy and palaeoenvironment from Western Garo Hills, Meghalaya. 29th Indian Colloquium on Micropaleontology and Stratigraphy, Department of Geology. University of Delhi, Delhi, 17-19th October, 2024, Abstract No.7.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS (BOTH ONLINE AND OFFLINE)

Anju Saxena, Pauline Sabina K, S Suresh K Pillai, Neha Aggarwal, Abha Singh and Ayushi Mishra

- Deputed to attend 29th ICMS, Department of Geology, University of Delhi, Delhi during 17th -19th October, 2024.

Pauline Sabina Kavali

- Deputed to attend Women Role Models in STEM. Under the Government supported initiative Mission Shakti (Phase-5), Department of Zoology, University of Lucknow, Lucknow on 16.12.2024.

S Murthy, Anju Saxena, S Suresh K Pillai, Neha Aggarwal and Abha Singh

- Deputed to attend the International Conference 'Annual Convention of the International Association for Gondwana Research (IAGR) and 21st International Symposium on Gondwana to Asia' during 18-22 November, 2024, Kuching, Malaysia.

Deepa Agnihotri, Neha Aggarwal, Neelam, Abha Singh, Divya Mishra and Ranveer S. Negi

- Deputed to attend 40th Convention of the Indian Association of Sedimentologists and National Conference on "An Odyssey to sedimentology from Precambrian to Anthropocene: Significant contributions in environmental, climatic and energy research held at Birbal Sahni Institute of Palaeosciences, Lucknow during December 11–13, 2024.

Neelam Das

- 'गृह मंत्रालय, राजभाषा विभाग द्वारा वर्ष 2023-24 के संयुक्त क्षेत्रीय राजभाषा सम्मेलन' जयपुर में दिनांक 17/02/2025 को भाग लेने हेतु प्रतिनियुक्त किया गया.

TRAINING/STUDY VISITS

Anju Saxena

- 'Advanced Technologies for Urban Development', National Institute of Advanced Studies, Indian Institute of Science Campus, Bengaluru, 17-21 February, 2025.

Neha Aggarwal and Divya Mishra

- Training was taken from S Kumar Roa (A NABL consultant) for National Accreditation Board for Testing and Calibration Laboratories from 19 August-22 August, 2024 at BSIP.
- Fire Training is taken from Fire Fighter Officers at BSIP, Lucknow on 9th December, 2024.

LECTURES DELIVERED

Anju Saxena

- स्पीति घाटी, एक ऊंची हिमालय पर्वत श्रृंखला, जहां कभी समुद्र था: प्राकृतिक जीवाश्म संग्रहालय की उत्पत्ति एवं उसके महत्व, पर 30 दिसम्बर, 2024 को बी.एस.आई.पी. में हिंदी व्याख्यान दिया ।

CONSULTANCY/TECHNICAL SUPPORT RENDERED

Abha Singh

- Industrial Micropalaeontology Laboratory, Calcareous Nannofossil Biostratigraphy, Oil India Limited (17 lakhs).
-

ACCOLADES RECEIVED

RS Negi

- Served as the Guest of Honour at the Science Exhibition celebrating National Science Day, held at Greenland Public School, Gomti Nagar, Lucknow, on February 23, 2024.
- Served as the Guest of Honour at the Intra-School *INNO-VISTA*S event, held at Greenland Public School, Gomti Nagar, Lucknow, on September 27, 2024.
- Awarded a Certificate of Appreciation by the Director of BSIP on the Institute's 78th Foundation Day, for representing BSIP at the 37th International Geological Congress (IGC), held in Busan, Republic of Korea, from August 25–31, 2024.

Ayushi Mishra

- Awarded Innovative Poster Award at the 29th Indian Colloquium on Micropaleontology and Stratigraphy, Department of Geology. University of Delhi, Delhi, 17-19 October, 2024 for her work on Resolution of the long pending debate on the taxonomic status of the Late Palaeozoic morphogenus *Callumispora* Bharadwaj and Srivastava 1969 and *Punctatisporites* Ibrahim 1933 emend. Potonié and Kremp 1954.

Anju Saxena

- Co-chaired a Technical Session six- 'Microfossils from Indian stratigraphic horizons and their applications' at ICMS-2024, University of Delhi, New Delhi' on 18.10.2024.
- Co-chaired a Technical Session of Theme 1 as Early Earth Lithosphere-Hydrosphere, atmosphere, biosphere evolution through sedimentary record in the 40th Convention of Indian Association of Sedimentologists IAS-2024 and National Conference held at BSIP, Lucknow on 12 December, 2024.
- Served as a Member of National Advisory Committee of the 'Indian Colloquium on Micropalaeontology and Stratigraphy' (ICMS): 2024 held at University of Delhi, New Delhi, October 17-19, 2024; and also a Member of Scientific Advisory Committee of the 40th Convention of Indian Association of Sedimentologists IAS-2024 and National Conference held at BSIP, Lucknow on 11-13 December, 2024.

Srikanta Murthy

- Chaired a Session at Annual Convention of the International Association for Gondwana Research (IAGR) and the 21st International Conference on Gondwana to Asia. Waterfront Hotel, Kuching, Malaysia. November 18, 2024.

Suresh Kumar Pillai

- The BSIP team is developing the Marine Fossil Park at Manendragarh, Chhattisgarh. The work is under progress.
- Chaired a Session at Annual Convention of the International Association for Gondwana Research

PH.D. PROGRAMMES

	**Ayushi Mishra (2024)**. Integrated palynological and sedimentological studies of the late Paleozoic sediments of Damodar Basin to resolve gaps in global correlation and palaeobiogeography, under the supervision of **Pauline Sabina Kavali (BSIP)** and Umakant Shukla (BHU) registered with Department of Geology, Banaras Hindu University, Varanasi. Status: In-progress.
	**Alok Kumar Mishra (2020).** Floristic changes in late Palaeozoic sediments of northeast India: implications in biostratigraphy and palaeoecology, under the supervision of **Deepa Agnihotri (BSIP)**, registered with AcSIR (Academy of Scientific and Innovative Research, Ghaziabad), Status: In progress.
	**Suraj Kumar Sahu (2022).** Phases and Pathway of marine incursion and vegetation dynamics of Gondwana sediments from Eastern India: Biological and Geochemical perspectives, under the supervision of **S. Suresh Kumar Pillai (BSIP) and Runcie Paul Mathews (BSIP)** registered with AcSIR (Academy of Scientific and Innovative Research, Ghaziabad), Status: In progress.
	**Anita Chattoraj (2022).** Palaeofloral diversity of Glossopteris flora and Palaeoclimatic significance of Permian period in Raniganj Coalfield, Damodar Basin, (West Bengal) India, under the supervision of **S. Suresh Kumar Pillai (BSIP)** and Sandip Mazumder (KNU) registered with Kazi Nazrul University, West Bengal. Status: In progress.
	**Bibin Mathew (2023).** Glossopteris floral biodiversity during Lower Permian Period and impact on flora due to palaeoclimate and palaeoenvironment variations: An emblematic Permian forest from Rajmahal Basin, Pakur District, Jharkhand, India, under the supervision of **S. Suresh Kumar Pillai (BSIP)**, registered with Sido Kanhu Murmu University, Dumka, Jharkhand. Status: In progress.
	**Deveshwar Prakash Mishra (2019).** Biozonation and palaeoclimatic reconstruction of Permo-Triassic sediments from Talcher Coalfield, Mahanadi Basin, Odisha, India, under the supervision of **Srikanta Murthy (BSIP)** and Prof. Bindhyachal Pandey (BHU) registered with Banaras Hindu University, Varanasi. Status: Awarded in 2024.
	**Raj Kumar (2016).** 'Palaeontological record from the Mesozoic sediment of the Jaisalmer Basin, Rajasthan: biostratigraphic, palaebiogeographic and palaeoclimatic implications', under the supervision of Neelam Das (BSIP) and Bindhyachal Pandey (BHU), registered with Banaras Hindu University, Varanasi. Status: Awarded in 2024.
	**Nazim Deori (2019)**. High resolution biostratigraphy and depositional environment of Harudi Formation (Type Section) Kachchh Basin, western India, Gujarat, under the supervision of **Abha Singh (BSIP)** and J.M. Patel, R.R. Lalan College Bhuj, Kachchh & M.G. Thakkar KSKV, Kachchh University, registered with K.S.K.V. Kachchh University. Status: in progress.

(IAGR) and the 21st International Conference on Gondwana to Asia. Waterfront Hotel, Kuching, Malaysia. November 18, 2024.

Suraj Kumar

- Received a 12-month ANRF Overseas Visiting Doctoral Fellowship (OVDF) at University of Alberta, Canada, in September 2024.

Abha Singh

- Chaired a Session at IAGR 2024 Annual Convention and 21 International Conference on Gondwana to Asia, Kuching, Sarawak, Malaysia, 19th November, 2024.

REPRESENTATION IN COMMITTEES/ BOARD

RS Negi

- Part of the Indian delegation representing the INSA Committee for IUGS and INQUA at the 37th International Geological Congress (IGC), held in Busan, Republic of Korea from August 25–31, 2024.
- Organizing Secretary for the 40th Convention of IAS and National Conference held at BSIP, Lucknow from December, 11–13, 2024

Anju Saxena

- Secretary of the prestigious society 'The Palaeontological Society of India', Lucknow on 24th August 2024 and continuing.
- Editor for the Abstract Volume of the 40th Convention of IAS and National Conference held at BSIP, Lucknow from December 11–13, 2024.
- **Associate Editor** – Journal of the Palaeontological Society of India, SAGE Publications
- **Editor-** Journal 'Geophytology, The Palaeobotanical Society of India

Divya Mishra

- Deputed for External Examiner in the End Semester Practical Examination of the B. Tech Civil Engineering Course (ECE-352: Building Materials Lab) at UIET (University Institute of Engineering Technology) on 02/12/2024 at 2.00 PM.
- Deputed for External Examiner in the End Semester Practical Examination of the B. Tech Civil Engineering Course (ECE-353: Geoinformatics Lab-I) at UIET (University Institute of Engineering Technology) on 03/12/2024 at 2.00 PM.

Pauline Sabina K

- Reviewer for the Elsevier Journal- Review of Palaeobotany and Palynology

Project 3: Pre- and Post-Collision biotic turnover(s) and climate change(s) pertaining to India (Terminal Cretaceous-Cenozoic)

Coordinator: Hukam Singh (Scientist E)
Co-Coordinator: Poonam Verma (Scientist E)

OBJECTIVES

- *Biotic turnover(s) K-Pg transition: palaeobiodiversity and Palaeobiogeography*
- *Biostratigraphy, age correlation, Sequence biostratigraphy and source rock characterisation of lignite-bearing sequences of western India*
- *Origin, evolution, Palaeobiodiversity, extinction, and Palaeobiogeographic aspects of Cenozoic biota of India*
- *Quantification of late Cretaceous to Cenozoic climate and monsoon evolution of India based on biotic and abiotic proxies.*

PREAMBLE

The Indian Plate separated from the Gondwana supercontinent about 90 million years ago and moved northward, undergoing significant climatic and palaeobiogeographic changes before colliding with Eurasia Plate during the Palaeogene Period. As it travelled, the Indian Plate experienced volcanic activity due to the Reunion Hotspot, resulting in Volcano-Sedimentary Successions (DVSS) that provide crucial fossils dating back approximately 66 million years. Establishing the chronology of the DVSS is essential for understanding the timing and extent of this event and the biotic turnovers during the Cretaceous–Palaeogene (K–Pg) transition. Global climatic events in the Palaeogene and Neogene (e.g., PETM at ~56 Ma; ETM2 at ~53.7 Ma, MECO at ~40 Ma and other small events) are important for studying the

1st Row (L to R): Priya Agnihotri, Harshita Bhatia, Ramanand Sagar, Satendra Kumar Gupta, Shakshi Singh, Sneha Santhosh; 2nd Row (L to R): Samiksha Shukla, Shreya Mishra, Adrita Chaudhari, Vivesh Vir Kapur, Gaurav Srivastava, Hukam Singh, Poonam Verma, Anumeha Shukla, Ansuya Bhandari, Kajal Chandra; 3rd Row (L to R): Runcie Paul Mathews, Prem Raj Uddandam, Arvind Kumar Singh, Suman Sarkar

effects of tropical warming events on both flora and fauna. Current research focuses on the palaeoenvironmental and ecological impacts of these events and the changes in vegetation and faunal diversity linked to climate change.

The project includes four components aimed at studying the Indian subcontinent's biota from the late Cretaceous to the Cenozoic (~67 to 2.5 million years ago). This research utilises a significant array of fossil data, as well as proxies like geochemistry, sedimentology, and various stratigraphic (-bio, -chemo, and -magneto) methods. Understanding the biostratigraphical data is vital for establishing a precise time framework for the Palaeogene lignite-associated sedimentary successions of western India. When combined with other palaeobiological data, this knowledge enhances our comprehension of the origin, early evolution, and palaeogeographical distribution of biota. Remarkably, the amber found in these deposits preserves an exceptionally well-preserved palaeobiota, offering invaluable insights into every aspect of the ecosystem. Furthermore, our ongoing research into changes in vegetation patterns and faunal diversity reveals critical links to climate change of the Palaeogene and Neogene periods. By quantifying climate parameters, we can deepen our understanding of the evolution of monsoons and the modernisation trends across the Indian subcontinent, which is essential for addressing future climate challenges.

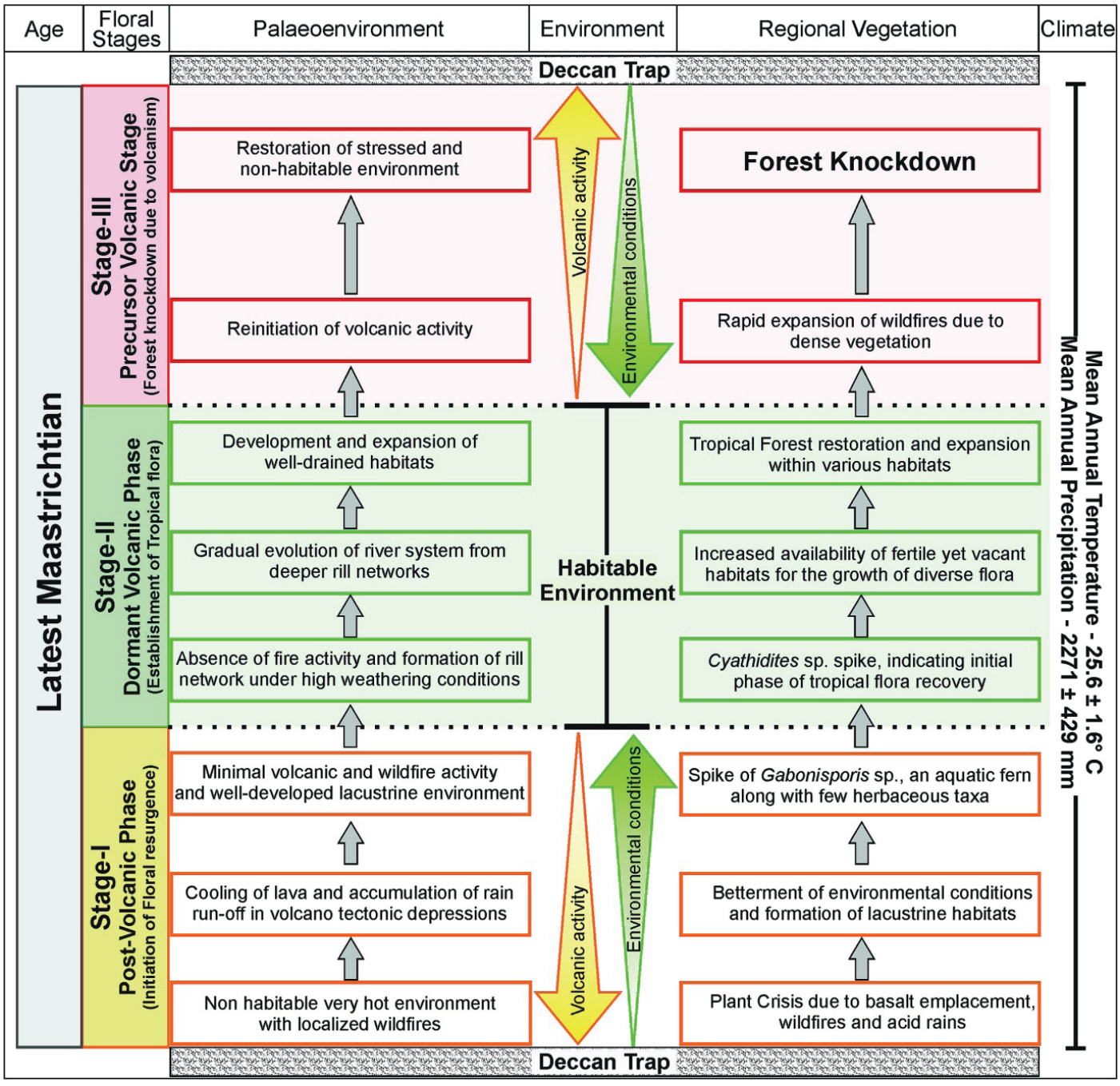


Fig. 1- Flow chart of events showing stages of vegetation succession and environmental changes in relation to the Deccan Volcanism.

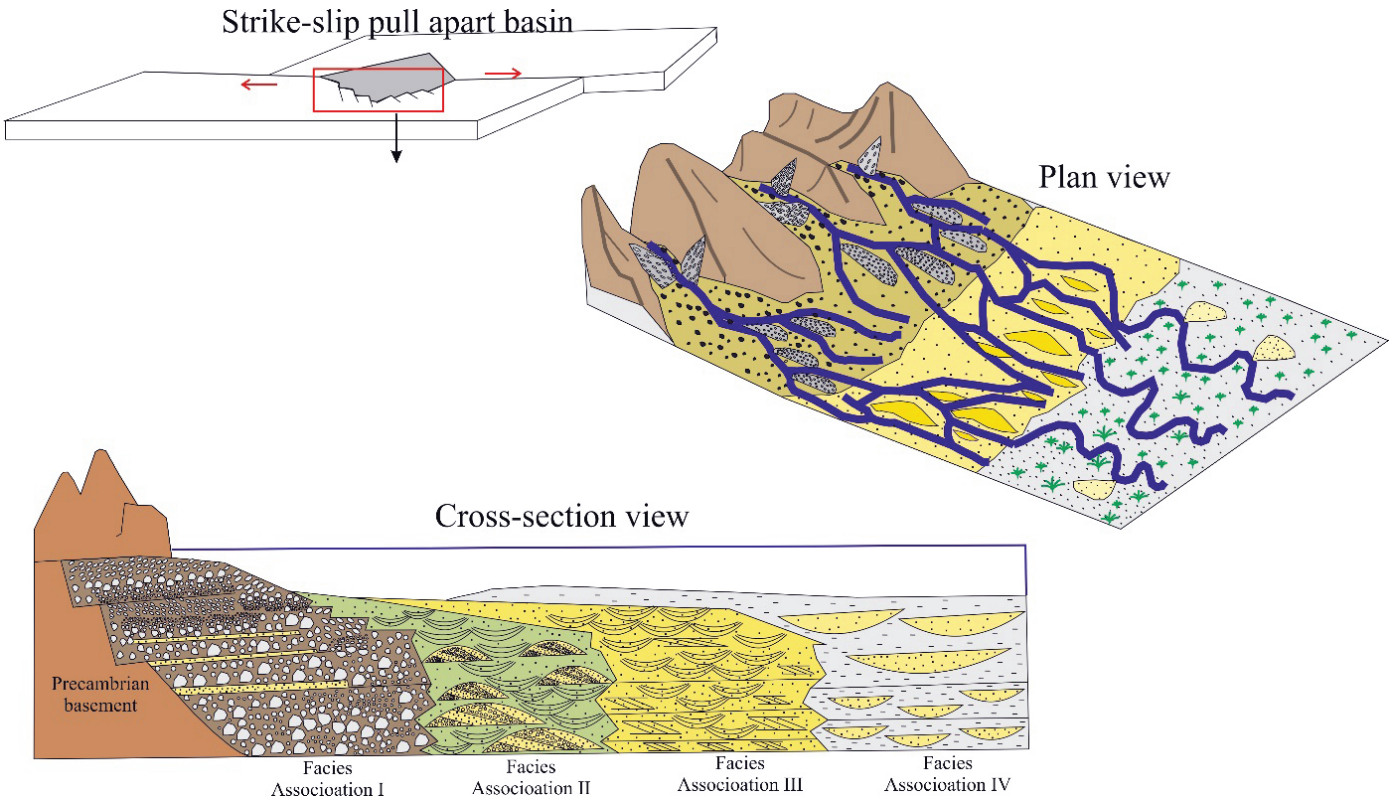


Fig. 2- Schematic diagram showing the evolution of a confined gravelly river to a braided-meandering river, deposited during the Late Cretaceous Period in the south Shillong Plateau.

PERSONNEL INVOLVED:-

Team Members: Gaurav Srivastava (Scientist E), Anumeha Shukla (Scientist E), Vivesh Vir Kapur (Scientist E), Runcie P. Mathews (Scientist D), Md. Arif (Scientist C), Ansuya Bhandari (Scientist C), Shreya Mishra (Scientist C), Prem Raj Uddandam (Scientist C), Adrita Choudhuri (Scientist C), Suman Sarkar (Scientist C)

Collaborators: Abha Singh (Scientist D), Arvind Kumar Singh (Scientist D)

Technical Support Members: Archana Sonker (Technical Assistant A)

Research Scholars: Sarvendra Pratap Singh, Sadanand, Samiksha Shukla

SIGNIFICANT FINDINGS

Resilience of Tropical flora to Deccan Volcanism:

The palynological study reveals that the Deccan Volcanism, while contributing significantly to the Cretaceous–Palaeogene (K–Pg) mass extinction, had a limited and short-term negative impact on tropical flora. Contrary to its devastating effects on terrestrial faunas—especially dinosaurs—the event may have indirectly facilitated the expansion and diversification of tropical angiosperms. The increased diversification of tropical flora was instigated due to the extinction of dinosaurs and the decline of gymnosperms due to volcanic activity and associated climatic disturbances, which created fertile yet barren ecological niches. These nascent, undisturbed, and fertile volcanic terrains, coupled with a warm and humid climate, provided ideal conditions for angiosperms to thrive, diversify, and colonize various habitats. Thus, the Deccan Volcanism may have played a pivotal role in the rise of angiosperm-dominated tropical rainforests. Our finding suggests that, under favourable climatic conditions, tropical rainforests possess an intrinsic capacity for rapid recovery (Fig.1)—a hopeful message for the preservation and restoration of present-day biodiversity amid the on-going climate change.

Fluvial channel evolution of Late Cretaceous rocks of the Khasi Group of south Shillong Plateau (Meghalaya):

Sedimentological studies on the Late Cretaceous rocks of the Khasi Group of south Shillong Plateau (Meghalaya) reveal different stages of fluvial channel evolution over time (Fig. 2). The findings suggest that tectonic activity played a major role in shaping the river systems of the Late Cretaceous. Research also revealed that a shift from river to marine environments occurred in the upper part of the Mahadek Formation. In the north, tidal processes dominated, shown by special sediment patterns and flow directions, while in the southwest, waves had more

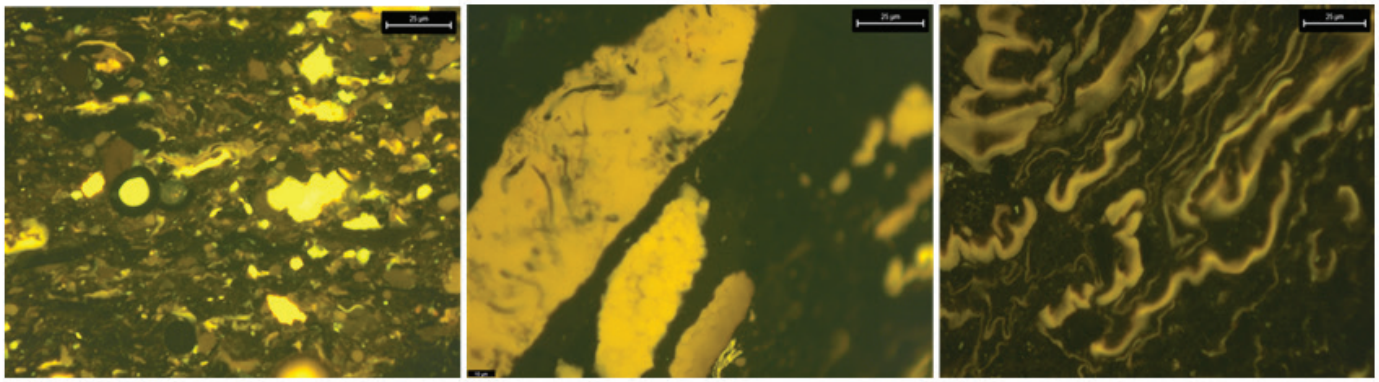


Fig. 3 - Representative liptinite macerals in the studied lignite sample (under fluorescent mode).

influence, indicated by wave-related structures and marine fossils. Ongoing work includes analyzing the sandstone's composition and grain size to understand where the sediments came from, the past climate conditions, and how tectonics influenced sediment deposits in the Mahadek Formation.

Biomarker Signatures from the Kapuri Lignite sedimentary succession, Rajasthan:

While attempting the comprehensive biomarker study of Kapurdi Lignite, Rajasthan, representative samples from all the seams were taken. Significant number of marker compounds was identified from these samples apparently suggesting the immature nature of the organic matter in this sedimentary sequence (Fig. 3). In general, the *n*-alkanes in the sample range from C_{14} to C_{31} with bimodal distribution. The C_{max} at C_{16} and C_{27} is observed in these samples. In most of the samples, C_{29} is the dominant *n*-alkane. Isoprenoids are present but in low concentration in most of the samples. Among various parameters calculated, the Pr/Ph ratio varies from 0.91 to 3.51. The P_{aq} varies from 0.17 to 0.45 while the P_{wax} varies from 0.67 to 0.88. The CPI varies from 2.12 to 20.18 and the TAR range between 1.53 to 10.01. The terpenoid composition of the studied samples includes sesquiterpanes, diterpanes and triterpanes. The sesquiterpenoid compounds identified in the sample includes dimethyl naphthalene, 4-Isopropyl-1, 6-dimethyl-1, 2, 3, 4, 4a, 5, 6, 8a-octahydronaphthalene isomer, Dihydro-ar-curcumene, Calamanene, 5, 6, 7, 8-tetrahydro-cadalene and Cadalene. The diterpane compounds are represented by tricyclic, tetracyclic and aromatic compounds such as abitanes, pimaranes and kauranes. Several A-ring degraded pentacyclic triterpenoids were identified along with other pentacyclic compounds such as Olean-13(18)-ene, Olean-18-ene and Olean-12-ene. Hopanoids are represented by hopanes, hopenes, homohopanes and benzohopanes.

Thermal maturity study on different coal samples:

For thermal maturity study on different coal samples, structural characterisation of Indian coal samples collected from various coal-bearing sequences has been performed

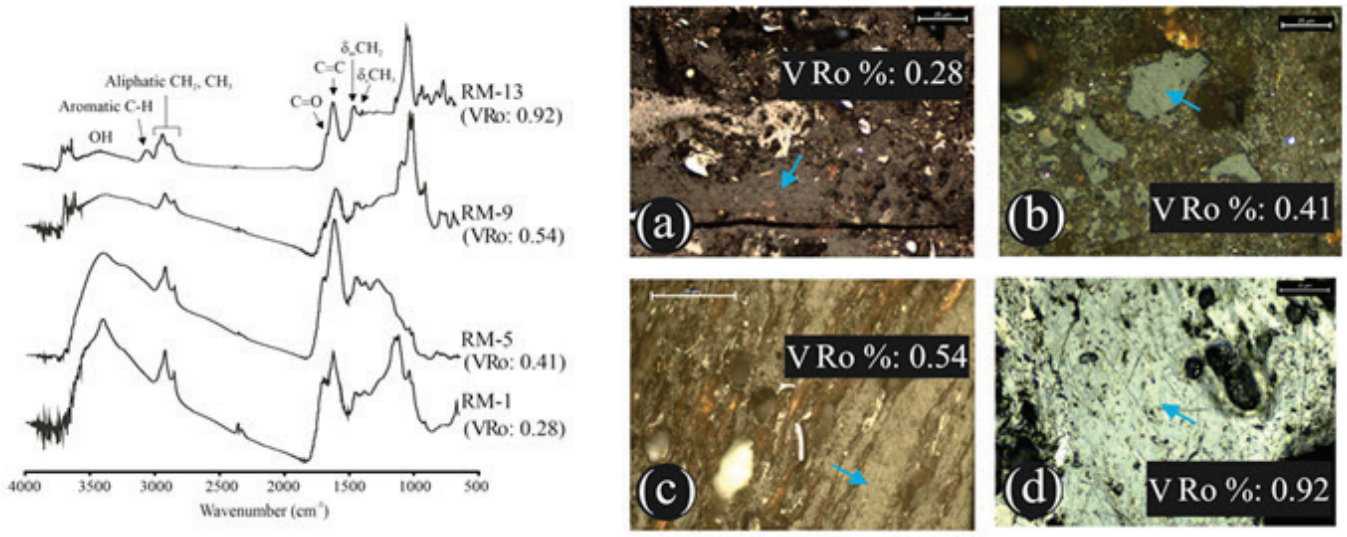


Fig. 4- FTIR spectra of coal samples of varying thermal maturity(left) and ulminite/ vitrinite grains in samples of varying thermal maturity(right).

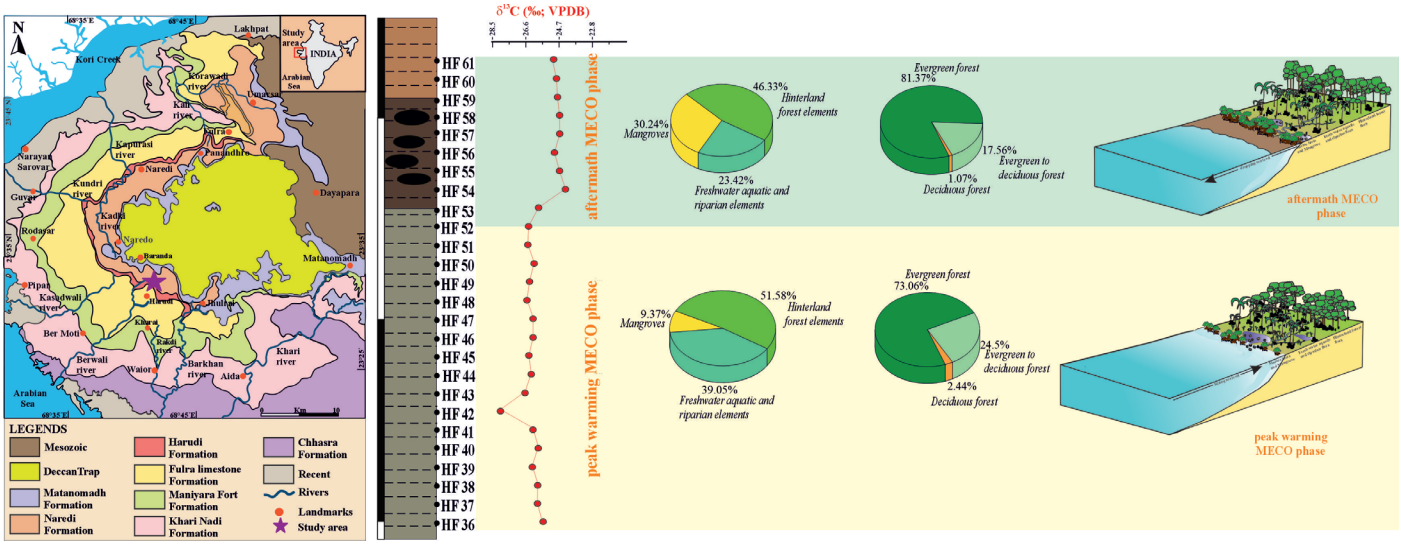


Fig. 5- Diagram illustrating the changes in the flora and palaeodepositional settings of the studied middle Eocene Harudi Formation succession in the Kutch Basin, Gujarat, during the peak warming and the subsequent phase of the MECO event.

using Fourier Transform Infrared (FTIR) and Raman Spectroscopy to understand the maturity characteristics, hydrocarbon source potential and palaeodepositional environments. The vitrinite reflectance (VR_o %) ranges from 0.28% to 0.92%. The samples are characterised by hydroxyl, aliphatic and aromatic stretching peaks, along with the oxygenated functionalities of varying intensities. The various FTIR semi-quantitative ratios were applied to understand the compositional variations across the rank. An increase in the aromaticity and aromatic ring condensation is evident from the I_1, C_{ar}/ (C_{ar} + C=O, CH_{ar}/C=C, and Har/C_{ar} ratios. Additionally, an increase in the aromatic hydrogen content is apparent from the fH and Hal/H ratios. The de-functionalization of oxygenated functional groups is manifested from the decrease in the C-factor. Below VR_o 0.5%, the samples exhibit consistent behaviour; however, beyond this point, the behaviour becomes abrupt, probably due to the diverse origin of the samples and/or physico-chemical factors controlling the structural transformations beyond the first coalification jump (Fig. 4).

Stable Carbon isotopic signature of global hyperthermal event of Palaeocene-Eocene Thermal Maximum (PETM):

Stable Carbon isotope and dinoflagellate cysts analyses from a Palaeocene-Eocene Jerain-Dauki (J-D) section from East Khasi Hills, south Shillong Plateau of NE Himalaya, India, revealed marginal marine restricted conditions. Stable Carbon isotope ($\delta^{13}C$) excursions (CIE) show two major and two comparatively minor warming phases. The negative shift of CIE for the two major events is ~6.5‰, and for the two minor events is ~3 to 4‰, respectively. The carbon isotope excursions are coeval with the well-known global hyperthermal event of Palaeocene-Eocene Thermal Maximum (PETM) that occurred ~56 Ma. The current study helps to resolve the question of whether multiple or single episodes of carbon release triggered the PETM event. And the four carbon isotope excursions clearly point towards the multiple injections of carbon and complex nature involved. The excursion value of 6.5‰ is more than generally accepted value of 4‰ is rare record but still within the range of some records from Tibet.

Response of tropical rainforests and mangrove communities to the Middle Eocene Climate Optimum (MECO) warming

Palynological and isotopic study from the age-constrained Harudi Formation succession of the Kutch Basin, western India, aimed to understand the impact of Middle Eocene Climate Optimum (MECO) warming on Eocene tropical rainforest and environments. The carbon isotopic characterisation ($\delta^{13}C$ values) of the studied succession exhibited a pronounced negative Carbon Isotope Excursion (CIE) of about 2.5‰, correlated to the peak warming phase of the MECO event. The middle Eocene climate was warm and wet, as indicated by the existence of a diverse array of tropical flora in the region. Notably, the peak warming MECO phase is characterised by the infringement of deciduous elements, indicating the seasonality in rainfall patterns. The subdued mangrove community is also a testimony to salinity fluctuations in the depositional system due to intermittent surges of freshwater flux. During the recovery phase after the peak warming, the evergreen flora restored in tropical rainforests and mangroves flourished under relatively stable environmental conditions. However, the diversity patterns showed an overall decline in diversity. From a broader perspective, the study demonstrated the sensitivity of tropical rainforests and mangrove communities to fluctuating environmental conditions during high atmospheric CO_2 levels and increased temperatures of MECO (Fig. 5).

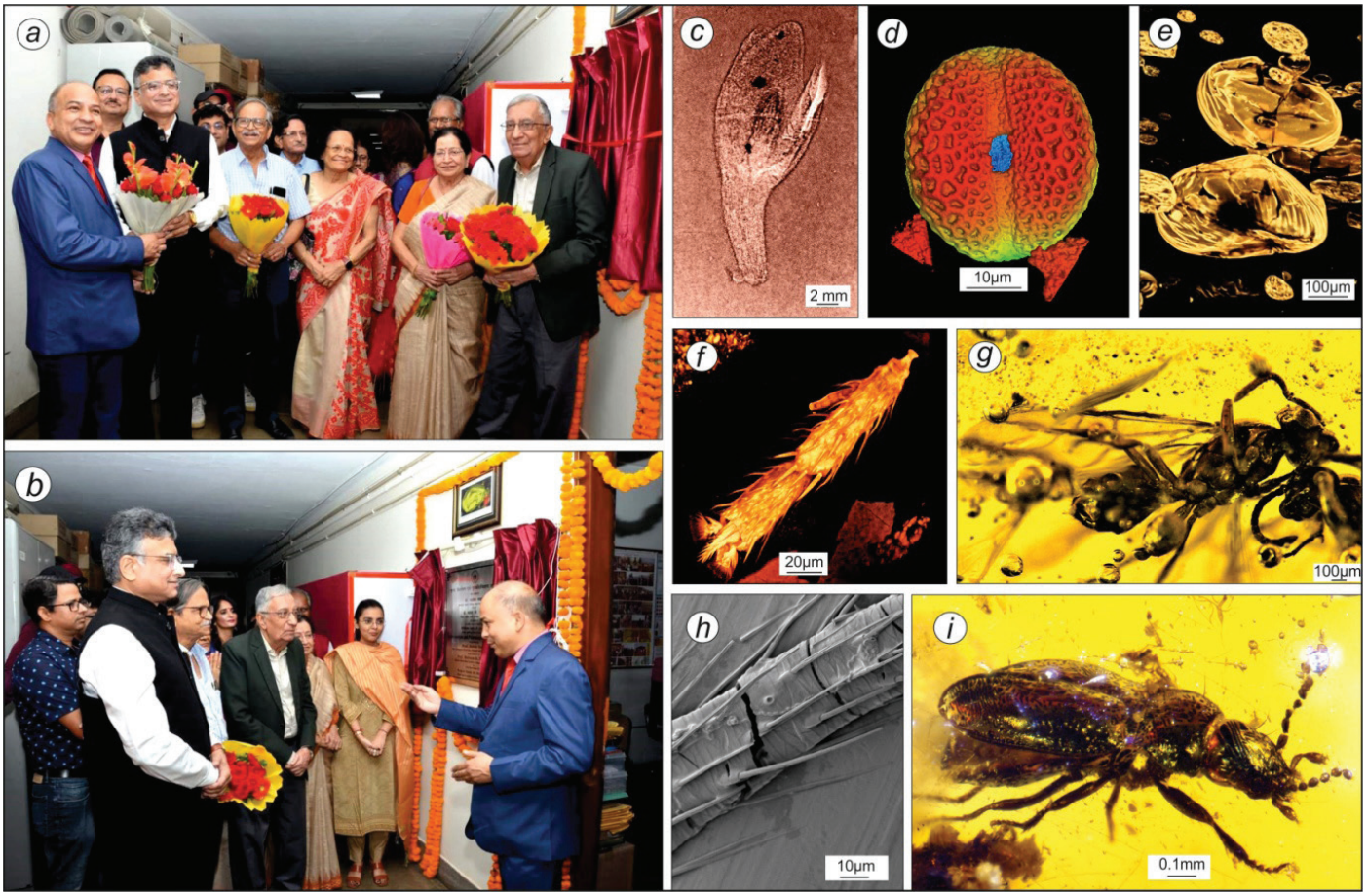


Fig. 6- a and b. Pictures of the newly inaugurated Amber Analysis and Palaeoentomology Laboratory at BSIP and amber preserved biota highlighting different microscopic techniques (SEM, CLSM, Synchrotron Micro-CT).

Highlights of newly established Amber Analysis and Palaeoentomology Laboratory:

The newly established Amber Analysis and Palaeoentomology Laboratory at the Birbal Sahni Institute of Palaeosciences, Lucknow highlights a new dimension to Indian palaeontology. The infrastructure facility has the potential for palaeoentomological research to investigate new fields in amber research. The 3-D model of a synchrotron X-ray micro-CT image of a flower in amber; CLSM-image of pollen, freshwater ostracods, broken body part of the insect, light microscopy image of a Formicid ant in amber, SEM-image of an enlarged morphological feature of spider leg extracted from amber and light microscopy image of a Carabidae beetle are available in laboratory. This development not only enhances the research capabilities within India but also fosters international collaborations, positioning the institute at the forefront of global palaeontological research (Fig. 6). These amber preserved biotic assemblages are also remarkable for the new, diversified and multidisciplinary research.

A first record of the mayfly fossils from Cambay amber, consisting of two male images from the family Leptophlebiidae, has been documented. One of the studied specimens has been described as *Aikahikaveta*gen. et sp. nov. (Fig. 7). This record represents the oldest unambiguous occurrence of *Atalophleboculata*, reaching its highest extant diversity in the fragments of former Gondwana, where it most likely originated. The mayfly fossils reported thus probably constituted one of the few Gondwanan survivors on the drifting Indian Plate.

Global warming-induced hydrological changes and vegetation shift near palaeo-equator:

We present the first quantitative evidence of a major hydrological and vegetational shift near the palaeo-equator (~0.6°N) during the Eocene Thermal Maximum 2 (ETM-2, ~53.7 Ma) using palynological data from western India. The key finding is a significant reduction in mean annual precipitation—from ~2870 mm pre-ETM-2 to ~1450 mm during the event—linked to elevated atmospheric CO_2 levels (>1000 ppmv). This reduction led to increased rainfall seasonality and a marked expansion of deciduous vegetation at the expense of tropical evergreen rain forests. The proportion of deciduous taxa increased from 3% to 12% during ETM-2, while evergreen taxa declined from 83% to 74%, indicating a longer dry season. These trends reversed in the post-hyperthermal phase. The study highlights that global warming-induced hydrological

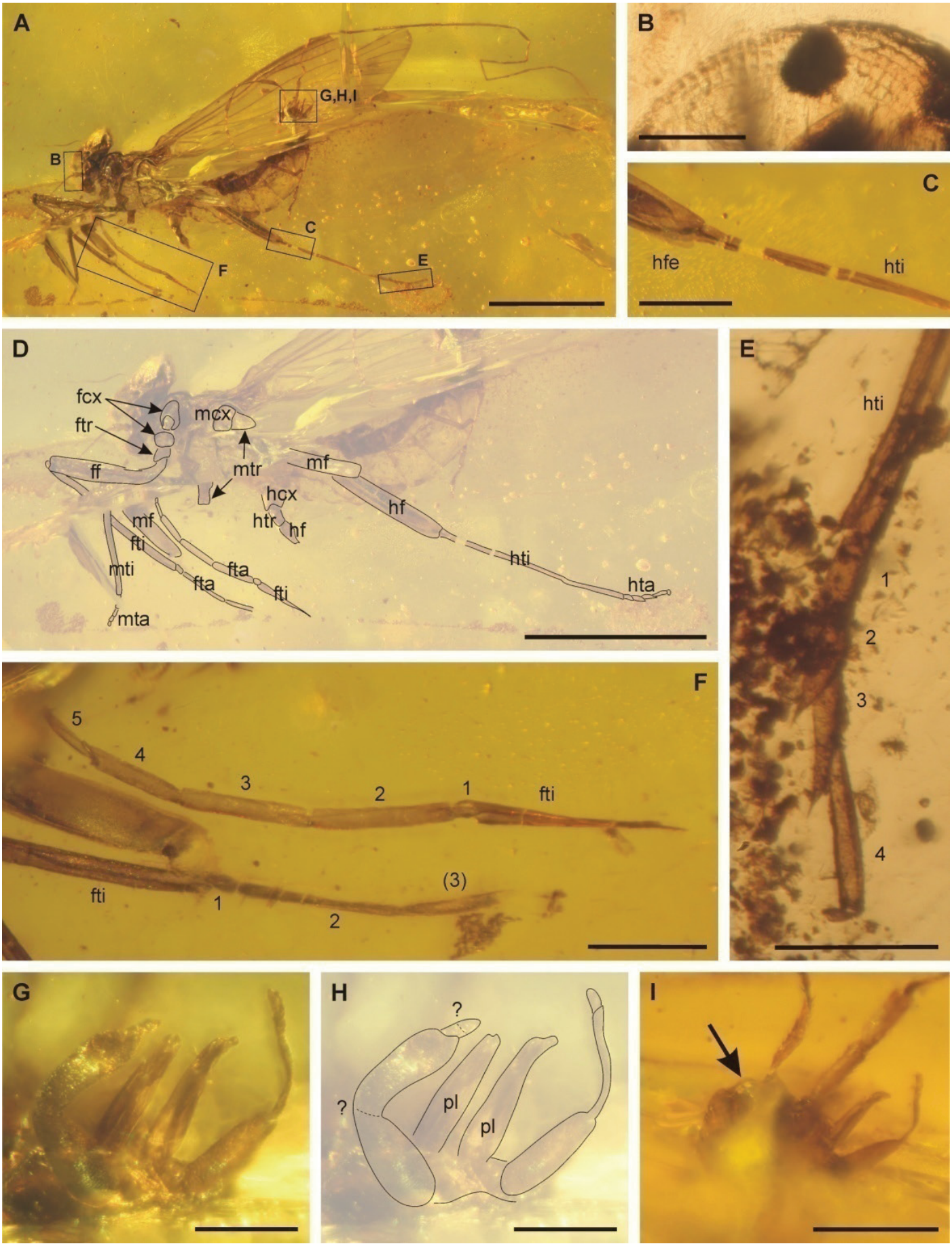


Fig. 7 - A-I. *Aikahikaveta*gen et sp. nov., holotype, specimen housed in BSIP

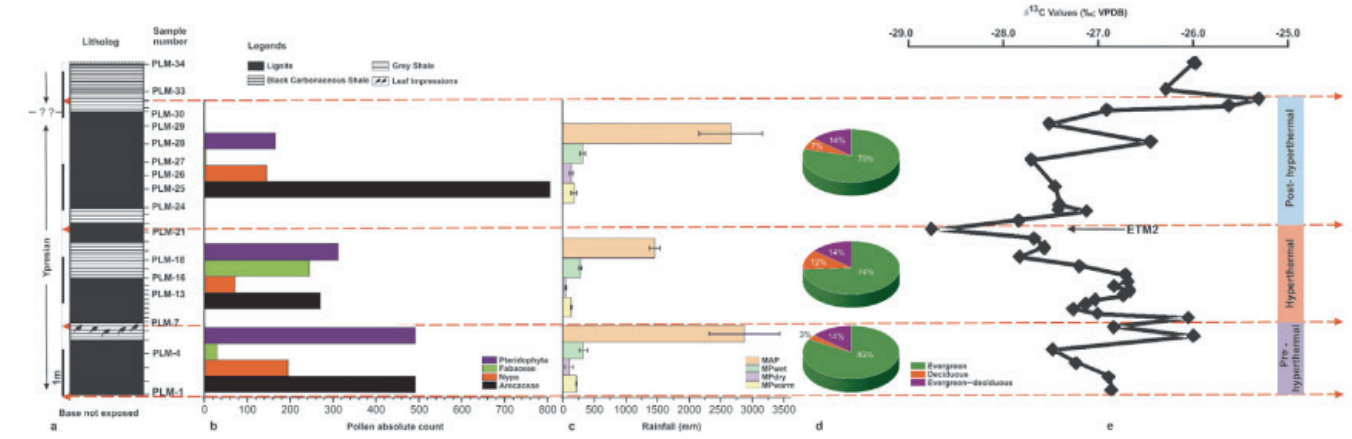


Fig. 8 - Schematic diagram showing the fluctuations in hydrological cycle and forest types during pre-hyperthermal, Hyperthermal and post hyperthermal.

changes can destabilize equatorial ecosystems (Fig. 8), offering critical insights into the potential future impacts of anthropogenic climate change on tropical biodiversity hotspots.

Evolutionary history of *Eriolaena*, commonly known as the Winged Seed Clade:

Fossil leaves, i.e. *E. Palaeowallichii,* exhibiting similarities to the modern genus *Eriolaena* (family Dombeyoideae),

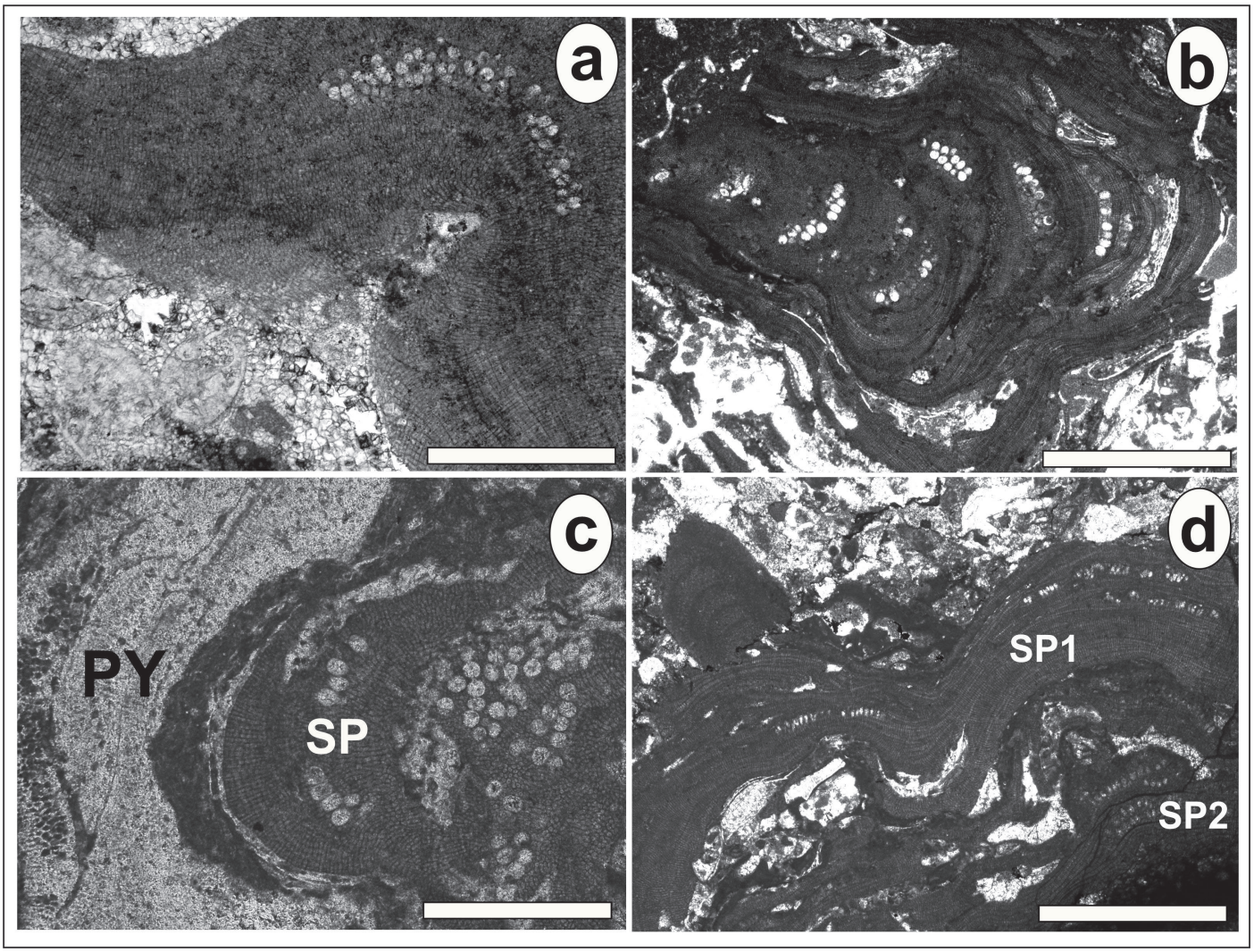


Fig. 9 - Palaeocene-Eocene crustose coralline algae from the Order Sporolithales. (a-b) Expansive crusts of genus *Sporolithon* on variable coarse-grained, hard to fine-grained soft substrates; (c) Peyssonneliacean genus *Polystrata* (PY) encrusting *Sporolithon* (SP) with indeterminate algal intercalations; (d) One species of *Sporolithon* (SP1) encrusting another species of *Sporolithon* (SP2). Scale Bars: 0.5 mm.

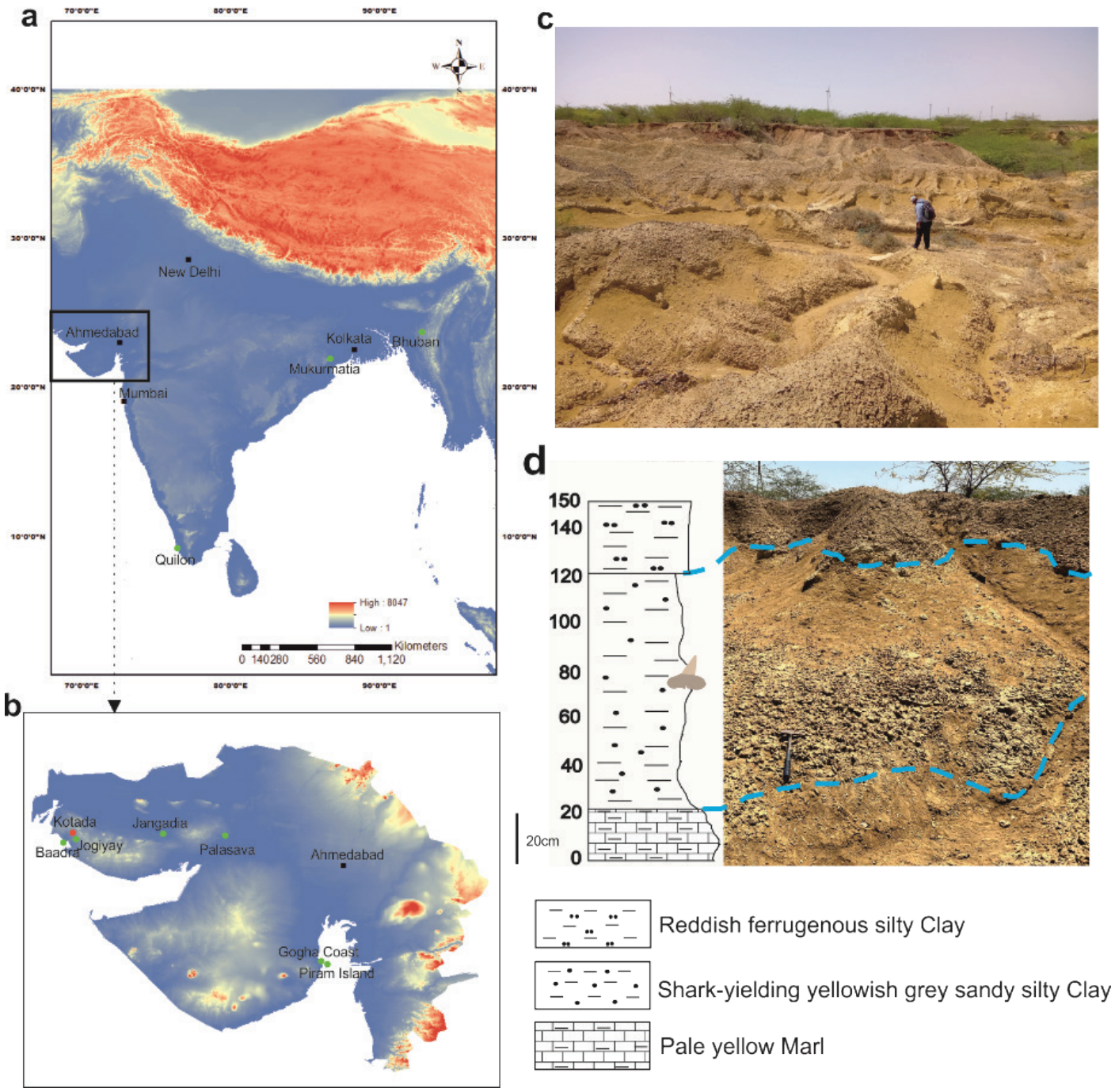


Fig. 10 - Location of the studied section and lithology. (a) DEM map of the Indian subcontinent showing the study area, i.e. Gujarat State (western India), marked with a black box showing the well-known Miocene selachian yielding site of Mukurmatia (near Baripada), Orissa State, eastern India (green circle). (b) DEM map of Gujarat State (western India) with location of the investigated site, i.e. Kotada (red circle) and other Miocene selachian (shark) yielding localities (green circle) within the Kachchh and surrounding regions. (c) Field photograph of the investigated Kotada Locality showcasing Badland topography and the Khari Nadi Formation sedimentary sequence. (d) Litholog showing the position of the shark-yielding horizon.

are identified from the early Palaeogene succession of Rajasthan (India). This marks the first fossil record of *Eriolaena*, commonly known as the Winged Seed Clade (WSC), making this discovery crucial for understanding the evolutionary history of the clade. This winged clade shows a palaeotropical intercontinental disjunction (PID), mainly located in Southeast Asia, India, and Madagascar, with only a single species in Africa. We assembled a dense sampling of the WSC throughout the current geographical distribution to reconstruct the historical biogeography of this clade. A detailed phylogenetic study indicates that the WSC diverged from its sister clade *Andringitra* in the lower Cretaceous (~88 Mya, credibility intervals 72.39–105.35), the initial diversification of the WSC occurred around

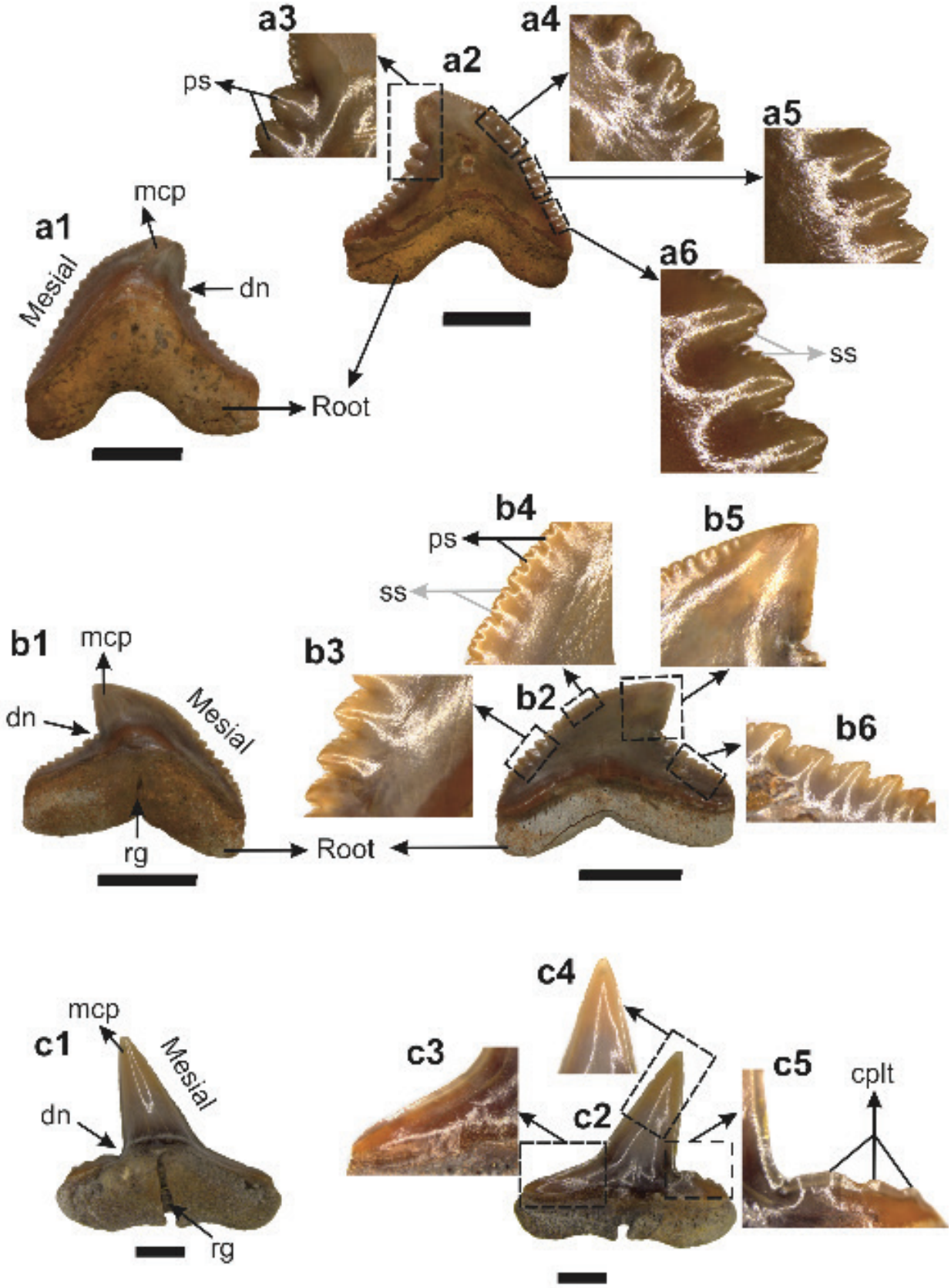


Fig. 11 - Selachian (shark) dental remains recovered from the early Miocene (Aquitanian) Khari Nadi Formation at Kotada, Kachchh District, Gujarat State, western India. (a1-a6) *Galeocerdo mayumbensis* Dartevelle & Casier, 1943, isolated tooth, Specimen No. KOT/23/7000-2, (a1) lingual view, (a2) labial view, (a3-a6) close-up views of tooth edges showcasing compound serrations; (b1-b6) *Galeocerdo cuvier* Peron & Le Sueur, 1822, isolated tooth, Specimen No. KOT/23/7000-6, (b1) lingual view, (b2) labial view, (b3-b6) close-up views of tooth edges showcasing compound serrations; (c1-c5) *Physogaleus* sp., isolated tooth, Specimen No. KOT/23/7000-25, (c1) lingual view, (c2) labial view, (c3-c5) close-up views of tooth edges. Scale bar equals 1 cm. Note: mcp (main cusp), dn (distal notch), ps (primary serration), ss (secondary serration), ng (nutrient groove), cplt (cusplets).

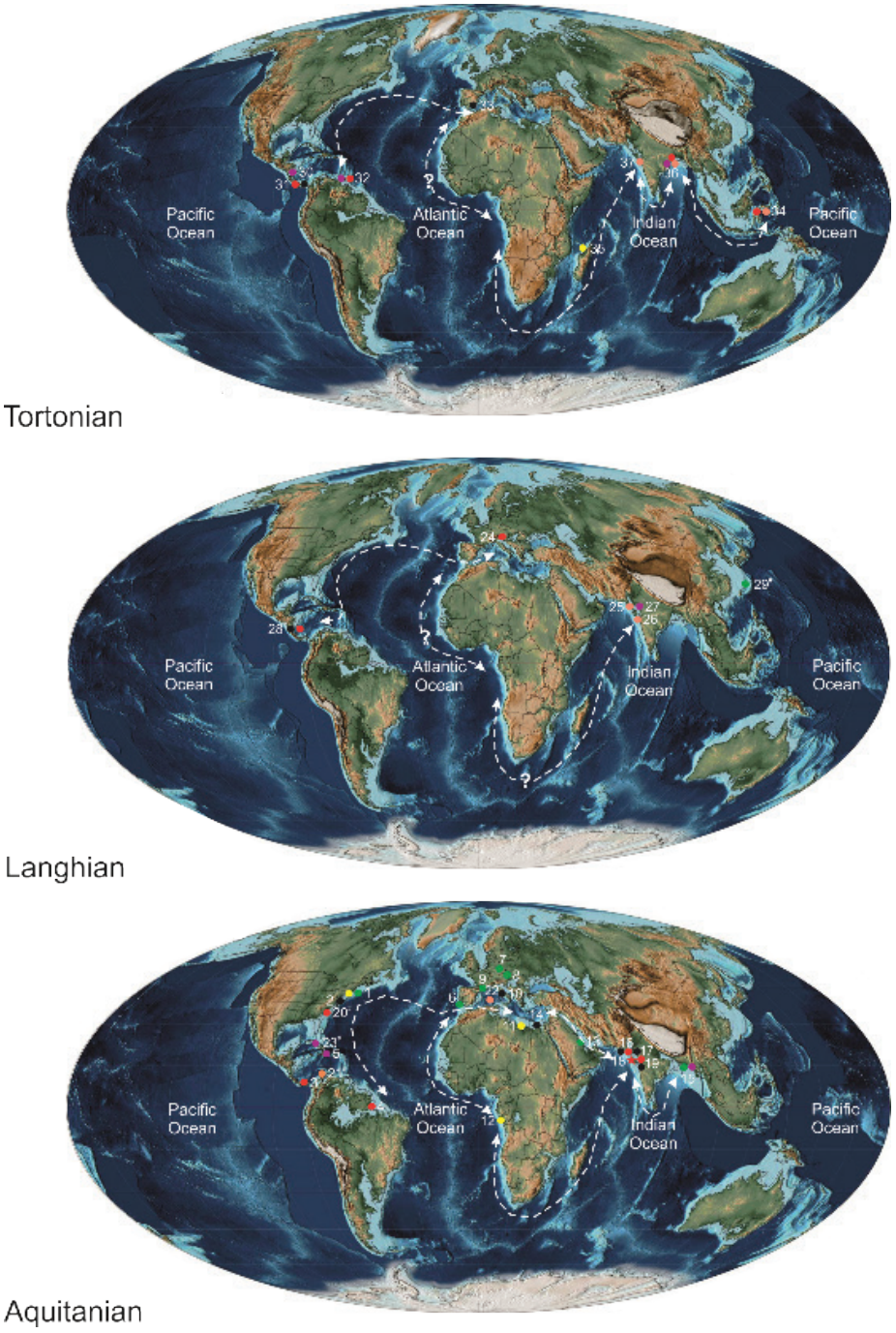


Fig. 12 - Palaeogeographic maps showing the spatio-temporal distribution of the recorded six selachian species during the Miocene. Note: Yellow Solid Circle (*Galeocerdo mayumbensis*), Red Solid Circle (*Galeocerdo cuvier*), Green Solid Circle (*Carcharhinus priscus*), Orange Solid Circle (*Carcharhinus falciformis*), Purple Solid Circle (*Negaprion brevirostris*), Black Solid Circle (*Hemipristis serra*), Red Star (Investigated locality: Kotada).

74.15 Mya (credibility intervals 60.82–88.62 Mya), and broadly this clade was globally diversified in the Miocene. Our findings suggest that an ancient origin connected with a dispersal history enabled by terrestrial land bridges and long-distance dispersals is likely to explain the winged seed clade's palaeotropical intercontinental disjunction (PID). The study indicated that WSC likely originated in Madagascar around 79 Mya and also highlighted the role of 'Out of India dispersals' for its diversification occurred mainly in the Miocene, allowing this clade to colonize in Southeast Asia.

Response of Crustose red calcareous algae to the Palaeocene-Eocene greenhouse to the Oligocene-Miocene icehouse climate regime:

Crustose red calcareous algae with critical functions like reef-building and substrate stabilisation worldwide were evaluated from multiple Palaeogene successions of the Jaintia and Khasi Hills of Meghalaya, NE India. Their diversity and palaeoenvironments were also deciphered from several Oligo-Miocene sections of the Sivas Basin and Siirt Province of Türkiye (Turkey) for comparative

analysis. Algal communities with larger benthic foraminifera as the other major benthic components were recorded as the dominant components from NE India, whereas corals (negligible in NE India) formed an important component of the Turkish assemblages with the crustose coralline algae and foraminifera. The algal assemblages from different epochs and varying localities diverged based on the sedimentary regime, environmental settings and the predominant taxa. Transition from the Palaeocene-Eocene greenhouse climate regime to the Oligocene-Miocene icehouse environment corresponded to a shift from crustose algal assemblages dominated by the Sporolithales to assemblages dominated by the Hapalidiales.

Biogeographical implications of the Aquitanian diverse assemblage of selachian (shark) fauna:

Ongoing investigation(s) reveal the most diverse assemblage of selachian (shark) fauna, to date, from the Aquitanian (~ 21 Ma) Khari Nadi Formation at Kotada, Kutch Basin, western India (Fig. 10). The recovered selachian (shark) fauna comprises five genera, including *Galeocerdo*, *Physogaleus*, *Carcharhinus*, *Negaprion* and *Hemipristis,* representing seven species (Fig. 11; see Chaskar *et al.*, 2024). *Galeocerdo mayumbensis*, *Carcharhinus falciformis*, and *N. brevirostris* comprise the oldest Neogene records from the Kutch Basin, western India. The diversity similarity coefficient data suggest that the Aquitanian selachian assemblage is quite dissimilar compared to the previously known Langhian-Serravallian assemblage from the Kutch Basin, western India. Global distribution patterns of the selachian fauna reveal intermittent biogeographic connectivity between the Atlantic, the Mediterranean, and the Indian Oceanic realms during the Aquitanian to Tortonian (Fig. 12). However, complete stratigraphic records across various Oceanic realms are warranted to fully understand the diversity change(s) and the direction(s) of migration(s) of the selachian fauna. Considering the data on Modern relatives of the recovered selachian fauna, it is most likely that the recorded selachian fauna dwelt in warm-temperate to tropical shallow coastal waters in the Neritic to Intertidal zones, i.e. coastal reef to mesopelagic environments.

SPONSORED PROJECT (SP)

SP 3.1. Palaeodietary habit(s) in deep time, linkages to producer taxa, and palaeoenvironmental inferences utilising Mesozoic-Cenozoic fossilised faecal matter (coprolites) from India. [Sponsored by Anusandhan National Research Foundation (ANRF) (Formerly SERB) Core Research Grant (CRG), CRG/2019/002204; 2020 to 2024]

Investigators: Vivesh Vir Kapur (PI), Kamlesh Kumar(Co-PI 1), P. Morthekai (Co-PI 2), Ramanand Sagar (JRF)

The project investigation has revealed for the first time the occurrence of microcoprolites within the Mesozoic (i.e., Upper Triassic Tiki Formation) interval of India (Fig. SP 3.1.1). The microcoprolite assemblage has been assigned to four new ichnotaxa, namely *Cylindrocopros gondwanensis* igen. et isp. nov., *Elliptocopros rewaensis* igen. et isp. nov., *Convolucopros shadolensis* igen. et isp. nov., and *Cylindribulbocopros triassicus* igen. et isp. nov. based on their external morphology, internal texture, and geochemical composition (Fig. SP 3.1.2). Geochemical techniques confirm the phosphatic nature of the microcoprolites recorded from the Tiki Formation. Taken together, the associated fauna and the morphological comparisons between previously known coprolites from the Mesozoic-Cenozoic sedimentary sequences suggest that the Tiki microcoprolites were likely produced by carnivorous actinopterygians. The dentalites or biting traces observed on the external surface of the ichnotaxa recorded herein are the oldest records from the subcontinent (Fig. SP 3.1.3). SEM analysis reveals the dominant presence of egg-like mineral spheres 'microspherulites', needle- and rod-shaped apatite crystals; however, the microcoprolites are devoid of biotic (floral and faunal) inclusions. Considering the abiotic crystals and geochemistry, we infer that the original faecal matter most likely underwent rapid precipitation during the early phase of mineralisation and had a very high potential for fossilisation.

SP 3.2: Indian monsoon seasonal dynamics across mid-Pleistocene transition. [Sponsored by Anusandhan National Research Foundation (ANRF) (Formerly SERB), Start-Up Research Grant (SRG), SRG/2022/002129]

Investigators: Prem Raj Uddandam (PI)

Marine microfossil records from the Arabian Sea (AS) are mainly limited to foraminifera, with scanty information on other phyto- and zoo-plankton remains. Calcareous dinoflagellate cysts are one of the rarely studied microfossil groups across the world. In the present study, a calcareous dinoflagellate cyst (dinocyst) record from the eastern Arabian Sea (Off-Goa (SC-26)) during the Holocene is presented. Coccoides (vegetative stage of calcareous dinoflagellates) of *Thoracosphaera heimii*, *Leonella granifera* shows a dominance of 82–92% of the total assemblage suggesting a eutrophic environment throughout the studied period. The relative percentage of the dominant species *T. heimii* and *L. granifera* shows an opposite trend. The high relative abundance of *Calciodinellum* species during the early Holocene (prior to 10 ka BP) indicates a comparatively warm and low productivity environment

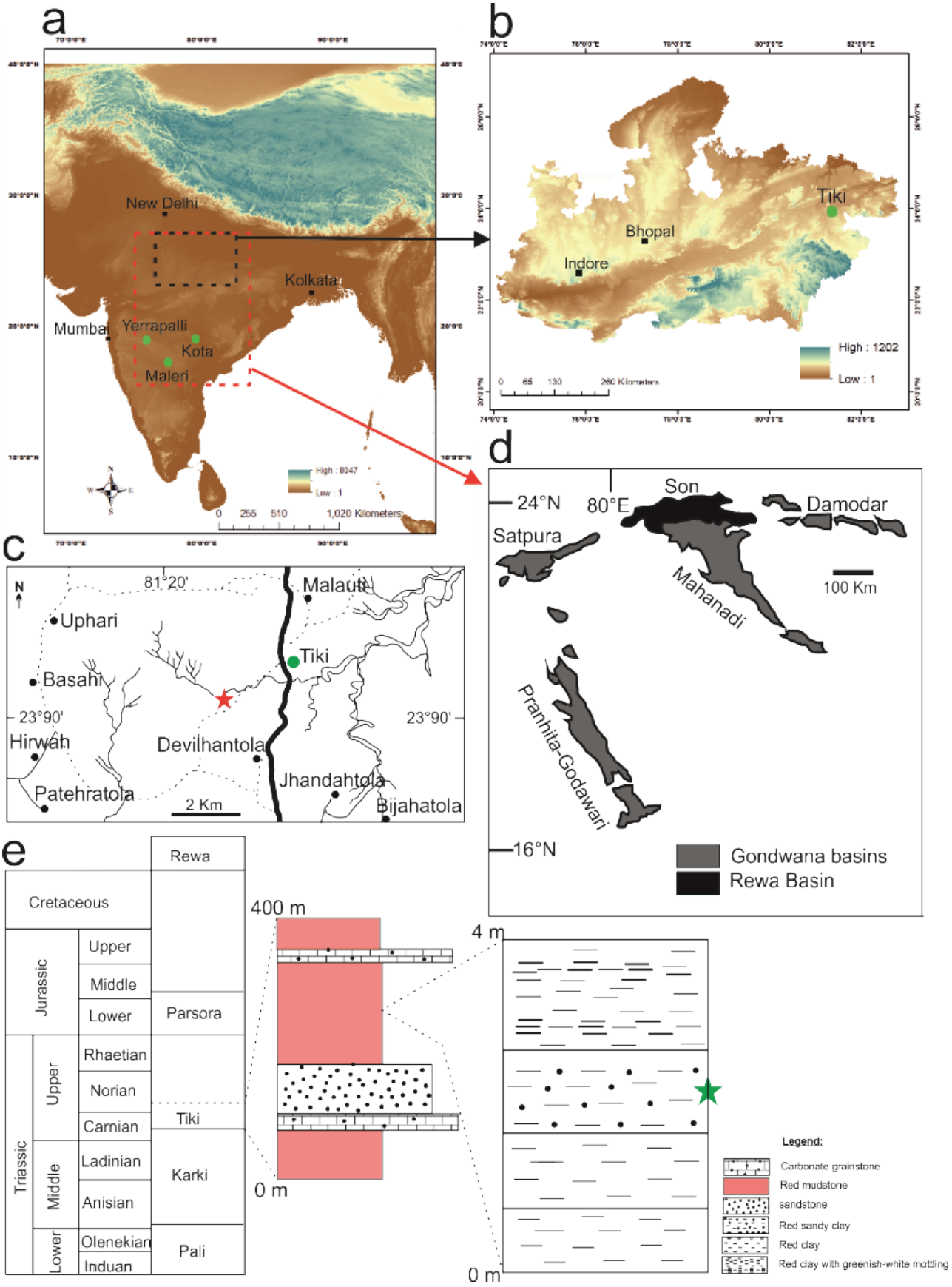


Fig. SP 3.1.1 - Locality information. (a) DEM of the Indian subcontinent showing the Triassic coprolite yielding localities; (b) DEM map of Madhya Pradesh State (central India) showing the investigated locality of Tiki (this study); (c) Map of the Gondwana basins of peninsular India; (d) Location map showing the microcoprolite-yielding site (red star) near Tiki Village, Madhya Pradesh State, central India; (e) Stratigraphic correlation chart for the Rewa Basin showcasing a composite litholog of the Tiki Formation and the microcoprolite-yielding level (green star). Modified after Mukherjee *et al.* 2012 (with permission; licence no. 5844180284540).

Fig. SP 3.1.2 - Digital photographs of the microcoprolite specimens recovered from the Upper Triassic Tiki Formation, central India. (a-c) *Cylindrocopros gondwanensis* igen. et isp. nov., (a) DUGF/TK/22/C36, holotype, (b) DUGF/TK/22/C21, (c) DUGF/TK/22/C9; (d-h) *Elliptocopros rewaensis*i gen. et isp. nov., (d) DUGF/TK/22/C19, holotype, (e) DUGF/TK/22/ C113, (f) DUGF/TK/22/C27, (g) DUGF/TK/22/C22, (h) DUGF/TK/22/C69; (i-l) *Convolucopros shadolensis* igen. et isp. nov., (i) DUGF/TK/22/C120, holotype, (j) DUGF/TK/22/C20, (k) DUGF/TK/22/C13, (l) DUGF/TK/22/C112; (m-n) *Cylindribulbocopros triassicus* igen. et isp. nov., (m) DUGF/TK/22/C10, holotype, (n) DUGF/TK/22/C31. The scale bar equals 1 mm for a-c, e-n, and 0.5 mm for d.

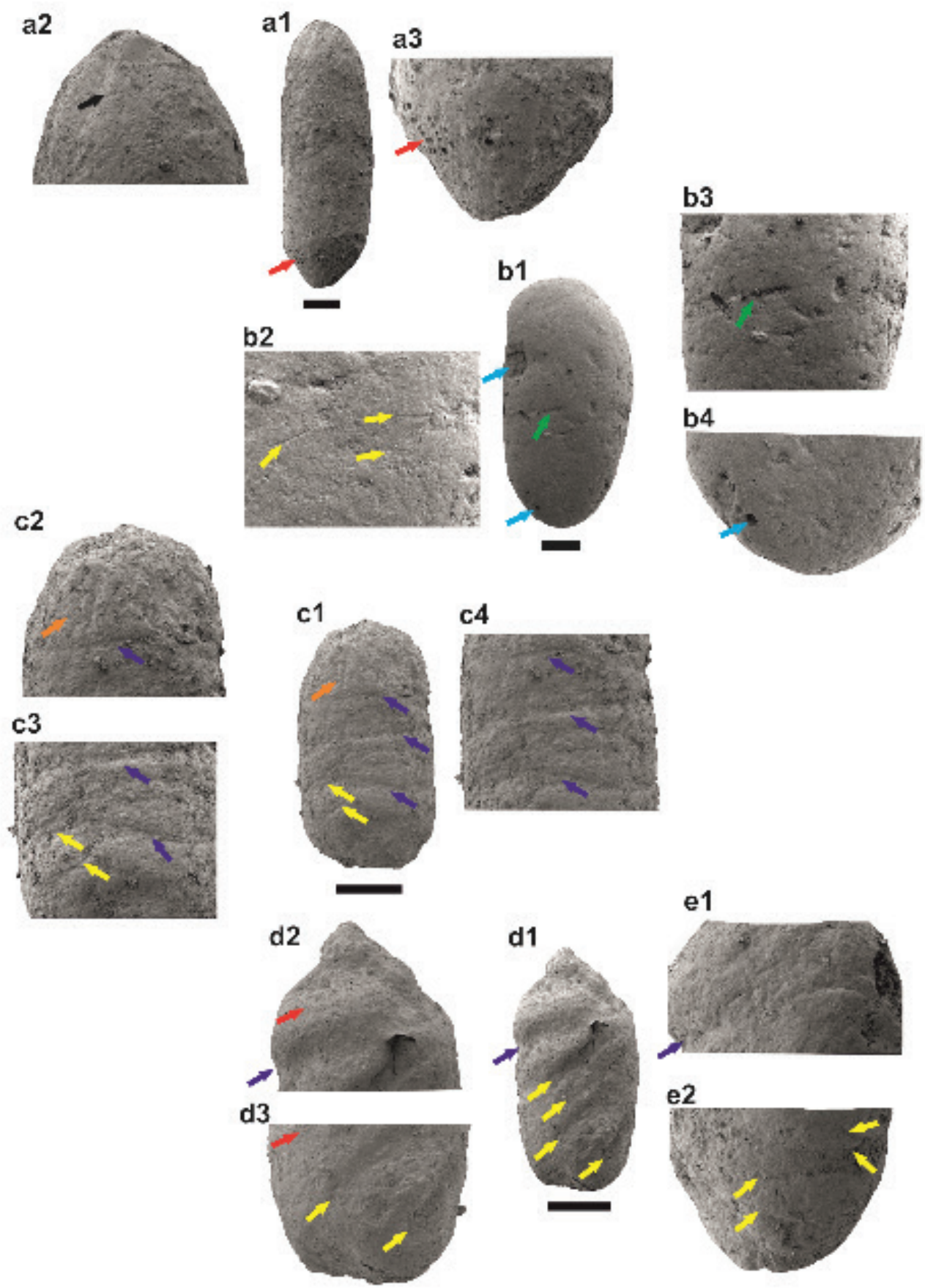


Fig. SP 3.1.3 - Scanning electron microphotographs of the Upper Triassic microcoprolites recovered from the Tiki Formation (central India) depicting external morphology and structures. (a1-3) *Cylindrocopros gondwanensis* igen. et isp. nov.; (b1-4) *Elliptocopros rewaensis* igen.et isp. nov.; (c1-4) *Convolucopros shadolensis* igen. et isp. nov.; (d1-3, e1-2) *Cylindribulbocopros triassicus* igen. et isp. nov. Note: black arrow (ridge), red arrow (pits), blue arrow (burrow), green arrow (dessication cracks), yellow arrow (dentalites or bite traces), orange arrow (striation), purple arrow (constriction). Scale bar equals 300 microns for a1, b1, c1 and d1.

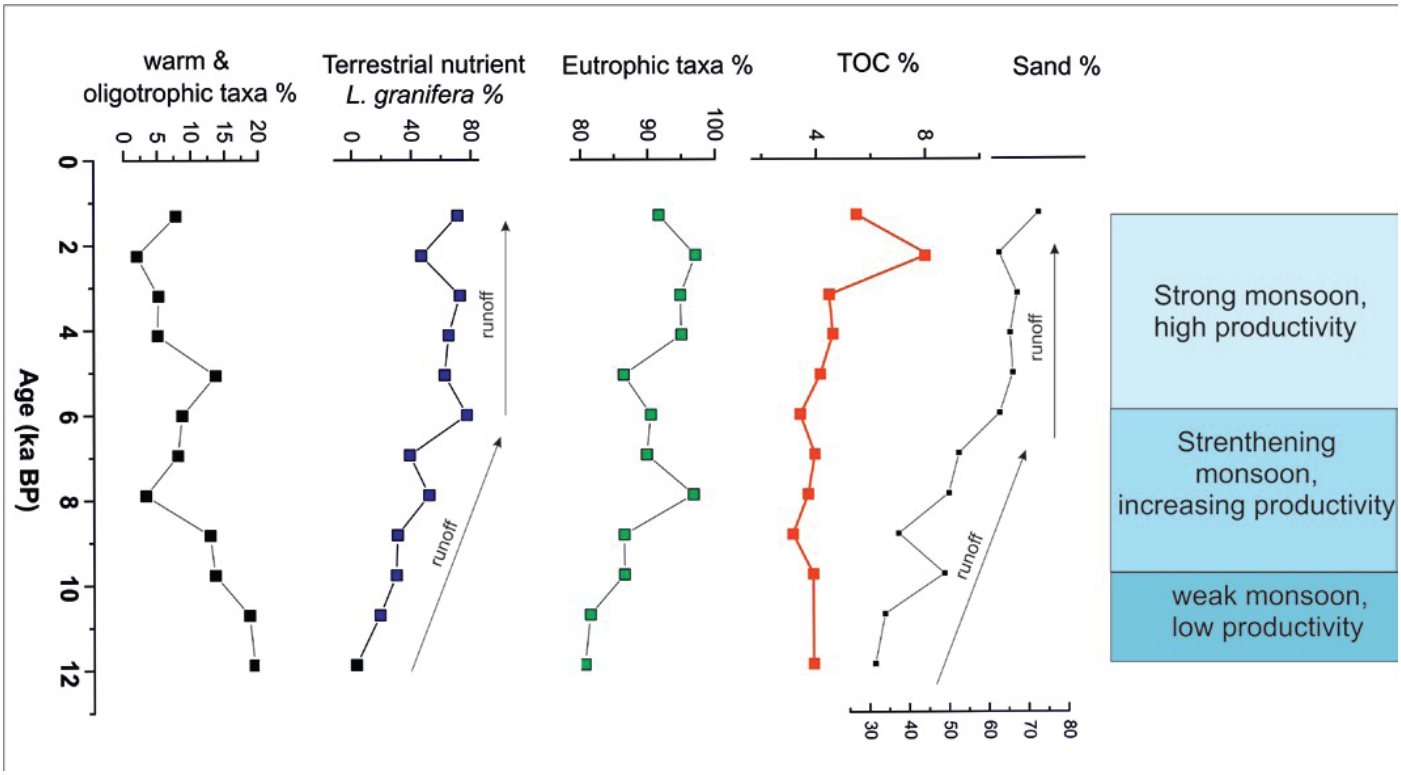


Fig. SP 3.2.1 - Calcareous dinoflagellates, TOC % and Sand % data of the studied core indicating monsoon changes (Uddandam *et al.* 2014).

compared with the late Holocene. A strengthening trend in the monsoon during the Holocene since 10 ka BP is reflected by the gradual increase in *L. granifera*, which is a runoff/terrestrial nutrient indicator. The high relative abundance of *L. granifera*, eutrophic taxa, and TOC since 6 ka BP reveals high primary productivity during middle to late Holocene compared with the early Holocene in the eastern Arabian Sea. Sand % which reflects runoff and *L. granifera* records show high similarity revealing that *L. granifera* % can be used as a terrestrial nutrient indicator, which has been suggested previously in studies from the Mediterranean Sea and South Atlantic. This record reveals the potential of calcareous dinoflagellate cysts to reconstruct monsoon variation, particularly runoff changes, in the Arabian Sea.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Acharya B, Kumar S, Verma P, Sanyal P & Srivastava P– Indus Basin Sedimentary Rocks (IBSR) in the Khangral-Samoni traverse: Insights from the mineralogical, palynological and bio-geochemical evidence, 40th Convention of Indian Association of Sedimentologists & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP Lucknow, December 11-13, 2024. Abstract: 34.
2. Bhandari A, Bajpai S & Tiwari BN − Discovery of Miocene mammals from Kutch, western India. 40th Convention of Indian Association of Sedimentologists & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP Lucknow, December 11-13, 2024. Abstract: 65.
3. Bhandari A − A new murid rodent from the Siwalik Group of Mohand (NW Himalaya) and Palaeontological implications in 29th Indian Colloquium on Micropaleontology and Stratigraphy (ICMS 2024) at Department of Geology, University of Delhi, Delhi during 17th-19th October, 2024. Abstract: 28.
4. Chaskar K, Sagar R, Padia DJ, Chauhan G, Kapur VV, Pandya PJ − New record of Elasmobranch (shark) fauna from the early Miocene (Aquitanian) of Kachchh Region (western India): Palaeoenvironmental and palaeobiogeographic significance. Oral presentation at 37th International Geological Congress (IGC), August 25-31, 2024, Busan, Republic of Korea. Abstract, pp. Pr. Presidency University, Kolkata.
5. Choudhuri A – Evidence of motile life from the mid-Neoproterozoic Sirbu Shale, Upper Vindhyan Group, India. National Conference

on "Women in Geosciences: Opportunities, Challenges and Accomplishments", NCESS, Thiruvannanthapuram 2-4 September, 2024. Abstract: 89.

6. Choudhuri A – Wave-dominated clastic shoreline with tidal imprint: a unique coast of the Late Cretaceous Mahadek Formation, southern Shillong Plateau, NE India. 40th Convention of the Indian Association of Sedimentologists (IAS) & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP, Lucknow, December 11-13, 2024, Abstract: 24.
7. Deori N, Verma P, Agrawal S, Thakkar MG & Patel JM – Palaeoenvironmental dynamics during the Middle Eocene Climatic Optimum (MECO) in the Kachchh Basin, western India: Palynological and geochemical insights, online poster presentation at The Micropalaeontological Society Annual Conference 2024, the Polish Academy of Arts and Science, Kraków, Poland., November 6th-19th, 2024. Abstract in TMS Newsletter Special Issue 4: 64.
8. Gupta SK, Mathews RP, Singh AK, Srivastava M, Chetia R, Singh VP, Pillai SSK & Aggarwal N – Spectroscopic study of selected Indian coals of different thermal maturity level to understand the chemical structural changes, hydrocarbon source characteristics and palaeodepositional environment. 40th Convention of Indian Association of Sedimentologists & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP Lucknow, December 11-13, 2024. Abstract: 109.
9. Kapur VV & Adrian P Hunt – Records of coprolite ichnofaunas from India: knowledge gaps in ichnotaxonomy, palaeodietary habit(s), producer association(s), and prey-predator interaction(s) in varied environments. Oral Presentation at the 40th Convention of the Indian Association of Sedimentologists, December 11-13, 2024, Lucknow, India. Abstract: 50.
10. Mathews RP, Chetia R, Verma P & Singh PK – Delineating the source of organic matter in the lignite-bearing Akli Formation, Barmer Basin, western India. 40th Convention of Indian Association of Sedimentologists & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP Lucknow, December 11-13, 2024. Abstract: 105.
11. Mishra S, Bansal M, Prasad V, Singh VP, Murthy S, Parmar S, Utescher T & Khangar R–Temporal impact of the Deccan volcanism on the flora of the shifting Indian Plate. 40th Convention of the Indian Association of Sedimentologists (IAS) & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP, Lucknow, December 11-13, 2024, Abstract: 84.
12. Sagar R, Gupta T, Parmar S, Uddandam P, Kapur VV – Coprolite ichnofauna from the lignite-associated sedimentary succession at Sonari Lignite Mine, Barmer Basin, western India: Palaeodietary habit(s) and producer association(s). Poster Presentation at the 40th Convention of the Indian Association of Sedimentologists, December 11-13, 2014, Lucknow, India. Abstract: 59.
13. Sarkar S – Environmental factors influencing carbonate skeletal associations: Palaeocene-Eocene examples from northeastern and western India. 40th Convention of Indian Association of Sedimentologists & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", BSIP Lucknow, December 11-13, 2024. Abstract: 47.
14. Srivastava G – उष्ण होती दुनिया में फलियों (लैग्यूम) की सहनशीलता: जीवाश्म साक्ष्यों से अंतर्दृष्टि (Resilience of legumes in a warming world: insights from fossil evidence), Oral presentation at Second All India Scientific and Technological Official Language Seminar 2024 entitled "Role of DST Autonomous Institutes in Self-Reliant India" organized by Aryabhatta Observational Science Research Institute (ARIES), Nainital, Uttarakand, November 20th - 21st 2024. Abstract: 14.
15. Verma P, Srivastava G & Bhatia G – High rainfall provided resilience to palaeotropical rainforests during Early Eocene Climatic Optimum (EECO): A palynological evidence from western India. Oral Presentation at 56th Annual Meeting AASP-The Palynological Society, Montpellier, France, June 24th-28th 2024. Abstract: 69.
16. Verma P. – उष्ण कटिबंधीय वर्षावनों की जलवायु प्रतिसंवेदनशीलता: पुरापरागाणुविज्ञान के दृष्टिकोण से (Climate sensitivity of tropical rainforests: a palynological perspective). Oral presentation at Second All India Scientific and Technological Official Language Seminar

2024 entitled "Role of DST Autonomous Institutes in Self-Reliant India" organized by Aryabhatta Observational Science Research Institute (ARIES), Nainital, Uttarakand, November 20th - 21st 2024. Abstract, pp. 9.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Adrita Chouduri

- Evolution of a confined gravelly river to a braided-meandering river in the Late Cretaceous Khasi Group, southern Shillong Plateau, NE India. 6th International Conference of Palaeogeography, Nanjing, China, 17th-20th May 2024.

Anumeha Shukla

- STREE 2024, an event organised in collaboration with @SHAKTI Vigyan Bharti, held at Maulana Azad National Institute of Technology, Bhopal from December 6-8, 2024.

Poonam Verma

- The 56th Annual Meeting AASP-The Palynological Society, Montpellier, France, June 24-28, 2024.

Poonam Verma, Shreya Mishra & Suman Sarkar

- The Brainstorming meetings regarding the new Consultancy/sponsored projects, at the Geology and Reservoir office of the OIL India Limited, Duliajan and The Centre of Excellence for Energy Studies (CoEES), Oil India Limited, Guwahati, May 27-31, 2024

Poonam Verma & Gaurav Srivastava

- Second All India Scientific and Technological Official Language Seminar 2024 entitled "Role of DST Autonomous Institutes in Self-Reliant India" organized by Aryabhatta Observational Science Research Institute (ARIES), Nainital, Uttarakand, November 20- 21, 2024.

Hukam Singh, Poonam Verma, Vivesh Vir Kapur, Adrita Chouduri, Shreya Mishra & Suman Sarkar

- The 40th Convention of the Indian Association of Sedimentologists (IAS) & National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research", held at BSIP, Lucknow,from December 11-13, 2024.

LECTURES DELIVERED

Vivesh Vir Kapur

- An Invited Talk (via online mode) titled "An Introduction to the world of Microfossils" delivered for post-graduate students of the PG College, Narnaul, Haryana on the 5th November 2024.

CONSULTANCY / TECHNICAL SUPPORT RENDERED

Hukam Singh

- Consultancy work in FESEM at BSIP: INR, 266090.

Runcie Paul Mathews

- Advanced Coal Petro-Geochemical Lab, FTIR analysis, Dr. Osama Bin Shams, CPGIDMS Lucknow, INR 4,720/-
- Advanced Coal Petro-Geochemical Lab, Petrography, Madhurima Mazumdar, IIT ISM Dhanbad, INR 17,700/-
- Advanced Coal Petro-Geochemical Lab, Petrography, Dr. Vikram Pratap Singh, CIMFR Dhanbad, INR 11,800/-
- Advanced Coal Petro-Geochemical Lab, Petrography, Rajesh Sharma, IIT Roorkee, INR 31,860/-

Poonam Verma, Abhijit Mazumder, Abha Singh, Prem Raj Uddandam, Shreya Mishra, Suman Sarkar

- Industrial Micropalaeontology Lab, Biostratigraphic analysis of the sub-surface samples of Exploratory/Development wells of Oil India Limited, Oil India Limited, Assam, INR 35,41,484/-

ACCOLADES RECEIVED

Poonam Verma

- **Certificate of Appreciation:** BSIP, Lucknow appreciated dedicated contributions as a subject expert for the successful completion of collaborative industrial project with RGL-ONGC, Vadodara in April 2024.
- **Certificate of Appreciation:** BSIP, Lucknow appreciated for participation and presentation at the 56th Annual Meeting AASP-The Palynological Society, Montpellier, France, June 24-28, 2024.

Vivesh Vir Kapur

- **Certificate of Appreciation:** Tethys Fossil Museum (Dangyari, Himachal Pradesh, India) for concerted contributions towards Geoheritage conservation and in palaeontology in India.

PH.D. PROGRAMMES

	**Harshita Bhatia (2020).** Advent of monsoonal climate and evolution of evergreen forests in South Asia: Evidence from the Oligocene flora of northeast India, under the supervision of **Gaurav Srivastava (BSIP)**, registered in the Academy of Scientific and Innovative Research (AcSIR), Status: Awarded in 2024.
	**Pawan Kumar Singh (2021).** Study of plant fossils from the Siwalik of Darjeeling District, West Bengal, India, under the supervision of **Hukam Singh (BSIP)**, registered with the Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: Ongoing.
	**Ramanand Sagar (2022).** Palaeobiological and geochemical aspects of Mesozoic and Cenozoic vertebrate coprolites from central and western India, under the supervision of **Vivesh Vir Kapur (BSIP) and Kamlesh Kumar (BSIP)**, registered with the Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In progress.
	**Rimpy Chetia (2018).** Organic geochemical and petrographic characterisation of lignite deposits from Barsingsar and Jalipa mines of western Rajasthan, under the supervision of **Runcie Paul Mathews (BSIP)** and Prof. P.K. Singh (BHU), registered with the Banaras Hindu University. Status: Submitted, 2024
	**Sadanand (2021).** Neogene climate evolution vis-à-vis floristic changes in northern India, under the supervision of **Gaurav Srivastava (BSIP)**, registered in the Academy of Scientific and Innovative Research (AcSIR). Status: In progress.
	**Samiksha Shukla** (2021), Evolution, diversification, and dispersal history of the pantropical family Phyllanthaceae: Based on the recovered early Palaeogene flora from north-western India, under the supervision of **Anumeha Shukla (BSIP)**, registered in the Academy of Scientific and Innovative Research (AcSIR). Status: In progress.
	**Sarvendra Pratap Singh (2019).** Magnetostratigraphy of Deccan basalts and Sedimentology of its associated intertrappean deposits in parts of central India, under the supervision of **Mohammad Arif (BSIP)** and A.S. Naik (Banaras Hindu University, Varanasi), registered with Banaras Hindu University, Varanasi. Status: Awarded, April 2024.
	**Satendra Kumar Gupta (2023)**. Geochemistry and petrology of low-rank coal-bearing sequences of Barmer Basin, western India: implications to palaeoenvironment and hydrocarbon source potential, under the supervision of **Runcie Paul Mathews (BSIP) and Arvind K. Singh (BSIP)**, registered with Academy of Scientific and Innovative Research (AcSIR), Status: In progress.
	**Tapas Roy (2023).** Facies tracts and sequence building of the Jhuran Formation, Kutch, India, under the supervision of **Adrita Choudhuri (BSIP)** and Anudeb Mandal (Presidency University, Kolkata), registered with Presidency University, Kolkata. Status: In progress.

- **Recognised Guide**: Indian Academy of Sciences (IASc), Bengaluru to actively contribute to Science Education activities (including in the Focus Area Science Technology Summer Fellowship [FAST-SF] program of the National Science Academies) to host students or teachers (In the year 2025) for two months in the VPPL-BSIP.

REPRESENTATION IN COMMITTEES / BOARD

Hukam Singh

- Member, Editorial Board - Journal 'Geophytology', BSIP
- Member, Journal Palaeontological Society of India
- Member, Journal Himalayan Geology, India
- Convener, Poster Committee in the 40th Convention of the Indian Association of Sedimentologists (IAS), India

Poonam Verma

- Editor, Rajbhasha Patrika of BSIP "पुराविज्ञान स्मारिका"
- Member, International Organization of Palaeobotany (IOP)
- Member, The Palaeobotanical Society of India
- Member, The Palaeontological Society of India
- Member, The Americal Association of Stratigraphy and Palynology -The Palynological Society (AASP-TPS)
- Member, NECLIME Group, Germany
- Convener, Decoration Committee in the 40th Convention of the Indian Association of Sedimentologists (IAS), India

Gaurav Srivastava

- Member, International Organisation of Palaeobotany
- Member, NECLIME
- Member, Editorial Board - Journal Global and Planetary Change (Elsevier)
- Member, Editorial Board - Journal Earth History and Biodiversity (Elsevier)
- Member, Editorial Board - Journal Phytotalks

Anumeha Shukla

- Co-organiser of "Women in Science, Technology and Innovation: As role models in transforming challenges into innovative solutions" held at the Birbal Sahni Institute of Paleosciences, Lucknow on October 4, 2024.

Vivesh Vir Kapur

- Council Member (2024 to present), The Palaeontological Society of India, Lucknow, India.
- Council Member (2022 to March 2025), The Palaeobotanical Society of India, Lucknow, India.
- Fellow Member (2011 to present), The Geological Society of London, United Kingdom
- Organizing Secretary, The 40th Convention of the Indian Association of Sedimentologists (IAS), India.
- Convener, "Publications/Abstract Committee" in the 40th Convention of the Indian Association of Sedimentologists (IAS), India.

Mohammad Arif

- Co-Chaired a Scientific Session "Geomagnetism & Volcano-Sedimentology" at the 40th Convention of Indian Association of Sedimentologists (IAS-2024), December 11- 13, 2024, at BSIP, Lucknow.
- Organiser of Lecture Session on 'Hybrid volcanics from Jamjodhpur area, Saurashtra, western India – an underrated petrogenetic model of magma mixing for the Late Cretaceous Deccan Traps Volcanic Province' presented by an Eminent Professor, Dr. Saumitra Misra (SAEES, University of KwaZulu-Natal, Durban, South Africa) on 26th September 2024 in BSIP.

Ansuya Bhandari

- Member, Palaeontological Society of India (PSI)
- Member, Indian Geological Congress (IGC)

Adrita Choudhuri

- Member, International Commission of Stratigraphy (Precambrian Subcommission) since 2023
- Member, International Biopetrological Society since 2021
- Associate Editor, International Biopetrological Society since 2021
- Member, SEPM Society for Sedimentary Geology (December 2015 to present).
- Member, Indian Association of Sedimentologists (November 2017 to present).

Suman Sarkar

- Assistant Editor, Journal of Palaeosciences

Project 4: Ocean and Polar paleoclimatic reconstruction during Neogene and Quaternary

Coordinator: Pawan Govil (Scientist E)
Co-coordinator: Vartika Singh (Scientist E)

OBJECTIVES

- *Paleoceanographic variations from the western Indian Ocean during the mid-late Miocene: micropalaeontological and geochemical approach.*
- *Climate variability of the Southern Ocean over the Mid-Pleistocene Transition.*
- *Paleoceanography reconstruction from the western Indian Ocean during late Quaternary.*
- *Late Quaternary palaeoclimate reconstruction from the high latitude (polar: Arctic and Antarctica) using multiproxy data.*

PREAMBLE

Miocene: As the Earth warms, geological data and computer simulations from periods before the Quaternary are essential for predicting future climate change. Global geological records indicate that the Miocene Era was characterised by warmer and more humid climates. By comparing sea surface temperature reconstructions based on proxies and palaeovegetation data with climate-vegetation model simulations from the Late Miocene, researchers have identified a global average temperature increase of 17-19°C.

The warm greenhouse conditions of the Eocene Period transitioned to a cooler, drier, and less stable climate during the Miocene. Following the middle Miocene climatic optimum, which occurred around 16 million years ago, the East Antarctic ice sheets expanded, resulting in a significant cooling of mid- to high latitudes. This expansion also enhanced zonal and surface ocean circulation by increasing deep-water production.

The tectonic and terrestrial events of the late Palaeogene and the mid- to late Neogene can be linked to climatic and marine cycles through the examination of sediment layers. The extension of the Antarctic ice sheet and changes in deep-water circulation during the middle to late Miocene further intensified temperature differences specific to various latitudes. These changes also impacted processes in the low-latitude Southern Hemisphere.

(L to R): Aditi Nautiyal, Sunil Kumar Shukla, Pawan Govil, Divya Verma, Vartika Singh, Adhra Renny, Brijesh Kumar, Manoj M. C. & Abhijit Mazumdar

Quaternary: The Southern Ocean (SO) plays a crucial role in connecting major ocean basins and shaping global climate patterns. Its influence on Pleistocene climate remains uncertain due to a lack of reliably dated palaeoenvironmental data near Antarctica. Sedimentary records provide insights into deep ocean water movement, the extent of sea ice, and the dynamics of ice sheet growth and retreat. The Mid-Pleistocene Transition (MPT) indicates a shift in the frequency of Pleistocene glacial cycles from 41 to 100 thousand years; however, the specifics of this transition continue to be contested within palaeoclimatology. Our study examines how the Indian Sub-Antarctic Southern Ocean affects global climate change, focusing on the complex boundary currents, notably the Mozambique and Agulhas Currents.

The western Indian Ocean is influenced by a complex system of boundary currents. Mainly, the Mozambique Current and Agulhas Current turn south as part of the global thermohaline circulation and enter to the western Indian Ocean. We reconstructed late Quaternary variations of the surface and thermocline hydrography using planktonic foraminiferal assemblages and stable oxygen ($\delta^{18}O$) and carbon isotopes ($\delta^{13}C$) in planktic foraminifera from three sediment cores recovered from the western Indian Ocean. We utilized micropalaeontology, sortable silt analysis, and the isotopic and elemental concentrations of planktic foraminifera to reconstruct changes in hydrography during the late Quaternary Period.

Antarctica: Lake sediment cores from East Antarctica indicate that the Holocene Period is limited in time because of the short length of existing sediment cores. To address this, it is proposed to study longer sediment cores in order to reconstruct climate-driven changes over an extended timescale in the eastern Antarctic peripheral region during the Quaternary. This research will utilize sedimentological, geochemical, micropalaeontological and biomarker analyses.

Arctic: Previous studies in the Arctic, particularly in Svalbard, have focused on glacial geology, stratigraphy, sedimentology, and environmental aspects of late Quaternary palaeoclimate. Efforts have been made to evaluate the late Quaternary palaeoclimate of the Arctic by utilising proxies such as dinoflagellates, thecamoebians, diatoms, and organic matter analyses. The geomorphology and sediments found in post-glacial marine terraces provide valuable insights into relative sea-level changes and the extent of sea ice.

PERSONNEL

Team Members: Abhijit Mazumder (Scientist E), Sunil Kumar Shukla (Scientist D), Manoj MC (Scientist D)
Associate Members: Anupam Sharma (Scientist G), Niraj Rai (Scientist D), Shailesh Agrawal (Scientist D), Santosh K. Pandey (Scientist D), Arif K. Ansari (Scientist D), Gurumurthy (Scientist C).
Research Scholars: Hidayatullah, Brijesh Kumar, Divya Verma, Masud Kawsar, Sneha Mary Mathew

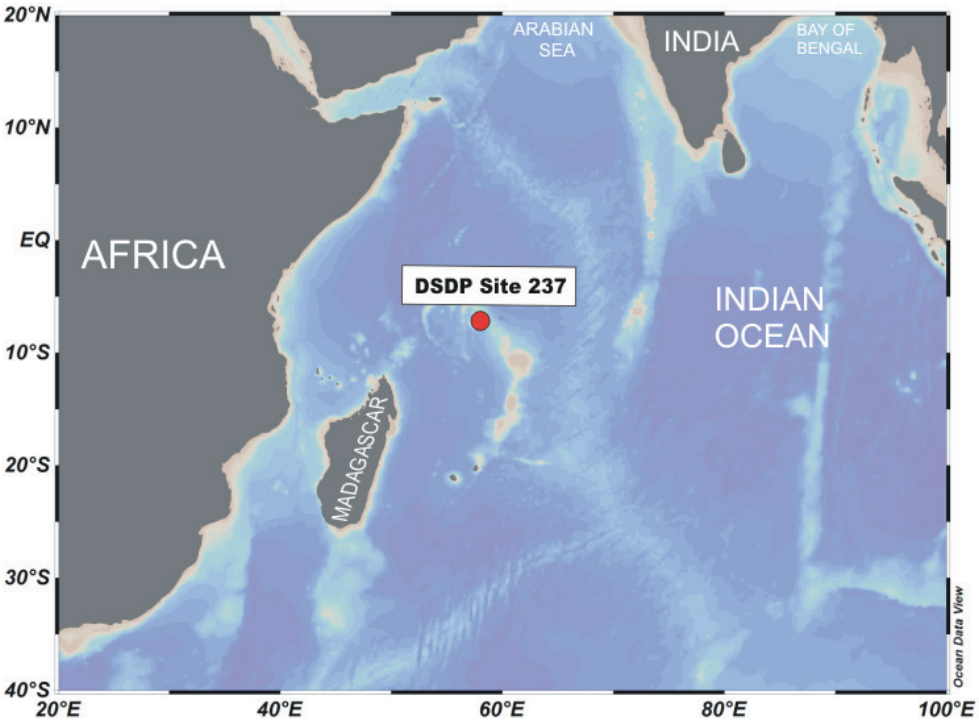


Fig. 1- The location map of the DSDP Site Leg 24 Site 237.

SIGNIFICANT FINDINGS

Palaeoceanographic variations from the western Indian Ocean during the mid-late Miocene: a micropalaeontological and geochemical approach

We analysed marine sediments from DSDP Site 237, from the western equatorial Indian Ocean (Fig. 1), to understand how ocean currents and climate have changed over the last 26 million years. By studying sedimentological parameters- especially the sortable silt—we tracked the strength of bottom currents linked to significant climate events during the Miocene Epoch (23–5.3 million years ago). Our findings show that during warmer periods, like the Mid-Miocene Climatic Optimum (~17–14.7 million years ago), bottom currents were weaker, while cooler periods, especially the Mid-Miocene Climate Transition (~14.7–13.5 million years ago) (Fig. 2), saw stronger currents as Antarctic ice expanded. These shifts reveal that deep ocean circulation became increasingly vigorous over time, influenced by Southern Hemisphere waters. This circulation helped ventilate the deep ocean and likely affected global climate patterns. Our study highlights how sediments in the Indian Ocean serve as valuable recorders of ancient climate and oceanographic changes, helping us understand Earth's climate history. Additionally, the samples were also studied for foraminiferal significance through both the assemblage and isotopic studies. The variation of assemblages and isotopic components clearly shows the signature of hydrological changes due to climatic responses. Further study is on process; once completed, the total climatic changes can be recorded through MCO and MMCT events.

Climate Variability of the Southern Ocean over the Mid-Pleistocene Transition

This study reconstructs deep-water circulation and sedimentary dynamics in the Indian sector of the Southern Ocean over the past 900 kyr, using sortable silt (SS) data from core MD19-3576 from the Del Cano Rise (Fig. 3). Our results highlight clear glacial–interglacial cyclicity, with elevated SS mean size and volume% using glacials indicating intensified Antarctic Bottom Water (AABW) and Antarctic Circumpolar Current (ACC) activity. Interglacial periods are characterised by reduced SS values, reflecting subdued bottom currents and increased Northern Component Water (NCW) influence (Fig. 4). The record captures a significant reorganization of ocean circulation across the Mid-Pleistocene Transition (MPT), marked by a shift toward amplified glacial bottom water export. Comparisons with $\delta^{13}C$ and δD records emphasise the interplay between Southern Ocean ventilation and global climate shifts, underscoring the role of Southern Component Water (SCW) in modulating deep ocean

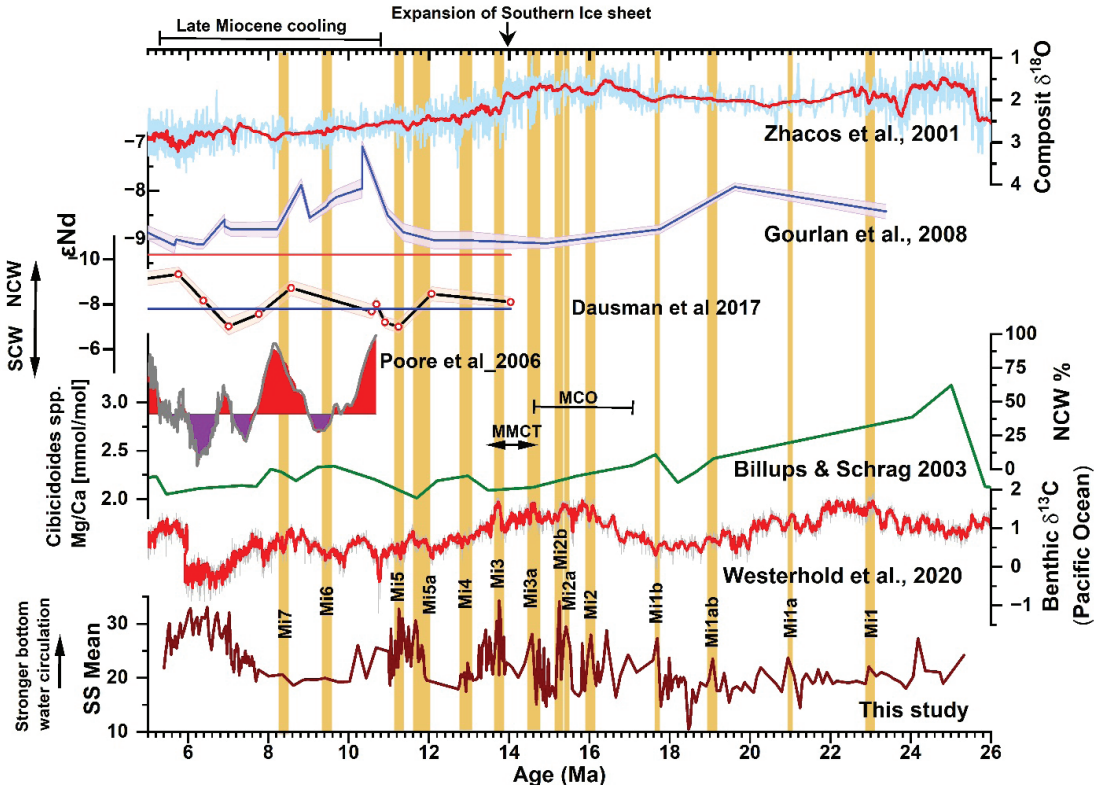


Fig. 2 - The present study from the core DSDP Site Leg 24 Site 237 sortable silt dataset compared with other records to see the coherence of events.

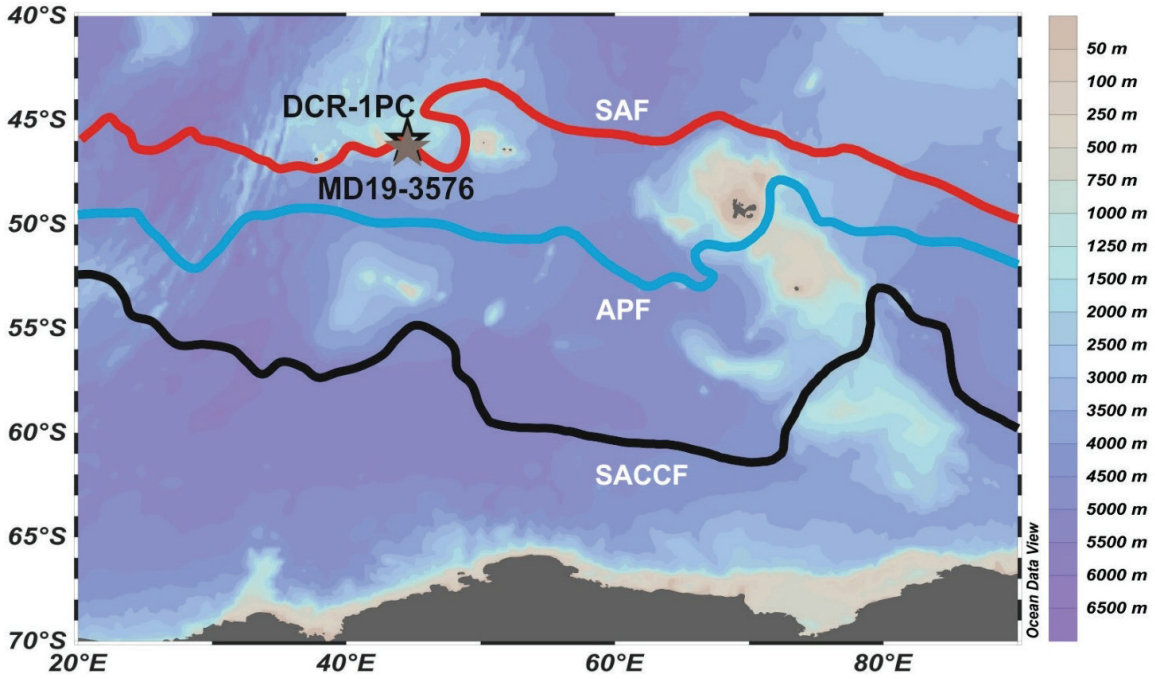


Fig. 3 - The location of the studied cores DCR-1PC (black star) and MD19-3576 (grey star) for the palaeoceanographic records in the Sub-Antarctic zone of the Indian sector of the Southern Ocean. Positions of the Sub-Antarctic Front (SAF—red line), Antarctic Polar Front (APF—blue line), and Southern Antarctic Circumpolar Current Front (SACCF—black line) are shown after Park *et al.* (2019).

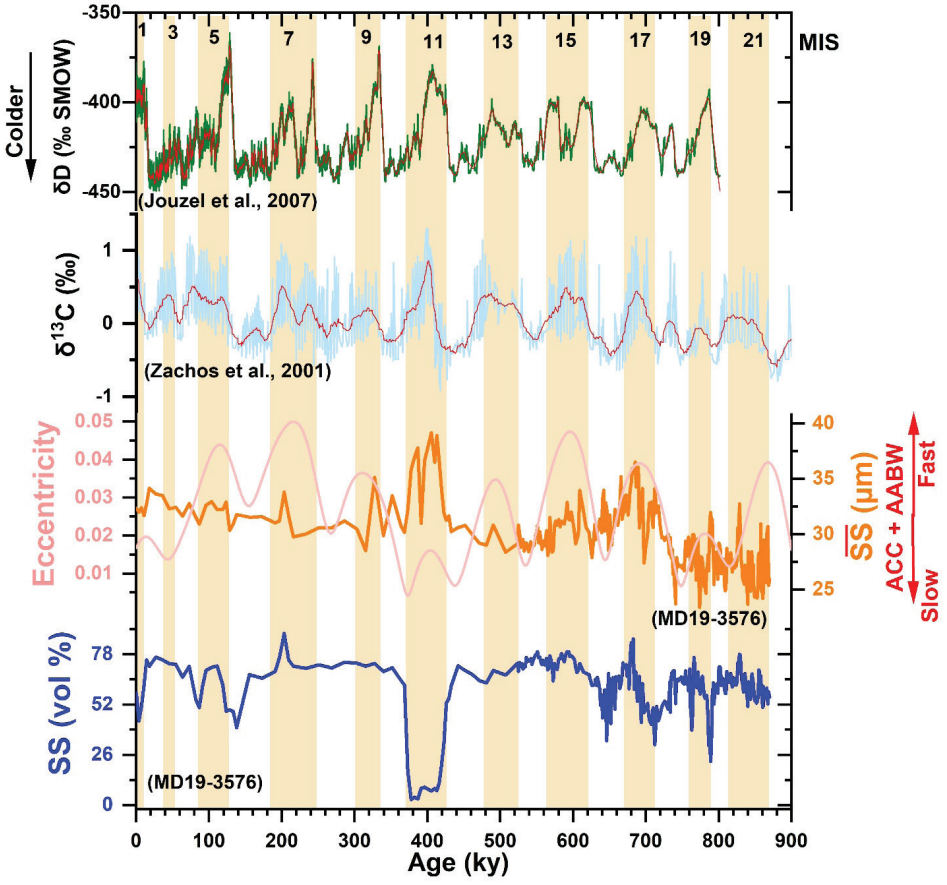


Fig. 4 - Palaeoceanographic proxies from core MD19-3576 over the past 900 kyr, showing sortable silt (SS) variations linked to Antarctic Bottom Water and ACC dynamics, alongside global δD, $\delta^{13}C$, and orbital eccentricity records.

structure. These findings demonstrate the Indian Ocean's sensitivity to Southern Hemisphere climate forcing, providing critical insights into past and future ocean circulation patterns.

The diatom census counts were done using the sediment core MD19-3576, and a total of 50 samples were analysed. The diatom counts show a clear glacial-interglacial pattern in the Sub-Antarctic zone of the Southern Ocean, where diatom productivity was high during the glacial periods, whereas low diatom productivity occurred during the interglacial periods.

Palaeoceanography reconstruction from the western Indian Ocean during the late Quaternary

The present study (Fig. 5) reconstructs long-term mixed layer and thermocline variability in the western Indian Ocean (WIO) during the late Quaternary Period from three marine sediment cores by using planktonic foraminiferal assemblages and stable isotope records ($\delta^{18}O$) from Sites VM29-045PC, 47-PC, and U1475. Our results from VM29-045PC reveal significant glacial-interglacial and suborbital fluctuations linked to monsoon dynamics and ocean circulation. A strong zonal circulation (IEW and IWC)-induced thermocline shoaling occurred, characterised by large $\Delta\delta^{18}O$ gradients and increased thermocline species abundance (Fig. 6). Short-term thermocline shoaling was also evident during glacial terminations. In contrast, periods of weaker zonal circulation (~410–367 ka, ~329–250 ka, and ~82–12 ka) are found in the western equatorial Indian Ocean. The 47-PC core was additionally used to reconstruct the palaeoproductivity, depositional environment, and source of organic matter. The majority of TOC concentration lies between 0.5 % and 1 % in our study area, which indicates that the preservation potential is shallow and degradation is high (Fig. 7). The oxygen-rich intermediate water masses from southern sources are present, which play a significant role in degrading the organic matter through microbial activity, which was indicated by the relatively higher TOC concentration during MIS6 and late MIS3 in our core record (Fig. 7). In another sediment core of U1475, summed percentages of thermocline species with relative abundance of different species as thermocline eutrophic species, mixed layer oligotrophic species (*G. ruber, T. sacculifer* and *O. universa*), mixed layer eutrophic species, relative abundance of *G. bulloides*, and fragmentation index (Fig. 8) shows enhanced productivity during glacial periods (MIS 4 and 2), may likely be attributed to several factors, including the strengthening and equatorward shift of the Southern Hemisphere westerlies, the northward migration

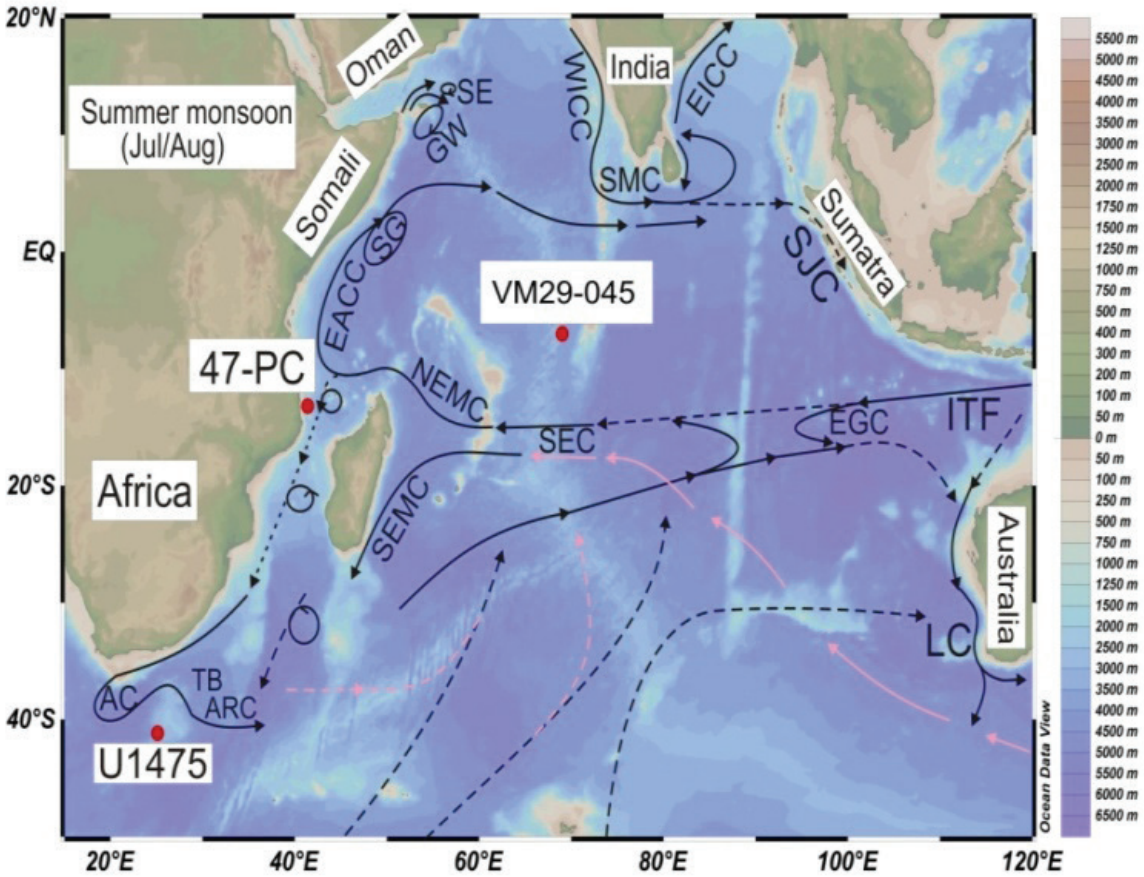


Fig. 5 - The location map of the marine sediment cores VM29-045, 47-PC, and U1475 from the western Indian Ocean.

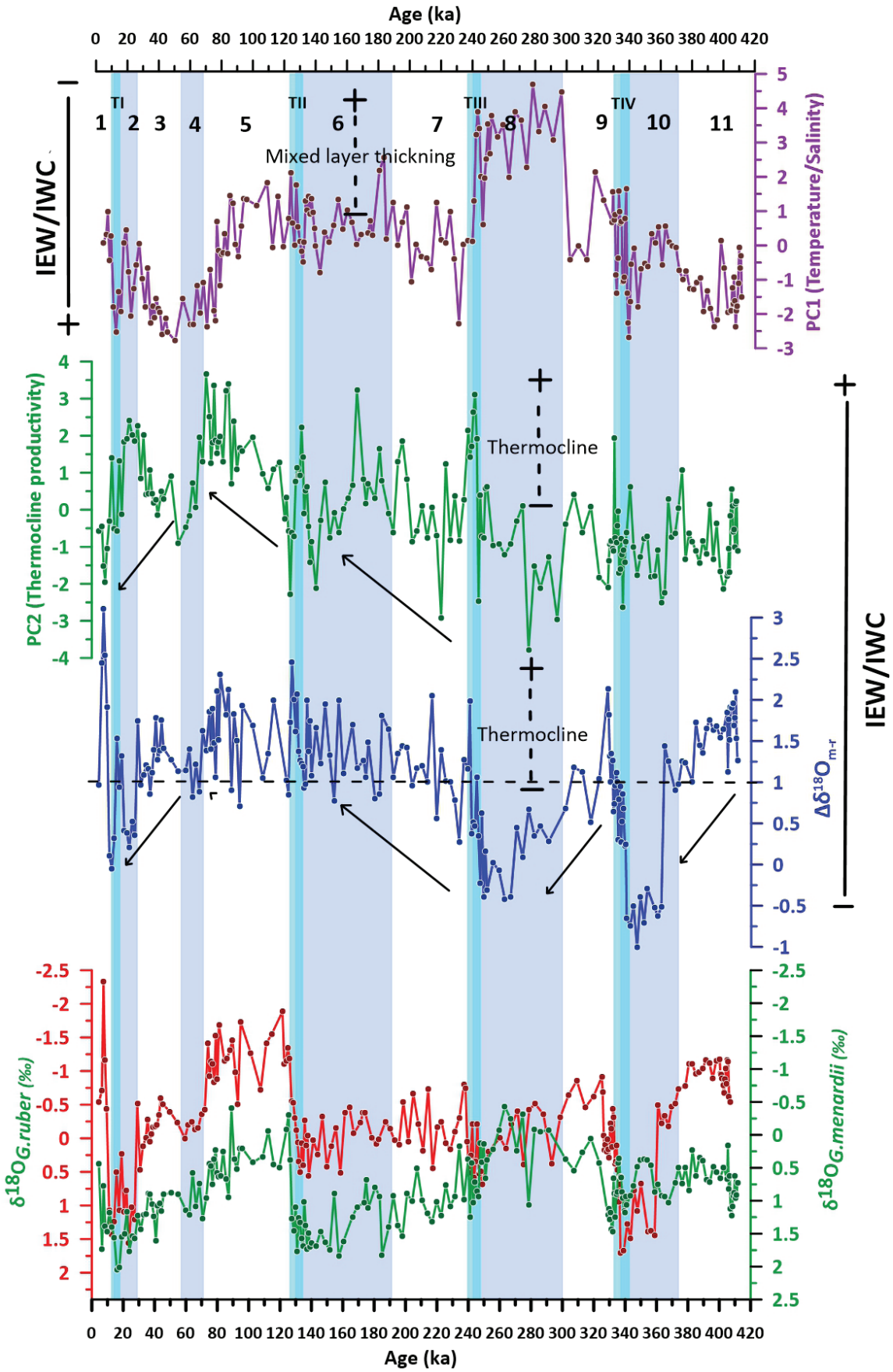


Fig. 6 - Downcore variations of $\delta^{18}O_{G.\ ruber}$ and $\delta^{18}O_{G.\ menardii}$ ($\Delta\delta^{18}O_{m\text{-}r}$) and relative abundance of mixed layer species (MIL%) and thermocline species (TS%) over the past ~412 ka. The red bands represent prolonged important climatic events, and the light and dark brown bands show the glacial cycle and glacial termination points, respectively. The red arrow on a graph represents IEW = Indian Ocean equatorial westerly, IWC Indian Ocean Walker circulation induced thermocline variability.

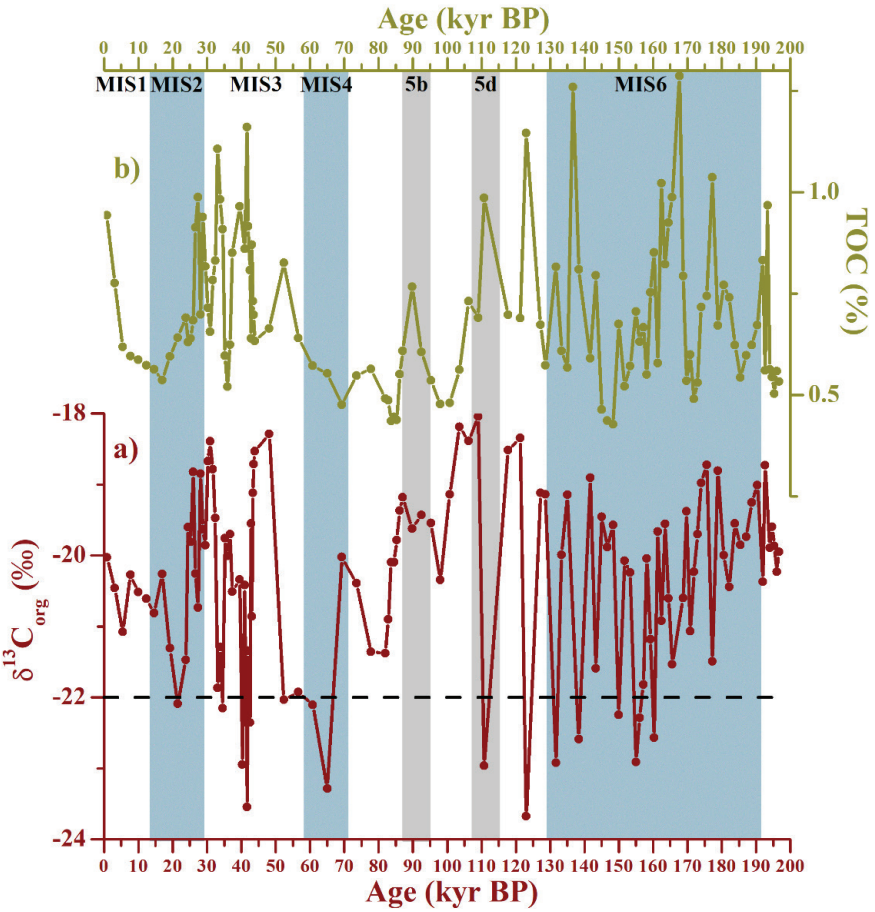


Fig. 7 - Discriminate source of organic matter and palaeoproductivity variation at core site 47-PC over the last ~196.6 kyr BP. (a) $\delta^{13}C_{org}$ variation; (b) TOC content variation. The blue and grey color shows glacial and stadial periods, respectively.

of the STF, the Antarctic Circumpolar Current and its associated fronts, along with the expansion in winter sea-ice extent.

Late Quaternary palaeoclimate reconstruction from the high latitude (polar: Arctic and Antarctica) using multiproxy data

Antarctica: The lacustrine sediment samples core from the shelf area of Larsemann Hills regions, Antarctica, are being studied to reconstruct the palaeoclimatic change during the mid- to late-Holocene. The diatoms throughout the core were studied, and each sample's relative percentage of total marine diatoms was calculated. The CONISS cluster analysis was also performed to strengthen the interpretation (Fig. 9). The data reflected the major Antarctic glacial retreat event ending at ~4 ka BP.

Arctic:

- The Arctic region is currently witnessing an unprecedented rise in temperature, leading to an alarming rate of shrinking sea ice. The published record of climate conditions during the last interglacial (approx. 130-115 ka) infer temperature conditions warmer than today.
- The study of dispersed organic matter and dinoflagellate cysts recovered from the sediments show variation in abundance and diversity (Fig. 10). There is very low occurrence of cysts of *Operculodinium centrocarpum* and higher proportion of land derived dispersed organic matter content. This provides a very significant indication of a weak North Atlantic Current at around 135 ka.
- The benthic foraminifera faunal assemblage provides indication of relatively high sea level conditions along with variations in sea-ice and nutrients. The study provides noteworthy Eemian biostratigraphic record of the High Arctic coastal sedimentary sequence.

SPONSORED PROJECTS (SP)

SP 4.1: **Late Quaternary quantitative climate reconstruction in the Indian sector of the Southern Ocean** (Sponsored by ANRF-SERB CRG Grant, Project No. CRG/2023/003120 w.e.f. 21/05/2024).

Investigators: Sunil Kumar Shukla & Kamlesh Kumar

The study includes the reconstruction of past oceanographic conditions in the Southern Ocean using diatoms. The diatom community composition data demonstrated the dominance of Open-Ocean diatom species over the past 40,000 years. The diatom productivity data demonstrated high diatom productivity during the Glacial Period (40,000 to 18,000 years), whereas low diatom productivity occurred during the deglacial and the early Holocene periods (18,000 to 8,200 years). Such variations in the diatom productivity could be attributed to the frontal migration and associated nutrient supply during the glacial-interglacial periods.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Yoshida K, Manoj MC, Sugiyama H - The Development of the Himalayan rain shadow recorded in the palaeosols of the Indus Group, Ladakh, NW India: Reference to the variation in groundwater table levels influenced by palaeoclimate and sedimentary environments. AGU Fall Meeting. Washington, D.C., USA, December 2024.
2. Prakash P, Srivastava J, Manoj MC, Sathimol AS, Reghunath R, Sharma R - Holocene vegetation-dynamics and sea-level fluctuations in northern Kerala: insights from terrestrial

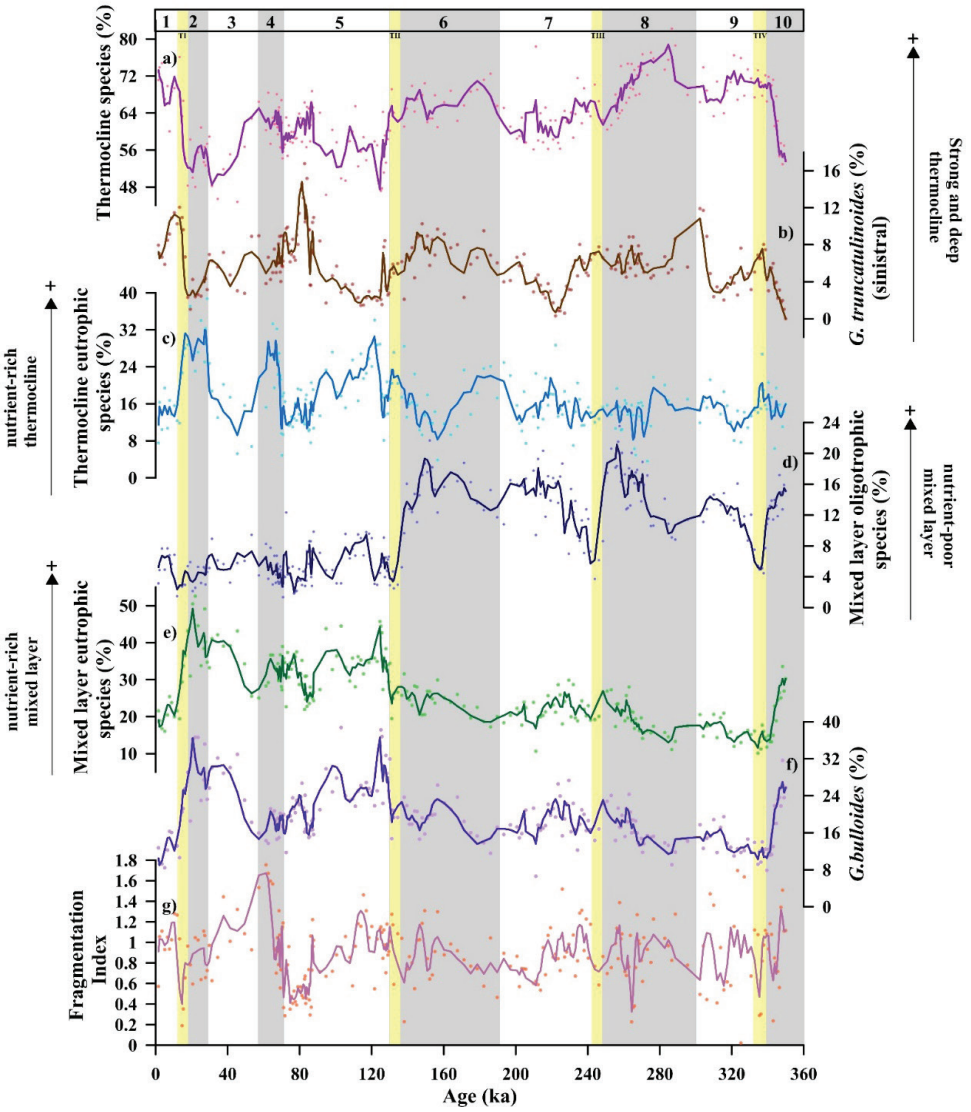


Fig. 8 - (a) Summed percentages of *G. inflata, G. truncatulinoides, N. incompta, G. hirsuta, N. dutertrei, G. scitula,* and *G. crassaformis* make up the thermocline species, (b) relative abundance of *G. truncatulinoides*, (c) *N. incompta* and *N. dutertrei* are grouped as thermocline eutrophic species, (d) mixed layer oligotrophic species (*G. ruber, T. sacculifer* and *O. universa*), (e) mixed layer eutrophic species (*G. bulloides* and *G. glutinata*), (f) relative abundance of *G. bulloides*, and (g) fragmentation index. Vertical grey bars indicate glacial periods, and yellow bars represent the terminations (T). The numbers in the top box correspond to the marine oxygen isotope stages MIS-1 to MIS-10

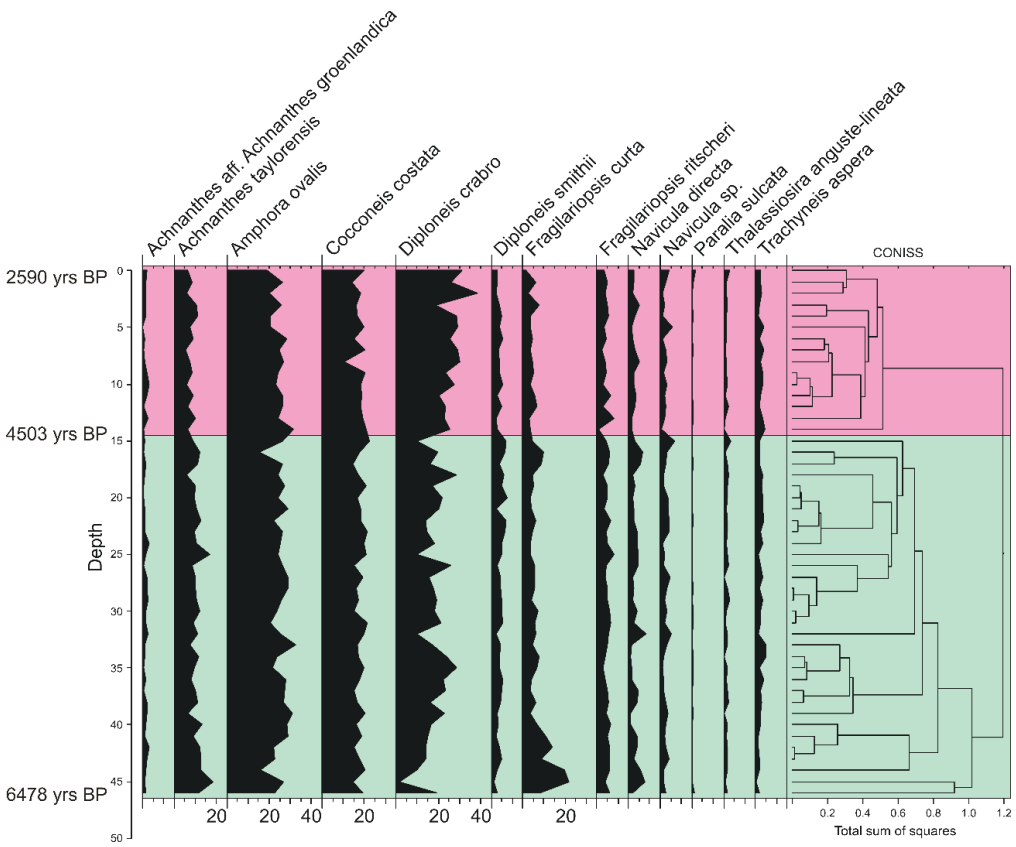


Fig. 9 - CONISS cluster analysis on the sediment core from Larsemann Hills.

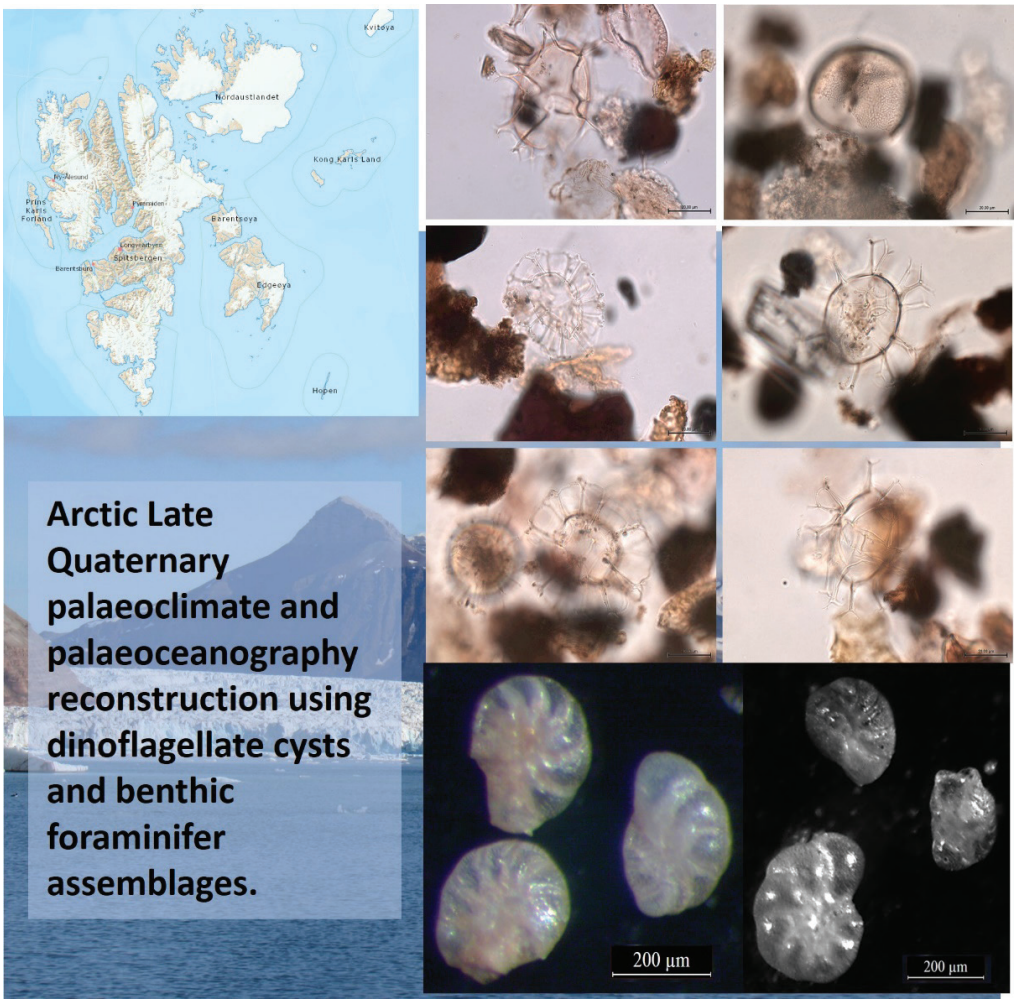


Fig. 10 - Dispersed organic matter and dinoflagellate cysts and benthic foraminiferal species recovered from the sediments.

multiproxy records. 29th Indian Colloquium on Micropalaeontology and Stratigraphy (ICMS), New Delhi, October 2024.

3. Renny A, Kawsar M, Manoj MC, Bikkina S, Thakur B, Kurian J & Mishra R - Decomposing sedimentary signals of monsoon seasonality and oceanic teleconnection in the South-East Arabian Sea during the last 50 ka. Conference of Integrated Earth (CITE) 2024 at Indian Institute of Science Education and Research (IISER), Pune, September 2024.
4. Yamuna AS, Warrier AK, Vyshnav P, Sandeep K, Manoj MC, Joju GS, Sharma R, Balakrishna K & Rao R - Sedimentological and geochemical responses of lake sediments to climate changes in southern India during the Late Holocene. 2nd Indian Quaternary Congress (IQC), Indian Institute of Science Education and Research, Mohali, June 2024.
5. Prakash P, Sathimol AS, Manoj MC, Kawsar M, Srivastava J, Reghunath R & Prasanna K - Preliminary sedimentological, geochemical, and palynological outcomes on the Late Quaternary sediments from Dharmadom, southwest India. 2nd Indian Quaternary Congress (IQC), Indian Institute of Science Education and Research, Mohali. June 2024.
6. Mathew SM, Parmar S, Manoj MC, Sanyal P, Agrawal S, Prasad V & Sharma A - Unveiling the Palaeocene-Eocene Thermal Maximum (PETM) in the western Indian section: A comprehensive investigation through Compound-Specific Carbon Isotope studies. International Conference on Climate Change and Natural Resources Management for Sustainable Development (ICNS-2024) at Mizoram University, March 2024.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Bikkina S & Manoj MC

- Deputed to MoES/NCPOR - Arctic Project Workshop at NCPOR, Goa, National Centre for Polar & Ocean Research, Goa "Tracing Aeolian dust and footprints of forest fires over the Arctic: Observation from Svalbard," during 11-14th March, 2024.
- "Source apportionment of atmospheric/ sedimentary black carbon and organic lipids from Prydz Bay, Antarctica: A molecular-level tracer approach and $^{14}C/^{13}C$-based isotope perspective," MoES/NCPOR-MoES/NCPOR- Antarctic Project Workshop at NCPOR, Goa, National Centre for Polar & Ocean Research, Goa, 29/04/2024 to 04/05/2024.

Shukla SK

- "Vikram Discussion – II (VD-II) on Astrobiology and Astrochemistry Workshop at Physical Research Laboratory, Ahmedabad, 02/01/2025.

TRAINING/STUDY VISITS

Manoj MC

- Pre-Antarctic snow-ice acclimatization training at Indo-Tibetan Border Police (ITBP), Auli. 10-08-2024 to 22/08/2024.
- 44th Indian Scientific Expedition to Antarctica at the Indian research station—Maitri, Antarctica. 06-11-2024 to 20-02-2025.

GUIDED DISSERTATION STUDENTS

Pawan Govil

- Madhu Singh, Chemistry Department, Lucknow University entitled "Processing and inferences of elemental geochemistry from marine sediment core samples" for a duration of 2 months (April-May, 2024).
- Amrita Nigam, Department of Geology, Babasaheb Bhimrao Ambedkar University, Lucknow entitled "Planktic Foraminiferal productivity variations from the Eastern Equatorial Indian Ocean: Palaeoceanographic implication" for a period of 5 months (January-May, 2024).

Vartika Singh

- Anchal Saini, University of Lucknow, Department of Geology entitled "Organic walled microfossils in marine sediments and their application in palaeoceanography" for a period of 3 months (March-May, 2024).

Sunil Kumar Shukla

- Prachi Verma, Chemistry Department, Lucknow University entitled "Basics of Diatoms and mineralogical studies from the Southern Ocean" for a period of 2 months (April-May, 2024).

Abhijit Mazumder

- Shreya Singh, Department of Botany, Lucknow University entitled "Study of diatoms for monitoring the environmental settings of Karamnasa River" for a period of 3 months (April-July, 2024).

Manoj MC

- Devu Vasanthan, Cochin University of Science & Technology (CUSAT), Kerala entitled "Modulations of the deep-water masses during the Middle Pleistocene in the Indian Sector of

PH.D. PROGRAMMES

	**Hidayatullah Khan (2020).** Reconstruction of Palaeoceanography of tropical Indian Ocean since Marine Isotopic Stages 5, under the supervision of **Pawan Govil (BSIP)** and Rajani Panchang (Pune University), registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad: Status: Awarded (2024).
	**Brijesh Kumar (2020).** Late Quaternary palaeoceanographic reconstructions from the Equatorial Indian Ocean: emphasis on Indian Ocean dipole, under the supervision of **Pawan Govil (BSIP)**, registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad. Status: In submission (PTOC-Done).
	**Divya Verma (2020).** High resolution reconstruction of palaeoceanography and paleoclimatology of the south-west Indian Ocean during Late Quaternary, under the supervision of **Pawan Govil (BSIP),** registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad. Status: In progress.
	**Masud Kawsar (2020).** The Bengal Fan evolution through Neogene and Quaternary: Implications for deep ocean circulation, productivity and monsoonal shifts under the supervisor of **Manoj M C. (BSIP)** and Micheal E Weber, registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad. Status: Awarded (2024).
	**Sneha Mary Mathew (2020).** Palaeocene–Eocene records of palaeohydrological and palaeoenvironmental changes from the lignite fields of Rajasthan, India under the supervision of **Manoj M C. (BSIP)** and **Shailesh Agrawal (BSIP)**, registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad. Status: In progress.
	**Aditi Nautiyal (2025).** Late Quaternary diatom productivity and oceanographic changes from the Indian sector of the Southern Ocean, under the supervision of **Sunil Kumar Shukla (BSIP)** registered with Academy of Scientific & Innovative Research AcSIR, Ghaziabad. Status: In Progress.

the Southern Ocean" for a period of 3 months (January-April, 2024).

- Swathy Mohanan K, University of Calicut, Kerala entitled "Middle-Late Pleistocene Palaeoceanographic changes based on the sedimentary records from the Indian Sector of the Southern Ocean" for a period of 3 months May-July, 2024).
- Litty Krishnan GS, University of Calicut, Kerala, entitled "Apportionment of sediment sources using end-member analysis of grain size records from the Southwestern Indian Ocean Since the Late Quaternary" for a period of 3 months (May-July, 2024).
- Firdaus Fatima, University of Lucknow, Lucknow, Uttar Pradesh entitled "Decarbonation Method – A pretreatment method for the determination of organic carbon in the soils and sediments" for a period of 2 months (May-June, 2024).
- Sumedh Vasant Jadhav, Government Institute of Science, Chh. Sambhajinagar entitled "Decomposition of sedimentary Signals from the Western Indian Ocean at Maldives since the Early Miocene" for a period of 2 months (August-September, 2024).
- Muskan Soni, National Post Graduate College, Lucknow, Uttar Pradesh entitled "Fourier Transform Infrared Spectroscopy (FTIRS): A Non-Destructive Approach for Inferring Biogeochemical Properties in the Kawar Wetland in the Central Ganga Plain, India" for aperiod of 1 month (September 2024)
- Ravi Sharma, National Post Graduate College, Lucknow, Uttar Pradesh entitled "Characterisation

of marine sediments by Fourier transform infrared spectroscopy (FTIRS): A case study from the lower Bengal Fan" for a period of 1 month (September 2024)

- Niharika Pal, Isabella Thoburn (IT) College, Lucknow, Uttar Pradesh entitled " Non-destructive biogeochemical xharacterisation of Kanwar Wetland Sediments in the Central Ganga Plain, India using Fourier transform infrared spectroscopy (FTIRS)" or a period of 1 month (August 2024).
- Anubhuti Gupta, Isabella Thoburn (IT) College, Lucknow, Uttar Pradesh entitled "Characterisation of Late Quaternary marine sedimentary composition in the Arabian Sea using Fourier transform Infrared Spectroscopy (FTIRS)" for a period of 1 month (August 2024).
- Muskan Parveen, Isabella Thoburn (IT) College, Lucknow, Uttar Pradesh entitled "Fourier transform infrared spectroscopy (FTIRS) for the characterisation of marine sedimentary composition from the lower Bengal Fan during the Late Miocene to Pliocene" for a period of 1 month (August 2024).

LECTURES DELIVERED

- Pawan Govil, Culture, Institute, and research, the awarded title. MIF Tokyo Meeting, Online from BSIP, 24th September, 2024.

CONSULTANCY/TECHNICAL SUPPORT RENDERED

Pawan Govil

- A number of samples on ICP-MS in the laboratory have been analysed. Samples are largely of soil and sediments collected from terrestrial realms, including glaciers, fluvial, and lacustrine environments. Besides routinely used international standard protocols, efforts are made to develop protocols for tough samples. The facility receives samples from different parts of the country on a consultancy basis. We have generated approximately Rs. 7,79,852/- through the Consultancy. Besides Consultancy, In-House project samples were also analysed and provided the data to the concerned lab/scientist.

Manoj MC

- A number of samples on the Laser Particle Size Analyser (LPSA) in the laboratory have been analysed. The facility receives samples from different parts of the country on a consultancy basis. We have generated approximately Rs. 1,16,820/- through the Consultancy. Besides Consultancy, In-House project samples were also analysed and provided the data to the concerned lab/scientist.

ACCOLADES RECEIVED

Pawan Govil

- Received an International Fellowship from The Matsumae International Foundation Fellowship of Japan from 1st November, 2024 to 30th April, 2025 (six months) at JAMSTEC and AORI, University of Tokyo, Japan.

REPRESENTATION IN COMMITTEES/ BOARD

Pawan Govil

- Secretary - "The Palaeobotanical Society, India" from 2022 to the present.
- Member of PhD Doctoral Advisory Committee (DAC) and Comprehensive Examination for the AcSIR students (Mr. Arif Ansari, Mr. Masud Kawsar, Mr. Guru Sewak and Mr. Katange).

Vartika Singh

- Scientific Reviewer for the International Climate Literacy and Energy Awareness Network (CLEAN), funded by the National Science Foundation (NSF) and National Oceanic & Atmospheric Administration (NOAA), USA.
- Reviewer of International Arctic Science Committee (IASC) fellowship applications.
- Professional Member of The Geological Society of America (GSA), Boulder, Colorado, USA.

Project 5: Biological and Biogeochemical changes during Late-Quaternary from Coastal regions of India: Insights into Coastal Dynamics and Monsoonal Variability

Coordinator: Biswajeet Thakur (Scientist E)
Co-Coordinator: Shilpa Pandey (Scientist E)

OBJECTIVES

- *To assess palaeoproductivity, palaeovegetation and relative sea-level changes using biotic– abiotic interactions.*
- *To assess variability in governing factor(s) for SW & NE monsoonal strength and coastal ecology.*
- *To evaluate relative roles of continental versus marine factors in governing climatic cycles/ transitional periods.*
- *To delineate controls of climate-tectonic forces on fluvio-marine processes with respect to sea level fluctuations/changes in palaeogulf settings.*

PREAMBLE

The Coastal Project was initiated to investigate the complex biogeochemical interactions among the biosphere, atmosphere, and hydrosphere. Coastal sediments act as vital archives, preserving records of regional and global climate dynamics. In recent decades, both inland and coastal aquatic systems have undergone significant degradation due to rapid industrialisation, urban expansion, and population growth. Climate variability, increased rainfall intensity, and human-induced pressures are reshaping coastal ecologies. Sediments, in turn offer critical evidence of ecological transformations, including changes in carbon sequestration and sea-level fluctuations. Essential elements—Carbon (C), Nitrogen (N), Sulfur (S), and Phosphorus (P)—serve as key indicators of biogenic

(L to R): P. Morthekai, Sanjay Kumar Singh Gahlaud, Niteshkumar Khonde, Biswajeet Thakur, Abhijit Mazumder, Shilpa Pandey, Srinivas Bikkina, Gurusewak Singh, Jinamoni Saikia, Anand Rajoriya, Kishor Katange

productivity and ecosystem health. Understanding the natural and anthropogenic influences on the biogeochemical cycles of these elements is crucial for environmental risk assessment, scenario modelling, and climate change mitigation strategies. The integration of stable isotopes ($\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$) with biological proxies, such as pollen, diatoms, palynofacies, and phytoliths provides robust evidence of past ecological conditions, enriching our knowledge of historical geochemical and biodiversity shifts. By combining these proxies, the project aims to decode both modern and ancient sedimentary records, offering critical insights into the ongoing degradation of wetlands and coastal margins. This research serves as a foundational step toward sustainable management and climate resilience in vulnerable coastal ecosystems.

PERSONNEL INVOLVED

Team Members: P. Morthekai (Scientist D), Niteshkumar Khonde (Scientist D), Sanjay Kr Singh Gahlaud (Scientist B)

Associate Members: Srinivas Bikkina (Scientist F), Abhijit Mazumder (Scientist E), Arif H. Ansari (Scientist D)

Research Scholars: Anand Rajoriya, Vartika Singh, Sangram Sahoo, Kishor V Katange, Gursewak Singh, Vinay K Tiwari, Jinamoni Saikia

SIGNIFICANT FINDINGS

Marine incursion in the GRK (Mid-Holocene)

A ~4 m trench near Nada Bet (NE Great Rann of Kachchh) reveals fine sediment dominance (>85%), increased sand content around ~6 ka B.P., and marine indicators (foraminifera, TOC/TN ~11, $\delta^{13}C_{org}$ ~–21.3‰), suggesting a mid-Holocene marine incursion (Figs 1, 2). This implies past connectivity between the Great Rann, Little Rann, and the Arabian Sea.

Kerala wetland insights (Little Ice Age)

A 70 cm core from Ashtamudi wetland (Kerala) shows high TOC%, enriched $\delta^{13}C$, and diverse diatoms, indicating intense agriculture, terrestrial runoff, and atmospheric CO_2 levels during the Little Ice Age. Later marine influence and cooling (~1°C) correspond to reduced solar insolation and a southward ITCZ shift.

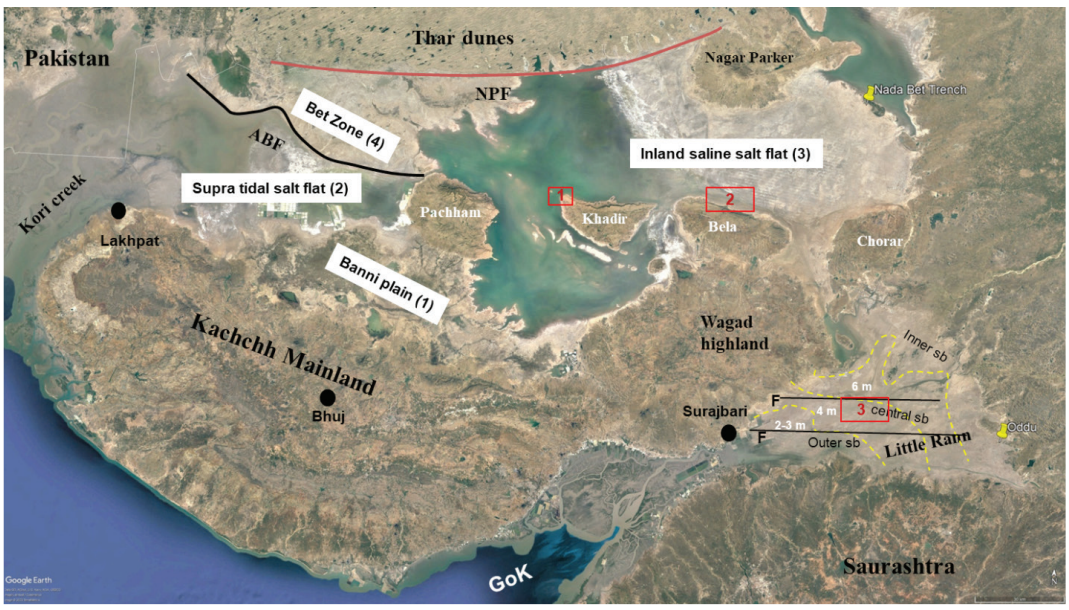
Roman Warm Period Signals

Arookutty core data from Kerala's southwest coast records monsoonal variability, sea-level changes, and elevated primary productivity during the Roman Warm Period.

Reconstruction of historical mangrove ecosystems

Pollen analysis was conducted on 50 surface samples and one sediment core collected from the Puri and Kendrapada districts of Odisha to evaluate the spatial, qualitative, and quantitative fidelity of pollen assemblages. The aim was to enhance the accuracy of reconstructing historical mangrove ecosystems.

The findings indicate that both biological and physical taphonomic processes can introduce biases that may lead to misinterpretation of the pollen record. Forest sediments were dominated by autochthonous pollen from true mangrove species, highlighting their reliability as indicators of mangrove environments. In contrast, the occasional presence of allochthonous and parautochthonous



Box 1: Raised marine sequence (Khadir Island), Box 2: Tidal notches and sea caves (Bela island), Box 3: Tidal notches and sea caves (central Little Rann of Kachchh basin)

Fig. 1 - Location map of the Great Rann of Kachchh for multiproxy study.

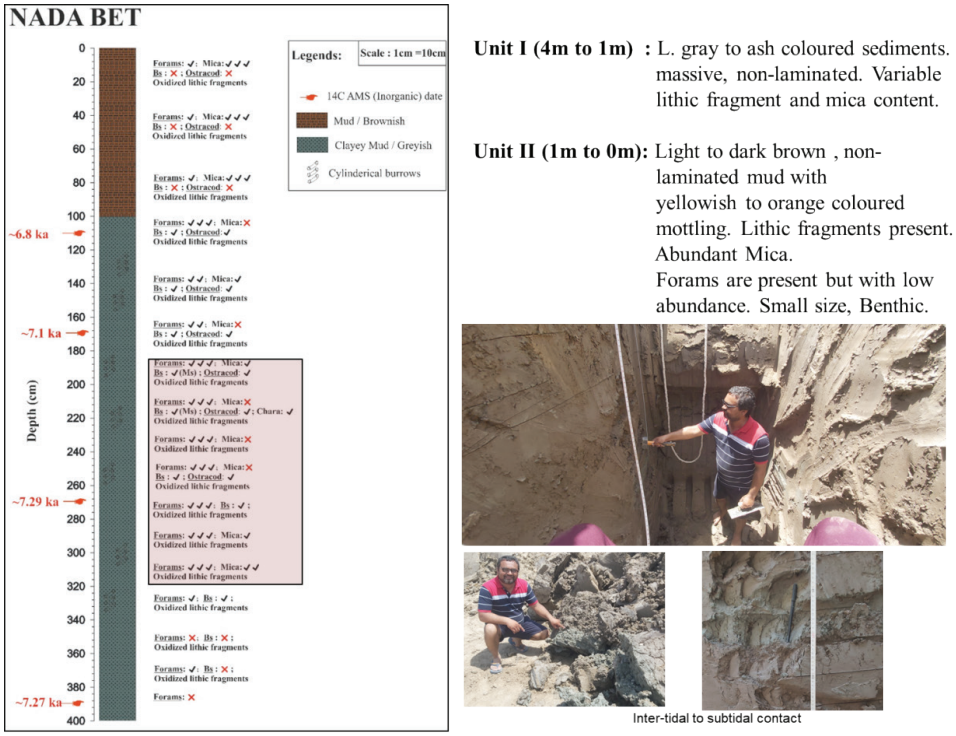


Fig. 2 - Core profile of Nada Bet for multi proxy study from Great Rann of Kachchh.

palynomorphs in low quantities suggests input from regional vegetation beyond the immediate mangrove zone.

Strong correlations were observed between the pollen and vegetation of species, such as *Bruguiera*, *Rhizophora mucronata*, *R. apiculata*, and *Sonneratia alba*. However, the spatial representation of pollen from *Avicennia officinalis*, *Aegiceras corniculatum*, *Ceriops tagal*, *Xylocarpus* spp., and *Phoenix paludosa* was less reliable.

The sediment core data indicate that mangrove forests have been gradually advancing seaward over time, maintaining a zonation pattern. A noticeable decline in *R. apiculata* pollen in the upper layers of all sediment cores suggests a recent reduction in its population, possibly due to logging activities. Radiocarbon dating results of the sub-surface samples are still pending.

SPONSORED PROJECT (SP)

SP 5.1: **Holocene land-sea interactions and palaeoenvironmental changes in the Great Rann of Kachchh Basin, western India** (Sponsored by SERB under Core Research Grant, New Delhi; Project No: SERB/2022/008845).

Principal Investigator: Niteshkumar Khonde (BSIP, Lucknow)

Surface sediment analysis from the eastern Great Rann of Kachchh (GRK) basin reveals distinct environmental characteristics. Munsell colour coding of 109 samples identified dominant shades such as dark greyish brown (10YR 4/2), dark grey (2.5Y 4/2), and very dark grey (5YR 3/1). Environmental parameters showed alkaline conditions (pH ~8) and variable salinity—higher (~18 ppt) in salt flats and lower (~5 ppt) near river mouths. Grain size analysis indicated depositional energy shifts across transects. Coarser sandy silts and silty sands dominated the margins, while finer mud fractions—silty clays and clayey silts—prevailed across most of the basin.

SP 5.2: **Utilizing biotic and isotopic signatures to investigate palaeoproductivity, palaeolimnology and relative sea-level change in the Kerala Coastal region, India during the Holocene Period** (Sponsored by ANRF under EEQ Project file No. EEQ/2023/000322).

Principal Investigator: Biswajeet Thakur (BSIP, Lucknow)

Grab sediment samples and two sediment cores were collected from various locations across Kerala to investigate depositional environments. The surface samples represent the topmost sediment layer, while the cores, subsampled at 1 cm intervals, offer high-resolution data on long-term deposition. Collection sites span diverse settings—from coastal and urban areas like Ernakulam and Alappuzha to upland regions such as Munnar—ensuring broad geographic coverage. The sediments are being

analysed for diatom assemblages, palynofacies (including pollen and spores), sediment texture, and stable isotopes of carbon, nitrogen, and sulfur. These proxies will help reconstruct Kerala's environmental and climatic history during the Holocene. The study aims to elucidate changes in water quality, vegetation, sediment dynamics, and biogeochemical processes, providing insights into climate variability, sea-level fluctuations, and human impacts on the region's landscape. This integrated approach will enhance understanding of Kerala's complex environmental evolution.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Saikia J, Thakur B, Singh G, Katange K, Agrawal S, Quamar F & Khonde N - Mid-Holocene high sea-level stand recorded in the Little Rann of Kachchh (LRK) Basin, western India: A microfossil approach. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 77.
2. Singh G, Katange K, Khonde N, Saikia J, Bhushan R, Jena PS & Dabhi A - Foraminiferal and sedimentological investigations of Bet Zone of Great Rann of Kachchh sediments: Implications for mid-late Holocene relative sea-level fluctuations. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 71.
3. Saikia J, Singh G, Katange K, Thakur B, Agrawal S, Quamar F, Kumar P, Sharma R & Khonde N - Mid-Holocene high sea-level signatures in the Little Rann of Kachchh (LRK) Basin, western India. Conference on Integrated Earth (CITE)-2024 held between September 1-2, 2024, Organised by Earth and Climate Sciences, IISER Pune. Abstract: 191.
4. Khonde N, Saikia J, Singh G, Katange K, Agnihotri R & Bhushan R - Holocene Sea-level fluctuations and land-marine distribution changes in the Great and Little Rann of Kachchh Basin, western India. Conference on Integrated Earth (CITE)-2024 held between September 1-2, 2024, Organised by Earth and Climate Sciences, IISER Pune. Abstract: 154.
5. Saikia J, Singh G, Katange K, Agrawal S, Quamar F, Kumar P, Sharma R & Khonde N - Palaeoenvironmental reconstruction and land-marine interaction phases in the Eastern Great Rann of Kachchh Basin: Insights from a 4-meter trench at Nada Bet. 2nd Indian Quaternary Congress (IQC): Quaternary Sciences for a Sustainable Future Earth (Q-SAFE), hosted by Association of Quaternary Researchers (AOQR) and organised at IISER Mohali between June 3-5, 2024.
6. Tiwari P, Thakur B, Srivastava P, Gahlaud SKS, Bhusan R & Agnihotri R - Late Holocene environmental changes and human impact in the Vembanad wetland: a palaeolimnological study from a Ramsar Site in Kerala, India. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 130.
7. Thakur B, Tiwari P, Srivastava P, Gahlaud SKS, Bose T, Kumar A, Bhushan R & Agnihotri R - Assessing the synchrony of the little ice age with equatorial tropical climate: a multi proxy study from the Southwest Coast of India. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 45.
8. Quamar MF, Banerji US, Thakur B & Kar R - An overview of the pollen-based hydroclimatic changes since the last glacial maximum from the Core Monsoon Zone of India. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 102.
9. Prasad N, Quamar MF, Maneesha M. ET, Tiwari P, Thakur B, Sharma A, Phartiyal B & Javed M - Weakening of the Indian Summer Monsoon at 8.2 kyr bp: Vegetation dynamics and hydroclimatic changes in the core monsoon zone of India. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 115.
10. Ali N, Tiwari P, Saxena S, Thakur B & Sharma A - Decoding past environments of Bakhira wetland using palynofacies: A case study from a Ramsar Site in Sant Kabir Nagar, India. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology, University of Delhi. Abstract: 117.
11. Saxena S, Tiwari P, Ali N, Thakur B & Sharma A - Depositional environment reconstruction of Kanwar Lake in the Central Ganga Plain, India incorporating palynofacies and sediment texture. 29th Indian Colloquium on Micropalaeontology and Stratigraphy held during October 17-19, 2024, organised by Department of Geology,

University of Delhi. Abstract: 174.

12. Tripathi S, Pandey A, Basumatary SK, Khan S, Singh H, Thakur B & Sharma A - Hydroclimatic variability and vegetation response in the Indo-Burma region over the past four millennia: A multiproxy assessment from Majuli Island (world's largest river island), northeast India. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 91.
13. Saxena S, Tiwari P, Ali N, Thakur B & Sharma A - Depositional environment reconstruction of Kanwar Lake in the Central Ganga Plain, India using Grain Size Analysis. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 138.
14. Tiwari P, Thakur B, Manoj MC & Mazumder A - Palaeolimnological Insights into the Vembanad Wetland, Kerala, India: Analysing sediment texture for environmental reconstruction. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 139.
15. Renny A, Kawsar M, Manoj MC, Bikkina S, Thakur B, Kurian JP & Mishra R - Glacial-Interglacial variability of the monsoon system and intermediate water circulation in the South-East Arabian Sea during the last 200 ka. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 141.
16. Ali N, Kawsar M, Ikram M, Ali S, Thakur B, Manoj MC, Phartiyal B & Sharma A - Holocene variability of hydroclimatic conditions recorded in the high-resolution sediment textural and mineral magnetic parameters in Bakhira wetland, Central Ganga Plain, India. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 146.
17. Rajoriya A, Thakur B, Singh AK, Gahlaud SKS, Farooqui A, Pandey S & Agnihotri R - Sediment dynamics in coastal ecosystem unravelled by biogeochemical and sedimentological investigation. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 148.
18. Pandey A, Tripathi S, Singh H & Thakur B - Vegetation vis-à-vis climatic alterations during Mid-Late-Holocene in Garamur wetland of Majuli Island, northeast India: A multiproxy assessment. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 150.
19. Prasad N, Quamar MF, Maneesha M. ET, Tiwari P, Thakur B, Sharma A, Phartiyal B & Javed M - Vegetation dynamics and its response to climate change during the past 3.5 k in the central Indian Core Monsoon Zone, evidenced by pollen proxy. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 153.
20. Gahlaud SKS, Agnihotri R, Pandey B, Singh A, Pathak DB, Rahi IC & Kurian S - Record of the Oceanic Anoxic Event in the Upper Jurassic sedimentary successions of the Spiti Himalaya (India) and its implications to palaeo-redox environments. 3rd Frontiers in Geosciences Research Conference, organised by the Physical Research Laboratory, Ahmedabad, during 5 –7 February 2025. Abstract: BGC-P/13.

21. Rajoriya A, Thakur B, Bikkina S, Singh AK, Gahlaud SKS & Agnihotri R - Unravelling the lake history from Central Ganga Plain (CGP): Insights from Biogeochemical records. 3rd Frontiers in Geosciences Research Conference, organised by the Physical Research Laboratory, Ahmedabad, during 5 –7 February 2025. Abstract: CLM-P/02.
22. Rajoriya A, Gahlaud SKS, Bikkina S, Kumar SS, Thakur B, Pandey S, Singh AK, Farooqui A & Agnihotri R - Multiproxy study from the Cauvery River coastal plain (India): biogeochemical evidence for anoxic event during Holocene. Indian Quaternary Congress (IQC) organised by IISER Mohali and Association of Quaternary Researchers (AOQR) during 3-5 June 2024.
23. Rajoriya A, Thakur B, Singh AK, Gahlaud SKS, Farooqui A, Pandey S & Agnihotri R - Sediment dynamics in coastal ecosystem unravelled by biogeochemical and sedimentological investigation. 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research held during December 11-13, 2024. Organised by Birbal Sahni Institute of Palaeosciences, Lucknow. Abstract: 153.
24. Rajoriya A, Thakur B, Bikkina S, Pandey S, Farooqui A & Gahlaud SKS - Late Holocene geochemical and environmental changes inferred from multiproxy investigation in sediments from Khondagai Lake, Tamil Nadu, India. GEM_2025 (Geology: Emerging Methods and applications) organised by Christ Autonomous College, Irinjalukuda, Thrissur, Kerala, during January 28-30th of January 2025.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Shilpa Pandey

- Deputed to attend CPGG Meeting with Eco-Tourism Board, Madhya Pradesh in Dhar, Indore during July 15-20, 2024.
- Nominated by the Department of Tourism, Government of Uttar Pradesh to attend 46th Session of the World Heritage Committee at the Bharat Mandapam International Exhibition and Convention Centre, New Delhi, India during July 21-31, 2024.
- Deputed to attend three-day National Seminar on 'Museum for 2047: Envisioning the Indian Museums' during September 20-22, 2024 at Allahabad Museum, Prayagraj, Uttar Pradesh.
- Deputed to attend India International Science Festival (IISF) held in Guwahati during 30 November to 03 December, 2024.
- Deputed to attend National Conference and Mega Expo STREE 2024 at Maulana Azad National Institute of Technology, Bhopal during December 6-8, 2024 focused on empowering women in Science, Technology, Research, and Entrepreneurship. Also chaired technical session on "Success Stories by Women Leaders in S & T and Technocrats" on December 7, 2024.

Jinamoni Saikia, Gursewak Singh, Pooja Tiwari, Nazakat Ali, Shivansh Saxena & Biswajeet Thakur

- Deputed to attend and participate in the 29th Indian Colloquium on Micropalaeontology and Stratigraphy organised by Department of Geology, University of Delhi during 17-19th October 2024.

Jinamoni Saikia & Niteshkumar Khonde

- Deputed to attend and participate in the Conference on Integrated Earth (CITE)-2024 organised by Earth and Climate Sciences, IISER Pune between 1-2 September 2024.

Jinamoni Saikia & Kishor Katange

- Deputed to attend and participate in the 2nd Indian Quaternary Congress (IQC): Quaternary Sciences for A Sustainable Future Earth (Q-SAFE), hosted by Association of Quaternary Researchers (AOQR) and organised at IISER Mohali between 3-5 June 2024.

Biswajeet Thakur, Shilpa Pandey, Shivansh Saxena, Nazakat Ali, Anand Rajoriya & Sanjay K.S. Gahlaud

- Deputed to attend and participate in the 40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research organised by Birbal Sahni Institute of Palaeosciences, Lucknow during December 11th-13th, 2024.

Sanjay K.S. Gahlaud & Anand Rajoriya

- Deputed to attend and participate in the 3rd Frontiers in Geosciences Research Conference, organised by the Physical Research Laboratory, Ahmedabad, during February 5–7, 2025.

TRAINING/ STUDY VISITS

Shilpa Pandey

- As Chief Vigilance Officer (part-time CVO-BSIP) attended Training Programme on Administrative

PH.D. PROGRAMMES

	**Sanjay Kumar Singh Gahlaud (2024).** Geochemical and stable isotopic characterisation of sediments from Arabian Sea: Implications to Nitrogen and Sulfur biogeochemical cycling of Late Pleistocene – Holocene, under the supervision of **Srinivas Bikina (BSIP)** registered with the AcSIR, Ghaziabad. Status: In-progress.
	**Nazakat Ali (2021).** Weathering processes, provenance character and climatic manifestations during the late Quaternary from Central Ganga Plain, India, under the supervision of **Biswajeet Thakur (BSIP)** registered with AcSIR, Ghaziabad. Status: In-progress.
	**Kishor V Katange (2020).** Geochemical and isotopic investigations on the high-frequency sedimentation in the Great Rann of Kachchh Basin, western India, under the supervision of **Niteshkumar Khonde (BSIP)** registered with AcSIR, Ghaziabad. Status: In-progress.
	**Gursewak Singh (2021).** Palaeoclimatic and palaeoenvironment studies on coastal sediments from western continental margin of India, under the supervision of **Niteshkumar Khonde (BSIP)** registered with AcSIR, Ghaziabad. Status: In-progress.
	**Vartika Singh (2022).** Holocene palaeoclimate and relative sea-level changes of the Mahanadi Delta: A multiproxy approach (tentative), under the supervision of **Shilpa Pandey (BSIP)** & Komal Verma (BHU, Varanasi) registered with Banaras Hindu University, Varanasi. Status: In-Progress.
	**Shivansh Saxena (2022).** Limnology and sedimentary organic matter characterisation from Central Ganga Plain and Core Monsoon Zone of India during the late Quaternary, under the supervision of **Biswajeet Thakur (BSIP)** registered with AcSIR, Ghaziabad. Status: In-progress.
	**Vinay K Tiwari (2022).** Assessment of climate and human impact on Bakhira Bird Sanctuary, a Ramsar Site of Uttar Pradesh, under the supervision of **Shilpa Pandey (BSIP)** & Sunita Verma (Department of Botany, Christ Church College, Kanpur) registered with Kanpur University, Kanpur. Status: In-progress.
	**Alka Rani (2022).** Melissopalynological analysis of natural honeys from forests of Uttar Pradesh, under the supervision of **Shilpa Pandey (BSIP)** & Sunita Verma (Department of Botany, Christ Church College, Kanpur) registered with Kanpur University, Kanpur. Status: In-progress.
	**Jinamoni Saikia (2023).** Mid-late Holocene land-marine interaction changes in the Little and Great Rann of Kachchh Basin, western India, under the supervision of **Niteshkumar Khonde (BSIP)** registered with AcSIR, Ghaziabad. Status: In-progress.
	**Sangram Sahoo (2023).** Mangroves development and dynamics in the Sundarbans, East Coast of India since mid-Holocene: Unravelling short-term impacts and long-term drivers, under the supervision of **Shilpa Pandey (BSIP)** registered with AcSIR, Ghaziabad. Status: In-progress.

Vigilance at Indian National Science Academy (INSA), New Delhi during July 31 to August 02, 2024.

- Fieldwork was conducted in coastal sites, Museums of Gujarat for establishing BSIP-Museum and Geoheritage Sites under CPGG during November 08-17, 2024.

LECTURES DELIVERED

Niteshkumar Khonde

- Holocene Landscape Dynamics and Sea-level fluctuations in the Great Rann of Kachchh Basin, western India. Refresher Course in Geography & Environmental Studies. Human Resource Development Centre, Jamia Millia Islamia University, Delhi. February 11, 2025.
- Geological processes in the Great Rann of Kachchh Basin during the Holocene. Geologist Day-2024. Department of Earth and Planetary Sciences, V.B.S. Purvanchal University, Jaunpur. April 6, 2024.

Biswajeet Thakur

- Aspects of Remote Sensing and GIS in

Archaeological Sciences. Masters and Refresher Course in Archaeology, Noida. April 22– 24, 2024.
- Remote Sensing and GIS. Babasaheb Bhimrao Ambedkar University, Lucknow. April 9, 2024.

CONSULTANCY/TECHNICAL SUPPORT RENDERED

Shilpa Pandey

- As the Convener of Outreach Activities organised Brainstorming Workshop on "Patenting your Innovations" at the BSIP, Lucknow on April 12, 2024.
- As the Convener of Outreach Activities organised various activities on World Environment Day on Land restoration, Desertification and Drought Resilience on June 5, 2024 at the BSIP and adjoining areas of Lucknow.
- As Convener Organised Brainstorming Workshop on "Museum exhibits for BSIP Museum of Palaeosciences" during August 28-29, 2024 at the BSIP, Lucknow.
- As Convener of Outreach Committee at BSIP, organised a symposium on *"Women in Science, Technology, and Innovations: Role Models in Transforming Challenges into Innovative Solutions"* in collaboration with Shakti, Awadh Prant, on 4th October 2024.
- As Chief Vigilance Officer (part-time CVO-BSIP) organised various activities like Theatre Play on "Anti-Corruption"; Integrity Pledge for Citizens; Outreach & Awareness Programs-Gram Sabha/Gram Panchayat in different Tehsil of Lucknow; Competitions on "Corruption Free: Vikshit Bharat"; Outreach & Vigilance Awareness Programs in PG/UG Colleges under Vigilance Campaign on Preventive Vigilance measures and Vigilance Awareness Week (VAW), 2024 from October 25, 2024 to November 21, 2024.
- Invited as Chief Vigilance Officer (part-time CVO-BSIP) at Plenary Hall, Vigyan Bhawan New Delhi to participate Vigilance Awareness Week-2024 in gracious presence of Honourable President of India on November 8, 2024.
- As the part-time Chief Vigilance Officer (CVO) of BSIP organised a One-Day Workshop on *"Anti-Corruption and Vigilance Matters"* on January 13, 2025. The event was graced by Shri Rajiv Verma, Consultant and former Director of the Central Vigilance Commission, New Delhi, who delivered the keynote address.
- As the Convener of Outreach Activities at BSIP, organised the 8th Dr. K.R. Surange Memorial Lecture on February 6, 2025. The lecture, titled *"Internal Immunity: Learnings from Plants"*, was delivered by Prof. Ajit Kumar Shasany, Director of CSIR–National Botanical Research Institute, Lucknow.
- As Convener of Outreach Committee at BSIP organised National Science Day on February 28, 2025 titled "Empowering Indian Youth for Global Leadership in Science and Innovation for Viksit Bharat"

Summer Internship imparted to Students:

- Mr Aditya Kumar (M.Sc.) Department of Chemistry, University of Lucknow, Lucknow (July, 2024).
- Ms Arpita Vini Gautam (M.Sc.) Environmental Sciences, Department of Botany, University of Lucknow, Lucknow (August, 2024).
- Mr Ramakant Chaudhary (M.Sc.) Environmental Sciences, Department of Botany, University of Lucknow, Lucknow (August, 2024).
- Ms Aakriti Singh, (M.Sc.) Department of Botany, University of Lucknow, Lucknow (September, 2024).

ACCOLADES RECEIVED

Shilpa Pandey

- Appointed as Chief Vigilance Officer (Part-time) of the Birbal Sahni Institute of Palaeosciences, Lucknow July 2024 by the Chief Vigilance Commission, New Delhi.
- As Jury invited to evaluate the Posters displayed by the students in the Chem Fiesta: A Fun Filled Expressions of Chemistry organised at the Department of Chemistry, University of Lucknow, Lucknow on 19 October, 2024.

Niteshkumar Khonde

- Reviewer for Massive Open Online Courses (MOOC), University Grants Commission (UGC) of India, SWAYAM Platform for two modules for Department of Geology, Central University of Punjab in 2025.

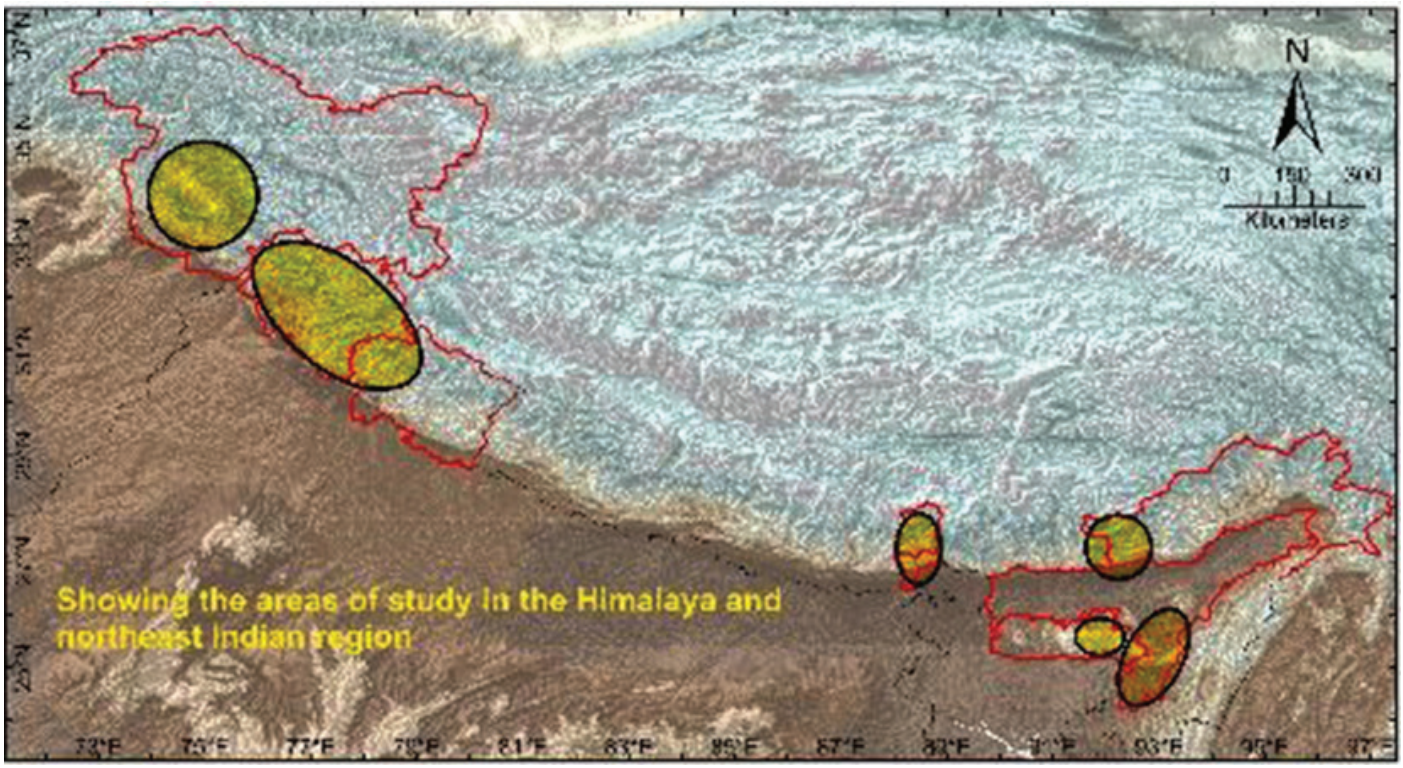
REPRESENTATION IN COMMITTEES/ BOARD

Biswajeet Thakur

- Joint Secretary, Palaeontological Society of India, Lucknow
- Member, Society of Earth Scientists, Lucknow
- Co-editor, Earthscienceindia.info (online journal)

Project 6: Late Pleistocene-Holocene vegetation and climate reconstructions for the Himalayan region: understanding the dynamics and forcing mechanisms

Coordinator: Ratan Kar (Scientist F)
Co-coordinator: Sadhan K. Basumatary (Scientist E)



OBJECTIVES

- *To reconstruct the vegetational changes, tree-line dynamics, glacial sensitivities and abrupt hydroclimatic events during Late Pleistocene-Holocene.*
- *To understand the driver(s) for Holocene vegetation and climate, based on modern proxy-climate analogues.*
- *To trace the inception and impact of anthropogenic activities.*
- *To structure spatio-temporal climate reconstructions using tree-ring data of multiple taxa.*

PREAMBLE

The present climate is changing at an unprecedented rate (IPCC 2018) and the mountainous regions are more susceptible to these changes as compared to other regions under the same latitudinal belt. The Holocene Epoch (the last 11,700 years) is marked by rapid climatic events (RCCs), where significant variability both in temperature and hydrological regime took place (example: 8.2 ka event, HCO, 4.2 ka event, MWP, LIA, etc). The Himalaya, especially the high-altitude region, is an exceptional repository of past climatic changes, as their signatures are well preserved in a relatively pristine environment. The great Himalayan range is unique due to its climatic, topographic, geological and altitudinal variations. The Western Himalaya is affected by both the Indian Summer Monsoon (ISM) and Western Disturbances (WDs), while the Eastern Himalaya and the Northeastern region, receives precipitation only from the ISM, and is also comparatively more humid.

In order to understand the trend of climatic changes and its impact on this highly vulnerable region, long term records beyond the instrumental range are necessary. The quest of this thrust area is to understand the Holocene climatic phases in the Himalaya (and Northeastern region), at decadal to centennial scales, using biological proxy records (pollen, tree-rings, phytoliths). The inception and impact of anthropogenic activities in this ecologically sensitive region would also be looked into. Besides, the teleconnections with the mid- or high-latitude regions would also be explored.

Although, a large number of palaeoclimatic records are now available from the Himalayan region, however, in most of the cases, the underlying forcing mechanisms are yet to be explored. An understanding of the forcing mechanisms and their impact on the past ecosystems will strengthen our knowledge for simulating palaeoclimatic models, to possibly obtain insights about future climate variability and its impact on the Indian subcontinent.

PERSONNEL INVOLVED

Team Members: Santosh K. Shah (Scientist E), K.G. Misra (Scientist E), Swati Tripathi (Scientist E), S Nawaz Ali (Scientist E)
Associate Member: Parminder Singh Ranhotra (Scientist E)
Technical Support member: Mr. Rajaram Verma (Technical Assistant E)
Research Scholars: Nidhi Tomar, Pushpendra Pandey, Arya Pandey, Deeksha, Ravi Shankar Maurya, Sadhana Vishwakarma, Prachita Arora, Shubhajit Ghosh, Nishant Minz, Benjamin Sam, Tanveer W. Rahman, Siddhant Vaish, Yubraj Dhakal, Khushboo Kashyap, Ajay Kumar

SIGNIFICANT FINDINGS

Late Holocene palaeoclimate and anthropogenic activities from Kedarnath of western higher Himalaya:

Palynological, magnetic susceptibility and granulometric studies, along the altitudinal transect (2700 to 3600 msl) in the Chopta-Tungnath region of western-higher Himalaya (Fig. 1), were completed from the three sub-surface trenches, from each of the three vegetation zones. (i) Profile C1 (105 cm; 4550 yr BP) from the mixed-temperate forest, (ii) Profile BT (150 cm; 11800 yr BP) from the sub-alpine forest and (iii) Profile TA (66 cm; 7600 yr BP) from the alpine scrub and meadows. A synthesis of the palaeoclimatic data from the three profiles have revealed the vegetation and climatic changes in the area covering the last 11800 years. The important Holocene climatic events, such as the HCO, the 4.2 ka event, RWP, MCA, LIA and the CWP are well-marked in the region, though with asynchronicity in their durations when compared with

1st Row (L-R): Arya Pandey, Tanveer W. Rahman, Nidhi Tomar, Mitra Rajak, Ravi S. Maurya, Siddhant Vaish, Benjamin Sam, Aroshi Kumar; 2nd Row (L-R): Swati Tripathi, Sadhan K. Basumatary, Santosh K. Shah, Ratan Kar, Amit K. Mishra, K. G. Misra, P. S. Ranhotra, Pushpendra Pandey, S. Nawaz Ali, Nishant Minz

Fig. 1 - Field photographs from Chopta-Tungnath. (a) Anthropogenic pressure in the form of grazing, mule track, hutments and forest clearings, (b) *Quercus semecarpifolia* and *Rhododendron arboreum* trees representing the mixed-temperate forest, (c) Flat terrain in sub-alpine zone indicating the location of BT profile, (d) Stunted *Rhododendron campanulatum* and *Abies spectabilis* forming the tree-line in the area, (e) View of the area around Tungnath Temple and Chandrasila peak, with stunted trees of *Rhododendron campanulatum* in the subalpine tree-line landscape forming the Krummholz Zone, (f) Alpine-scrub vegetation.

the global counterparts. Palynological studies (cultural pollen taxa and coprophilous fungi) have also indicated the impact of anthropogenic activities in the high-altitude vegetation during the Late Holocene.

Studies from two trenches in Kedarnath (one from the outwash plain and another from the kame-terrace), covering a time span up to Middle Holocene, are also continuing to reconstruct the vegetational and climatic changes and to decipher the inception of anthropogenic activities (Fig. 2).

Modern pollen and vegetation relationship from Meghalaya:

Modern botanical analogue has been documented in relation to the different vegetation types (*Schima wallichii* forest, evergreen forest, pine, forest openland and cropland) from the Jaintia Hills of Meghalaya. The generated pollen data has displayed a close relationship with the current vegetation (Fig. 3). The continuous recovery of evergreen elements along with *Pandanus* and *Nepenthes* pollen is indicative of the high rainfall activities in the region. This generated data is a prerequisite and baseline for the interpretation for the palaeovegetation and climate in the region.

Studied 25 bat guano samples, collected from a cave of Mausyram area of Meghalaya. The pollen data reflected an evergreen forest composing of *Cinnamomum*, *Symplocos*, *Syzygium*, *Schima*, and *Duabanga* which will be helpful for the interpretation of the palaeovegetation and climate in the region.

50 wild herbivores dung samples have been studied collected from the different region (tropical and temperate) to know their primary dietary plants in relation to their habitat. This study will be helpful for the palaeodietary and palaeoecological analysis and their correlation in the regional and global level.

Modern pollen-vegetation relationships and palaeoclimate reconstruction in upper Assam:

Newly developed modern pollen analogue (surface soil as pollen traps; Fig. 4) has been established using multivariate statistical analysis, including the Bray-Curtis method, Principal Component Analysis (PCA) (Fig. 5)

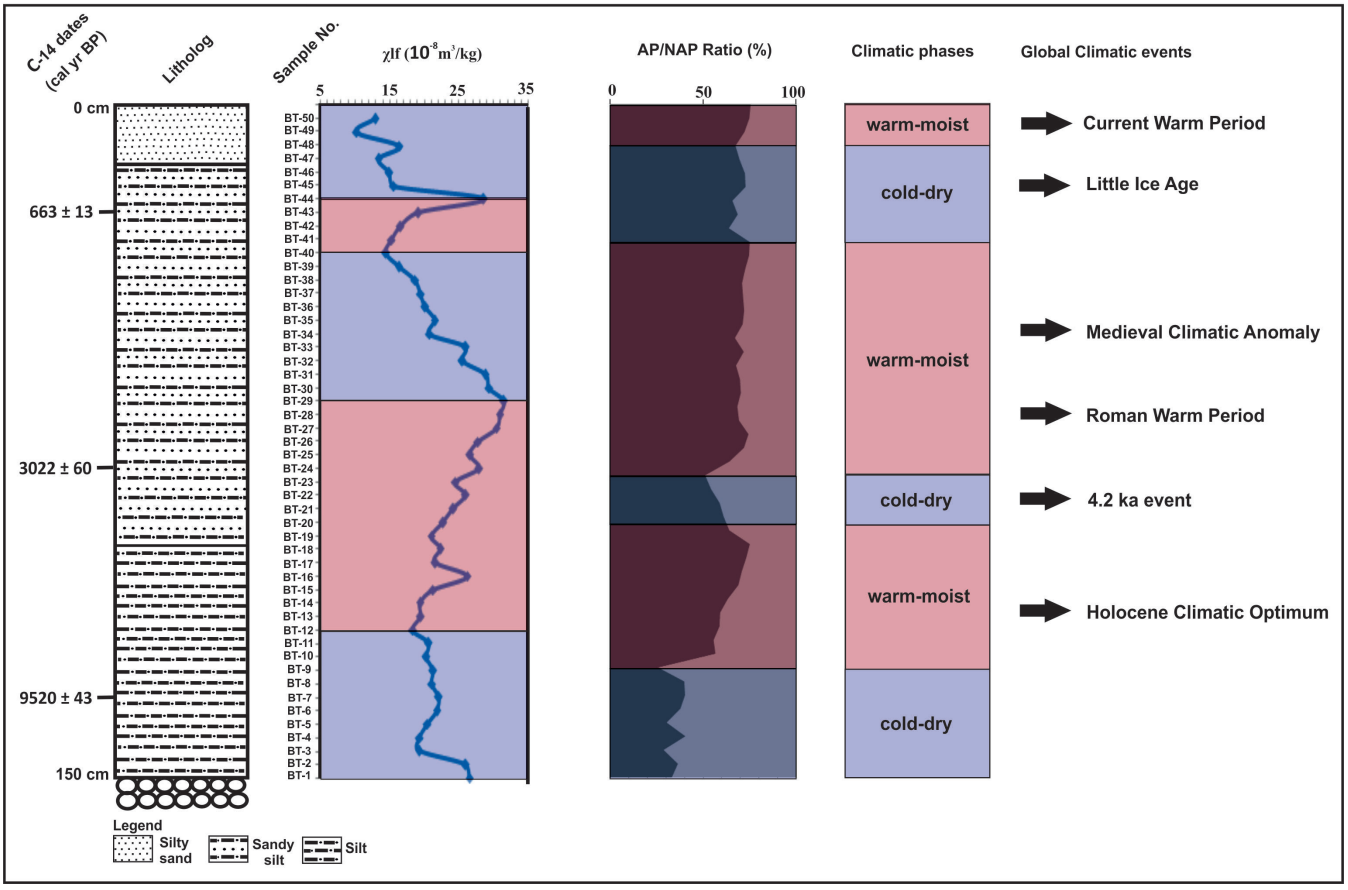


Fig. 2 - Summary diagram showing the results of different proxies and the climatic phases of BT profile (χlf: magnetic susceptibility, AP/NAP: arboreal pollen / non-arboreal pollen ratio).

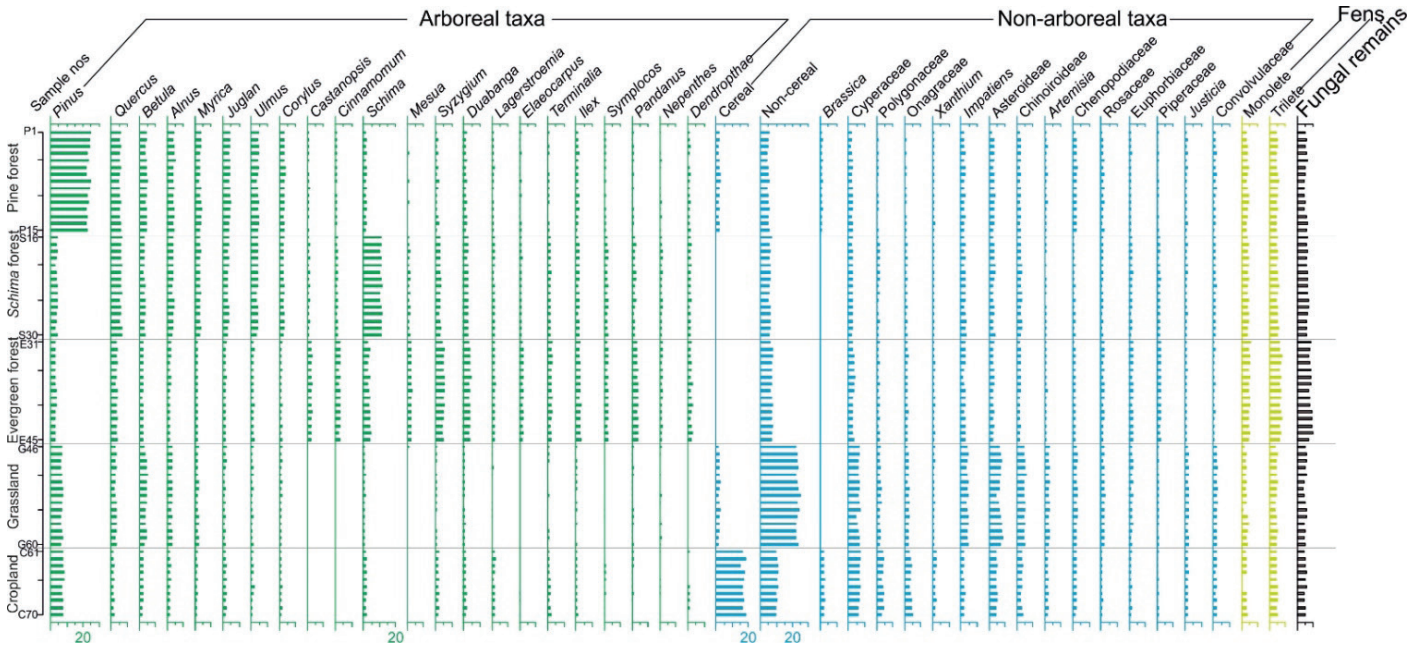


Fig. 3 - Pollen spectra from the Jaintia Hills, Meghalaya

and Box-Whiskers' Plot, to evaluate the similarities, and dissimilarities in pollen frequency across different depositional environments within the Majuli Island, which could be an accurate reference tool for decoding the past ecology of upper Assam.

The pollen-based (Fig. 6) quantitative palaeoclimatic reconstruction in Majuli Island indicates the monsoonal peak with dense forest cover (relative dominance of arboreal) around 4100 cal. yrs. BP. Subsequently, relatively decreased monsoon precipitation from 2200 to 1100 cal. yrs. BP aligns with MPC (Migration Period Cooling).

Streamflow reconstruction from Kullu Valley, western Himalaya based on tree-rings:

Sutlej streamflow for monsoon (June-August) season has been reconstructed using five ring-width tree-ring records of three conifer tree taxa (*Abies pindrow, Cedrus deodara,* and *Pinus roxburghii*) from Kullu Valley, Himachal Pradesh, western Himalaya. The time span of the reconstruction is 228-year (1787-2014 CE). It accounts

Fig. 4 - (a) Collection of surface soil samples from the Lohit River margin areas; (b) A view of Pharam wetland in the Majuli Island, Assam.

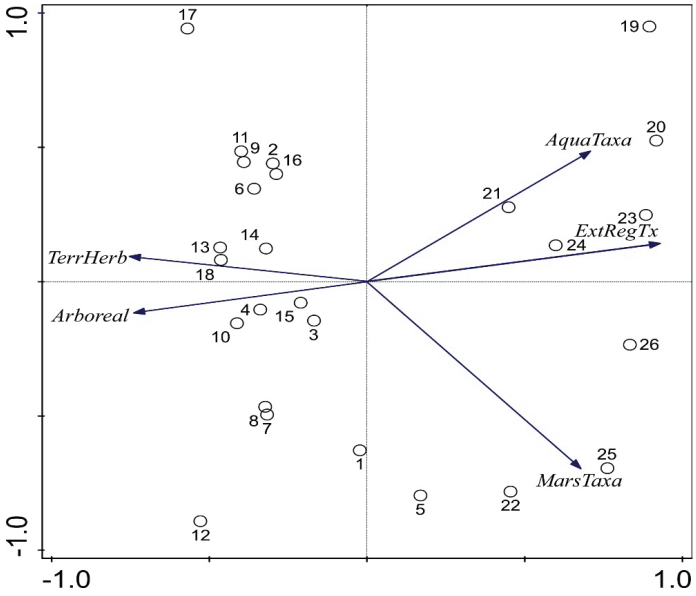


Fig. 5 - The biplot that shows the result of PCA analysis based on the vegetation type found in all 26 surface samples.

for 34.5% of the total variance of the gauge records from 1964 to 2011 CE. The reconstruction shows occurrences of short (2.0–2.8 and 4.8–8.3 years) to medium (12.5 years) periodicities, which signify their teleconnections with large-scale climate variations such as the El Niño–Southern Oscillation and the Pacific Decadal Oscillation (Fig. 7). In addition to this, tree-ring samples collected earlier from the Kashmir Valley are re-assessed for multi-parameters study.

February–March minimum temperature record from Lahaul-Spiti, Himachal Pradesh:

Developed the February–March minimum temperature reconstruction for the cold-arid western Himalaya using tree-ring chronologies of *Betula utilis* (Himalayan birch). A strong and statistically significant negative correlation between tree-ring width and February–March minimum temperatures highlights the critical influence of late-winter temperatures on the radial growth of *B. utilis* under cold-arid climatic conditions. Based on this climate-growth relationship, the reconstructed temperature record extends back to AD 1752. The reconstruction reveals a prolonged period of multi-decadal cooling during the Dalton Minimum (AD 1790–1830), coinciding with the latter phase of the Little Ice Age in the western Himalaya. This reconstruction aligns closely with other regional temperature records, reflecting consistent patterns of warm and cold phases across the western Himalaya. Moreover, the reconstructed February–March minimum temperatures exhibit strong associations with snow-fed river discharge and snow water equivalent records, underscoring the broader hydrological significance of late-winter temperature variability in this region (Fig. 8).

Dendroclimatic investigations from treeline sites of Ladakh, north-western Himalaya:

The Ladakh region is a cold desert situated in the northernmost part of India, renowned for its striking landscapes and harsh climatic conditions. Rugged mountain ranges, deep valleys, high-altitude plateaus, and vast barren expanses characterise the region. Flanked by the

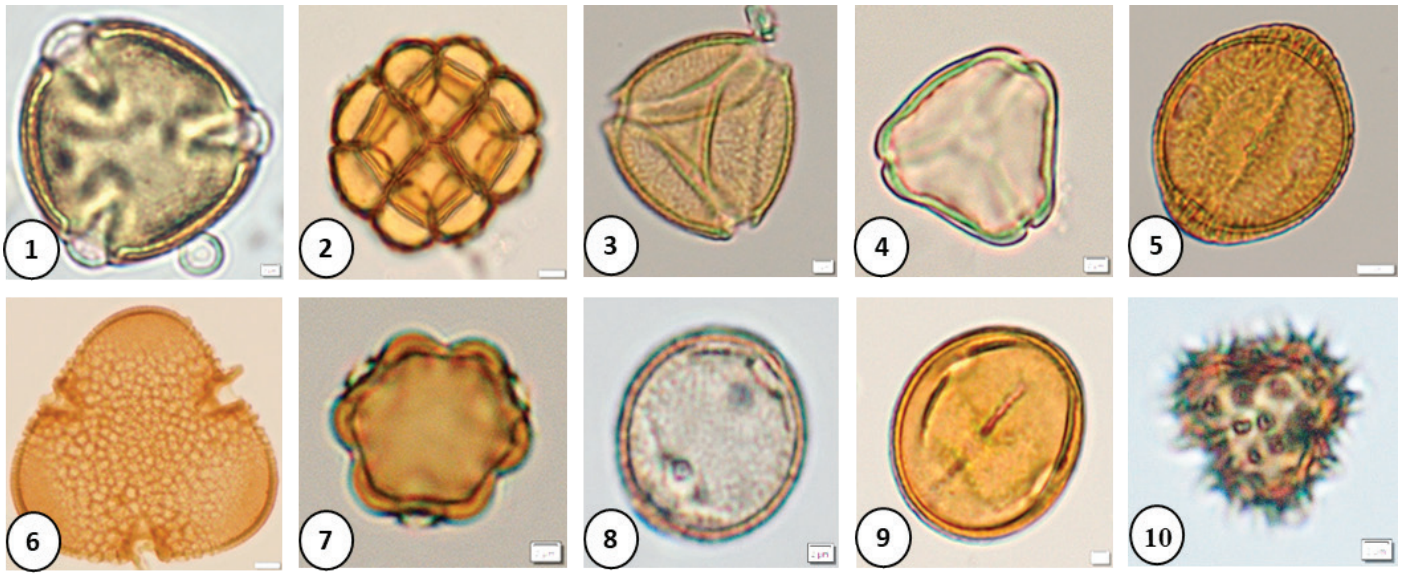


Fig. 6 - Pollen recovered from the sediments of endangered wetland in Majuli Island, Assam. 1. *Butea monosperma*, 2. *Acacia nilotica*, 3. *Schleichera*, 4. *Syzygium*, 5. *Lagerstroemia,* 6. *Bombax Cieba*, 7. *Terminalia*, 8. *Emblica*, 9. Sapotaceae, 10. Asteraceae.

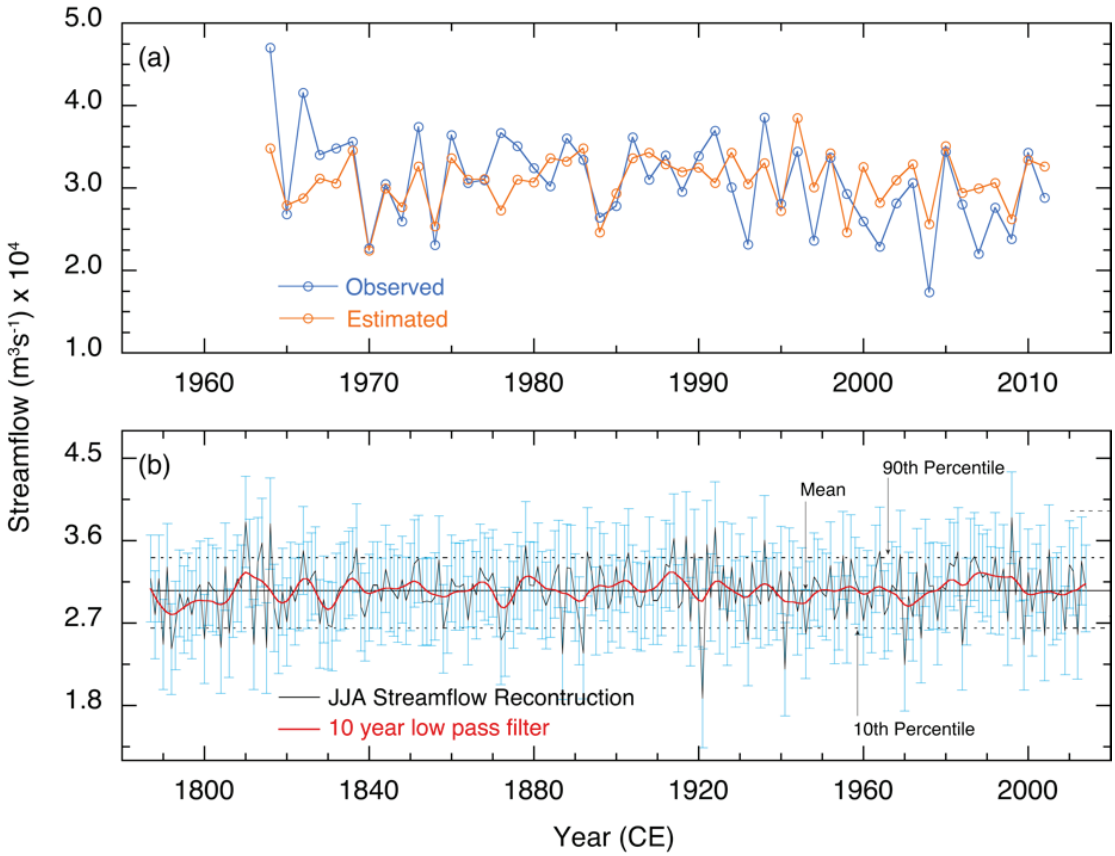


Fig. 7 - (a) Observed and estimated June-August streamflow of Kasol Gauge Station, Satlej River, (b) Reconstructed June-August streamflow spanning 1787-2014 CE with 10 years low pass filter, long-term mean and extreme high-flow and low-flow based on 90th and 10th percentile respectively.

Karakoram range to the north and the Greater Himalayas to the south, Ladakh lies at elevations ranging from 2,500 to over 7,000 meters above sea level. This extreme altitude and complex terrain make Ladakh ecologically fragile and climatically significant, making it valuable for dendrochronological studies. Therefore, tree-ring samples in the form of increment cores and discs of Himalayan pencil cedar and Sea buckthorn have been collected from several localities across Ladakh Himalaya, for the first time so far. Using Himalayan pencil cedar samples more than seven-century-long tree-ring chronology from the highest treeline sites has been developed for climatic reconstructions and high-altitude ecological studies.

Geohazards analysis in relation to moisture reconstruction from Kinnaur, Himachal Pradesh:

Understanding the frequency and causes of geohazards (landslides, rockfalls, avalanche, etc.) beyond documented records in the Himalayas underscore proper

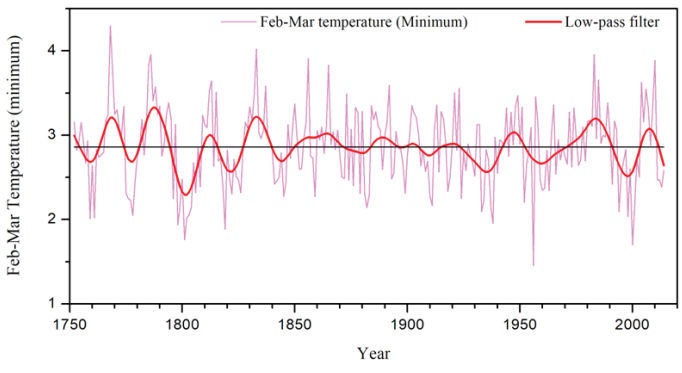


Fig. 8 - February–March minimum temperature reconstruction for the Lahaul-Spiti, HP.

Fig. 9 - Highest treeline site of Himalayan pencil cedar from Kargil, Ladakh Himalaya.

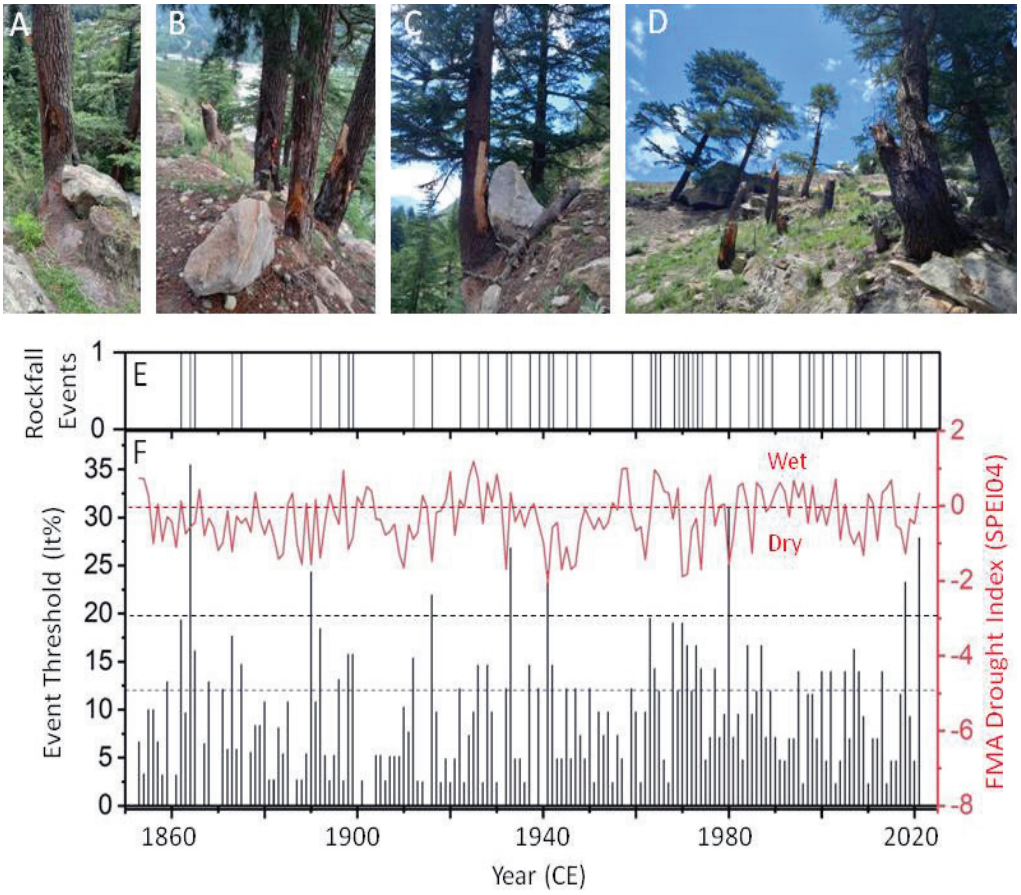


Fig. 10 - (A-D) Boulder impacted and broken trees of Deodar (*Cedrus deodara*) during July 2021 rockfall event at Batseri, Kinnaur (HP). (E) 53 reconstructed Rockfall Events. (F) 8 high intensity above threshold (IT%) rockfall events (black dashed line) correspond to years with dry spring February-April (FMA) months (SPEI04= standardized precipitation evapotranspiration index).

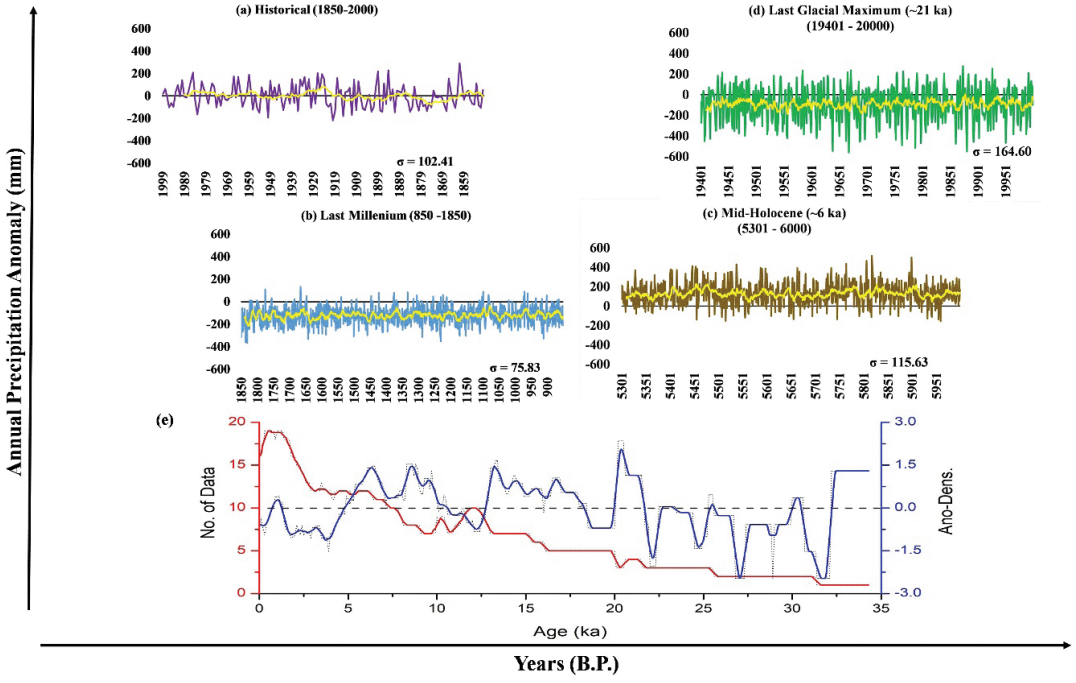


Fig. 11 - Annual rainfall anomaly (mm) averaged over Indian grid points during (a) Historical (1850–2000), (b) Last Millenium (850–1849), (c) Mid-Holocene (~6 ka; 5301–6000), and (d) Last Glacial Maximum (LGM; ~21 ka; 19,401–20,000) from (a) CSIRO-Mk3L-1-2, (b) MRI-ESM2-0, (c) CESM2, and (d) COSMOS-ASO global climate models respectively. For each period, 'σ' represents the standard deviation over the years while the line curves show the 11 years moving average over that period. (e) Synthesis of palaeoclimatic records from the Central Indian Himalaya shown by an anomalous probability density function (blue line) and the temporal availability of the number of data points (climatic records; red line).

risk management. A pioneer study in Batseri, Kinnaur (Himachal Pradesh) reconstructed 169 year's (1853-2021CE) rockfall events by analysing growth disturbances (traumatic-resin-ducts, callus-tissues, compressed/released wood) in injured Deodar trees using dendrogeomorphology (Fig. 9). Rockfall events coincided with dry spring months (February-April). Spring droughts lead to dry surfaces with poor vegetation cover, making slopes more prone to failure when saturated by summer rainfall. Warming spring seasons could amplify geohazard episodes in the Himalayas, highlighting preparedness in the region (Fig. 10).

Pollen and tree-ring studies highlighted that tree-lines in the western Himalayas reached altitudes between 3200 and 3400 masl around 7ka. Tree-lines reached to their current altitudes (~3600 masl) by mid-19th Century, the end of little ice age (LIA) phase. "Elevation dependent warming" and "spring droughts" in recent decades are reducing the growth of conifers (Deodar and Fir) calling for conservation strategies.

Semiquantitative palaeoclimatic synthesis from the Indian Central Himalayan Region:

The Indian Central Himalayan Region (ICHR), influenced by both the Indian Summer Monsoon (ISM) and Mid-Latitude Westerlies (MLW), exhibits complex climate dynamics. A synthesis of 29 palaeoclimate records using the Weighted Palaeoclimate Index (WApCI) reveals six monsoon-enhanced and eight drier phases over the past 34,000 years (Fig. 11). Cold-dry events such as the LGM and Younger Dryas align with Northern Hemisphere forcings via MLWs, while warmer phases correlate with insolation-driven ISM variability. WApCI reconstructions are consistent with PMIP3/4 model simulations. Granger causality analysis highlights the influence of solar irradiation, Arctic Oscillation, and mixed factors on seasonal precipitation.

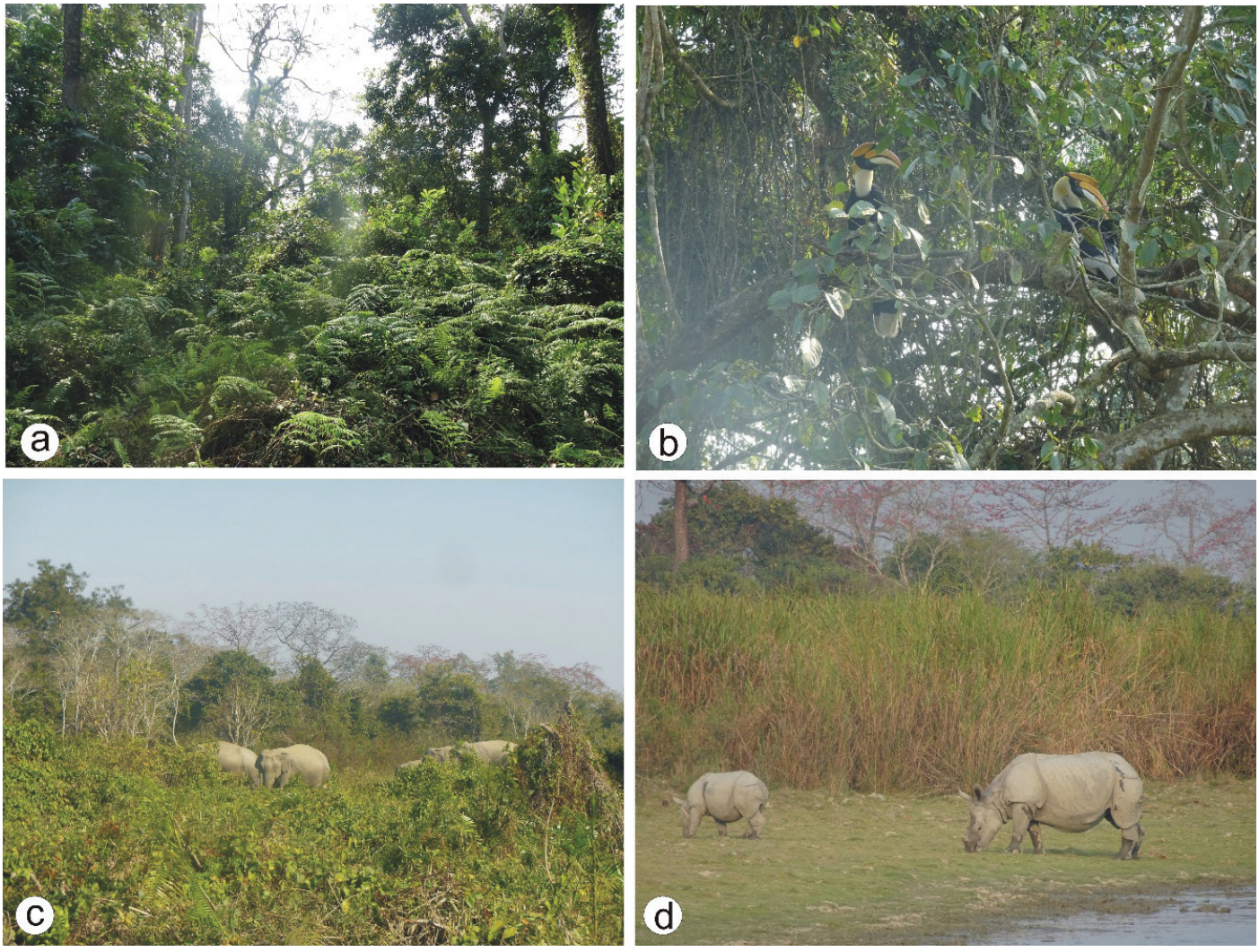


Fig. SP 6.1 – (a) Thick evergreen forest within Kaziranga National Park, (b) *Buceros bicornis* (Hornbills) sitting on the tree within the evergreen forest, (c) Group of *Elephas maximus* (Asian Elephant) in deciduous forest in Kaziranga National Park, (d) *Rhinoceros unicornis* grazing in the periphery near swamp.

SPONSORED PROJECTS (SP)

SP 6.1: **Holocene palaeovegetation and climate changes in relation to the palaeoflood episodes in central Brahmaputra Valley of Assam, India based on multiproxy analysis** (Sponsored by DST No: EEQ-2021/000846).

Investigators: Sadhan K Basumatary (PI) & Siddhant Vaish (JRF)

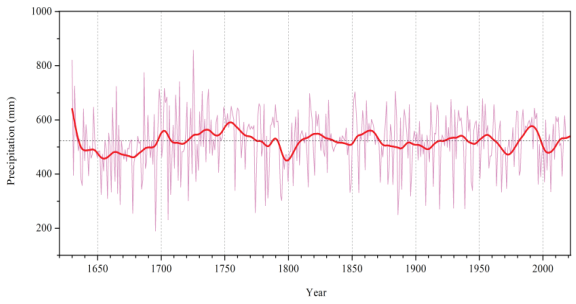


Fig. SP 6.2 - Precipitation reconstruction from Parvati Valley, Himachal Pradesh.

Modern pollen and non-pollen palynomorphs especially fungal spores have been observed in relation to the different vegetation types (evergreen, mixed deciduous, openland, grassland and swamp) from the Kaziranga National Park to understand of the pollen and fungal spores distributional pattern (Fig. SP 6.1). The pollen data displayed a good relationship with the current vegetation scenario, whereas the fungal spores especially coprophilous fungal spores (*Sporormiella*, *Ascodesmis*, *Podospora*, and *Saccobolus*) were observed in some site by site variation in the National Park which characterised due to variation of herbivores activities.

25 surface soil samples collected from the forest, swamp and grassland in the Pobitora Wildlife Sanctuary of Assam has been pollen analysed and observed. Pollen data has reflected a good relationship in relation to the extant vegetation.

20 different types of fungal spores both coprophilous and non-coprophilous have been identified and characterised in relation to their ecological significance. This recorded data will be helpful for the palaeoecological and

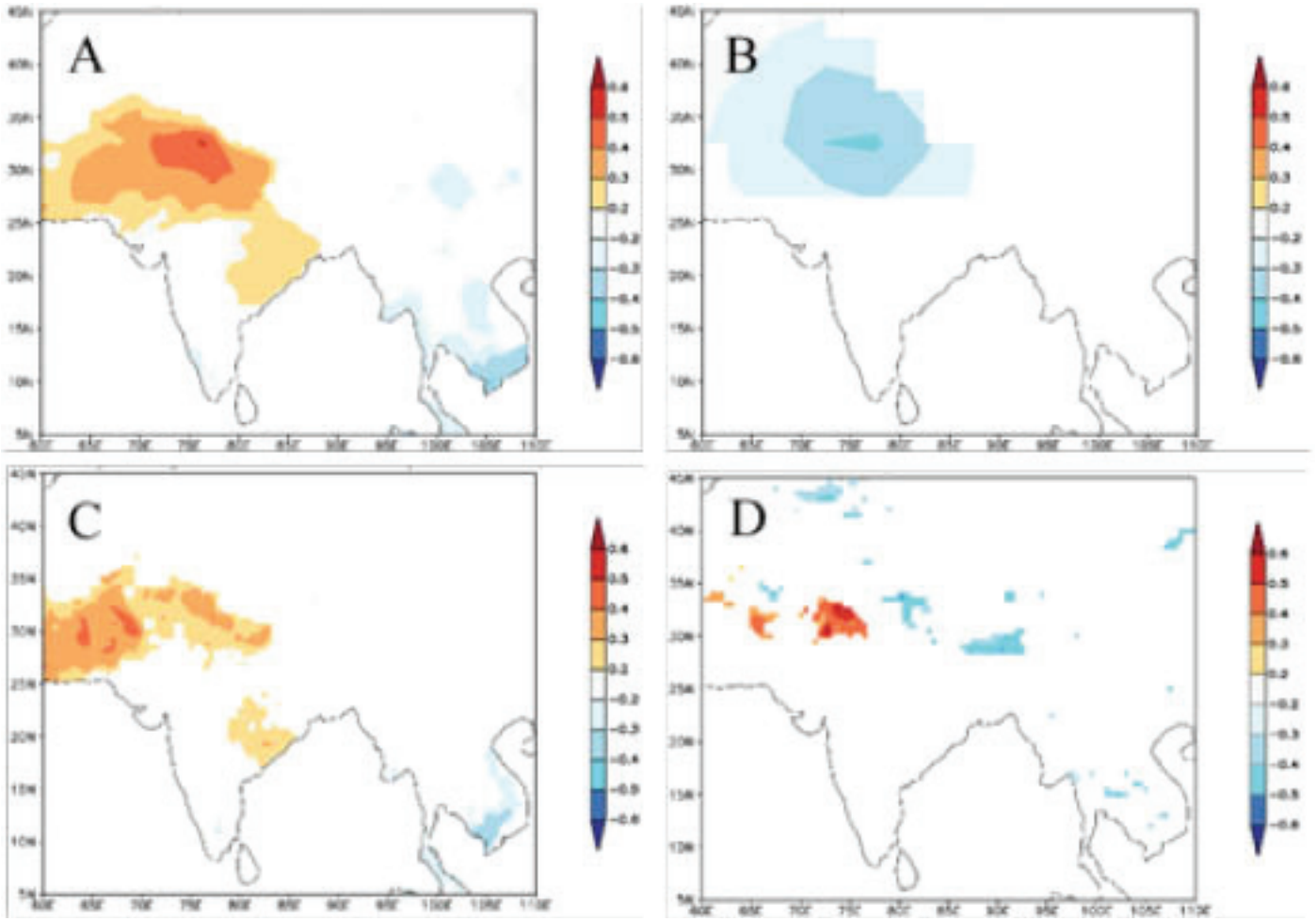


Fig. SP 6.3 - Spatial correlation of reconstructed data with gridded precipitation (A), temperature (B), *sc*PDSI (C) and with NDVI data (D).

palaeoherbivory analysis in the wildlife sanctuaries and its neighbouring areas.

SP 6.2: **Response of forest ecosystem to climate change in the Karnali region of Nepal Himalaya** (Sponsored by Tribhuvan University, Nepal under Excellent Research Grant, Project No. TU_079/080_ERG-12, In progress).

Investigators: Narayan Prasad Gaire (PI), Binod Baniya, Bidur Nepal, Raju Chauhan (Tribhuvan University, Nepal) & SK Shah (BSIP Lucknow)

Laboratory processing of the 571 samples of both conifer broadleaved taxa collected from Karnali Province, Nepal are in progress. The necessary geospatial data for NDVI and climate analysis have been collected. The datasets include gridded data of temperature and precipitation, LANDSAT 8 and 9 satellite imagery, MODIS data and other topographical data such as DEM, slope, aspect, etc. Additionally, tree-ring record is correlated with streamflow data from 6 gauge stations of Karnali river, and based on the correlation pattern streamflow for the monsoon (June-September) season was reconstructed from 1778 to 2020 CE.

SP 6.3: **Investigation of xylogenesis from alpine and high altitude Himalayas to analyse climate change and its consequences on extreme ecological environments** (Sponsored by ANRF-DST, Project No. SCP/2022/000706, w.e.f. 15.03.2023).

Investigator: KG Misra (PI) & Ravi Shankar Maurya (RA)

Using the Himalayan cedar (*Cedrus deodara*) samples reconstructed previous year November to current year May precipitation variability from Parvati Valley, Kullu, Himachal Pradesh extends back to ~ past four centuries. The reconstruction revealed significant year-to-year and interdecadal scale variability in the reconstruction. During entire reconstructed period, 1696 (189.6 mm) was recorded as the driest year, while 1726 (857 mm) was the wettest. Other dry years included 1706 (231 mm), 1888 (249 mm), 1678 (255 mm), 1775 (257 mm), and 1921 (271 mm), whereas significantly wet years were 1630 (820 mm), 1687 (774 mm), 1715 (740 mm), 1632 (724 mm), and 1665 (723 mm). The reconstruction showed significant spatial correlation with gridded precipitation, temperature, *sc*PDSI and with NDVI data (Fig. SP 6.2).

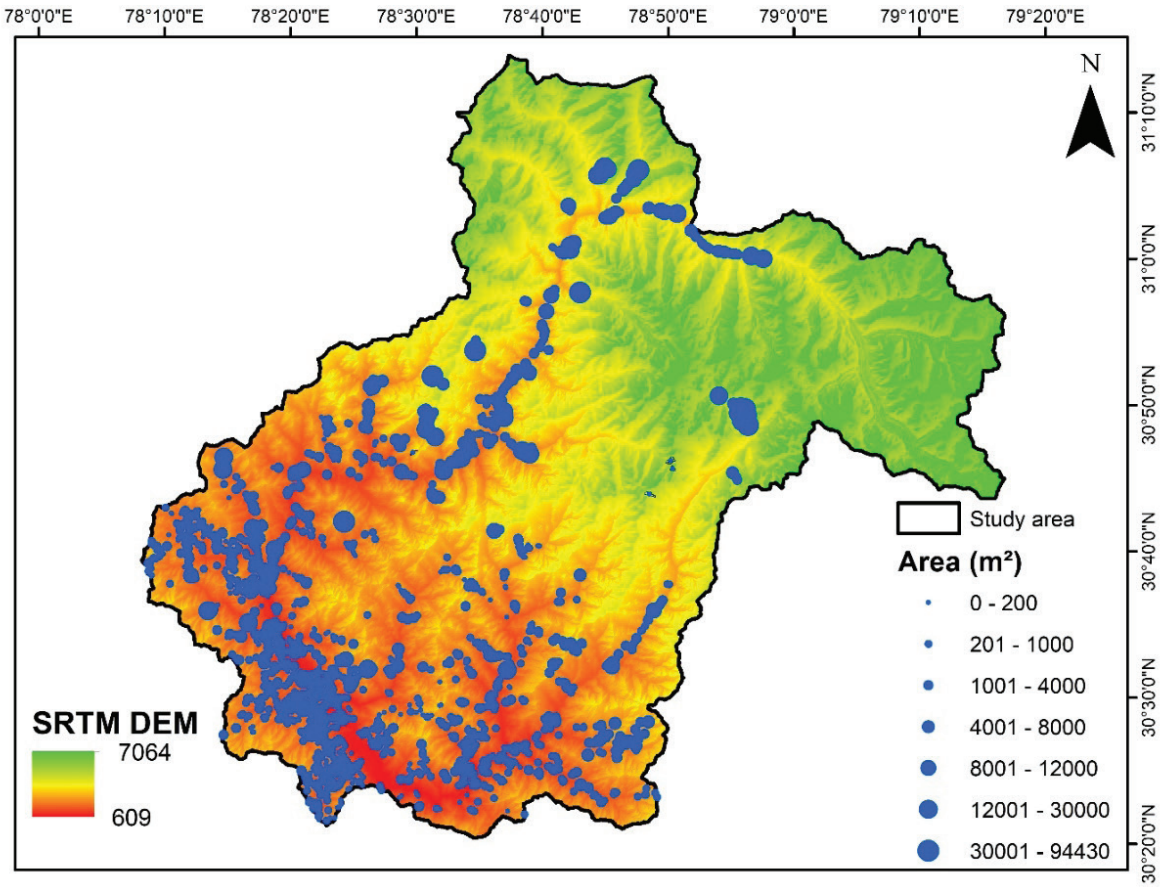


Fig. SP 6.4 - Blue denotes to the area of the landslides in the study area. Background image is SRTM Digital Elevation Model.

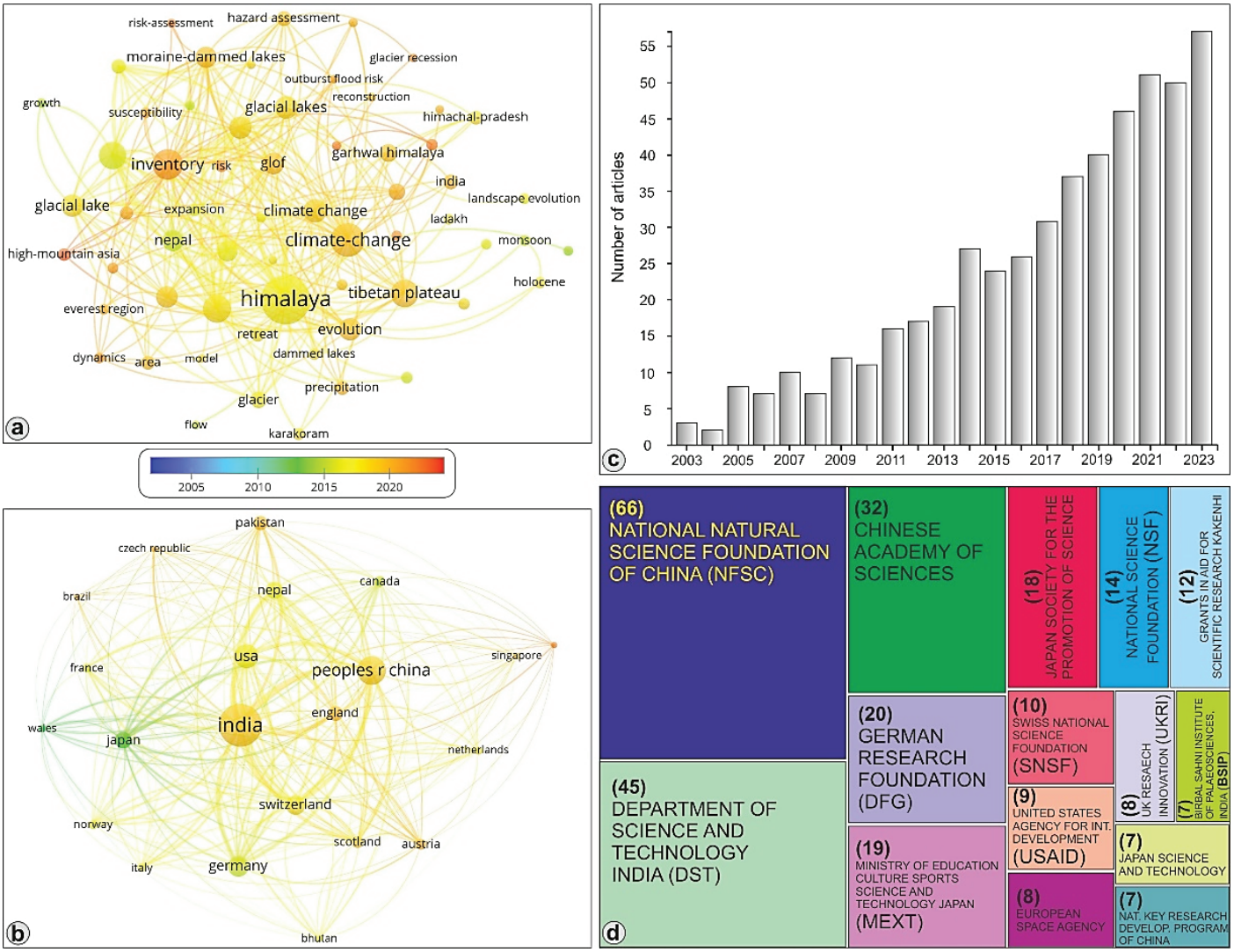


Fig. SP 6.5 - Bibliometric statistics on the Himalayan glacial lake research since 2003 from Web of Science: (a) A bibliometric network map for relevant keyword clusters based on their frequency of co-occurrences in literature; (b) a map of key country clusters for the author affiliations, leading or collaborating on Himalayan glacial lake research; (c) total number of published articles on the Himalayan glacial lakes in each year since 2003; and (d) the top 15 national/international agencies offering funding/in-kind support for glacial lake research. The software used to plot (a) and (b) is VOSviewer (https://www.vosviewer.com) (Van Eck & Waltman, 2007).

SP 6.4. An Interdisciplinary Analytical Framework for High-Mountain Landslides and Cascading Hazards: Implications for Communities and Infrastructure Project Reference No.-: APP- 18128
(Sponsored by Ministry of Earth Sciences (MoES), Government of India, and Natural Environment Research Council (NERC), UK).

Principal Investigator (India): Sheikh Nawaz Ali, Scientist E, BSIP, Lucknow, India.
Principal Investigator (UK): Anshuman Bhardwaj, Senior Lecturer, University of Aberdeen, UK.
Co-Investigators: Dr. Mayank Shekhar, Prof. MC Sharma (JNU), Prof. K Suri (JU), Dr. Mayank Joshi (GBP), Dr. Gulab Singh (BGRL), Dr. Lydia Sam, Prof. Brice Rea, Dr. Matteo Spagnolo, Dr. Martin Mills, and Dr. Shaktiman Singh.

The study conducted in the Bhagirathi Valley, Indian Himalayas, comprehensively addresses two key research objectives related to landslide hazards. A multi-temporal landslide inventory was developed using Planet Scope and LISS-IV satellite imagery, validated through field surveys and Google Earth data, covering 2017–2024 (Fig. SP 6.3). Tree-ring analyses (~700 samples) from three conifer species enabled the reconstruction of historic landslide events, revealing strong correlations with extreme rainfall and infrastructure development. Spatial mapping identified areas where critical infrastructure (roads, power lines, military facilities) overlaps with landslide-prone zones. To assess community vulnerability, 48 household interviews across four villages documented demographic

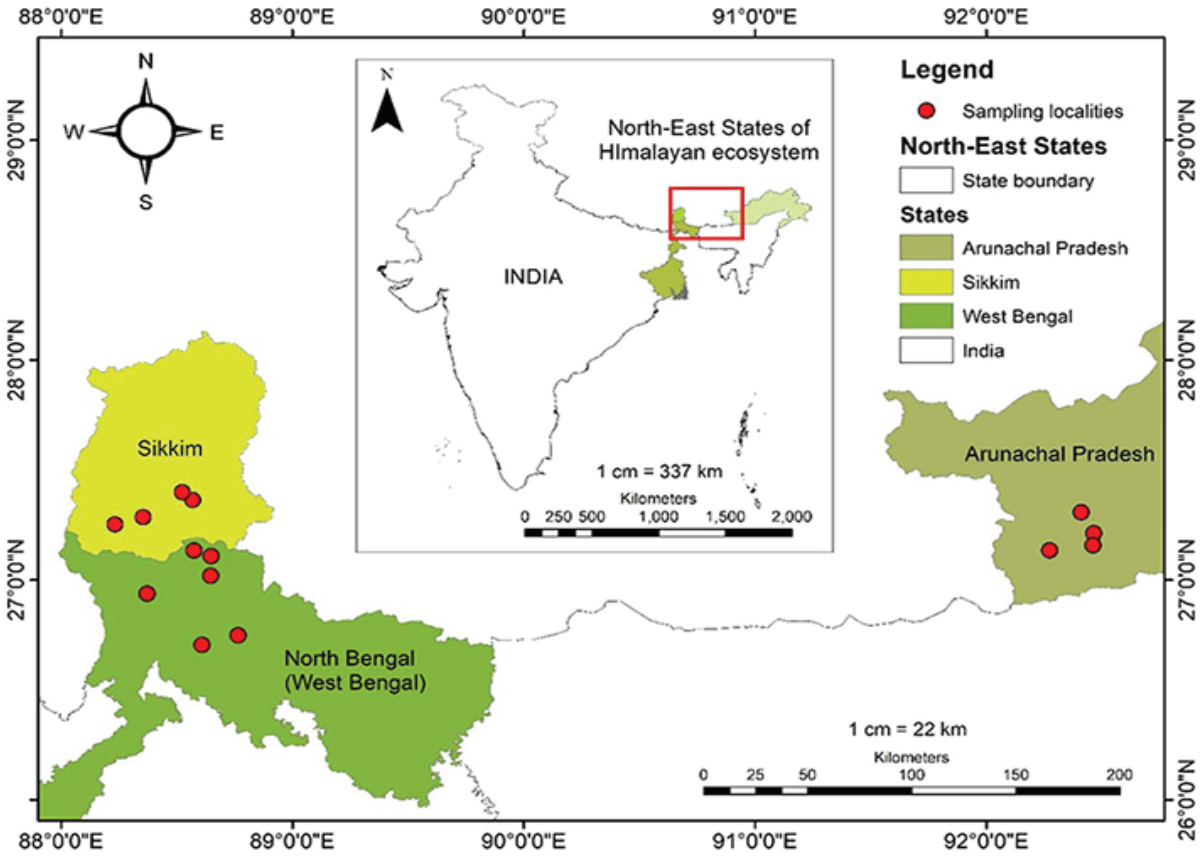


Fig. CP 6.4 - Map of hawkmoth sampling localities (produced originally by using ArcGIS) (after Singh *et al*. 2025).

patterns, local perceptions of hazards, and climate change impacts. Findings revealed limited institutional support, reliance on community coping mechanisms, and shared concerns over healthcare, education, and infrastructure. The development of Demographic Vulnerability Indices and perception-based hazard mapping enhances localised risk assessment. This integrative approach highlights the cascading nature of landslide impacts and offers critical insights for resilience planning in high-risk Himalayan regions.

Recent research has significantly advanced understanding of Himalayan glacial lakes and their associated hazards (Fig. SP 6.4). However, accelerating climate change and land-use shifts demand adaptive management strategies. Our recent perspective proposes a SWOT framework to guide future GLOF research and policy, promoting regulated interventions, community engagement, and context-sensitive approaches adaptable to global mountain regions (Fig. SP 6.5).

COLLABORATIVE PROJECTS (CP)

CP 6.1: SK Shah [Elena A. Babushkina & Team (Khakass Technical Institute, Siberian Federal University, Abakan, Russia)]

Investigated Siberian spruce (*Picea obovate*) experimental plantation established in 1982 with wide gradient of planting densities in southern taiga zone of Siberia, Russia. For this we studied wood anatomical parameters, their relationships among themselves, with tree growth and dependences of wood structure on planting density.

CP 6.2: SK Shah [Nazimul Islam & Team (Institute of Earth Surface Dynamics, University of Lausanne, Switzerland)]

Streamflow reconstruction of Zemu River, north Sikkim, eastern Himalaya: Tree-ring chronology of Bhutan fir (*Abies densa*) was used as a proxy to reconstruct a century-long May-June streamflow of the Zemu River. The reconstruction was carried out based on a scaling approach which explained 64 % of variance in river discharge. The manuscript has been submitted in Journal of Hydrology-Regional studies.

CP 6.3: SK Shah [Nivedita Mehrota & Ratan Kar (BSIP, Lucknow)]

Modern pollen-rain analysis was carried out for the first time across central, western and eastern regions of Mizoram, encompassing different regional climatic zones. The modern pollen data were analysed statistically,

PH.D. PROGRAMMES

	**Siddhant Vaish (2022).** Holocene climate changes based on geobiological proxies and geomorphological investigations in parts of central Brahmaputra Valley of Assam, India, under the supervision of **Sadhan K. Basumatary (BSIP)** and Ajay Kumar Arya (Lucknow University, Lucknow). Status: In Progress.
	**Deeksha (2021).** Hydroclimatic variability based on instrumental and proxy records of Chhattisgarh, Central India, under the supervision of **Santosh K Shah (BSIP, Lucknow)** and Munendra Singh, Geology Department, Lucknow University. Status: In-Progress.
	**Tanveer W. Rahman (2022).** Climate reconstruction from Kashmir Valley, northwest Himalaya, based on blue intensity from tree rings, under the supervision of **SK Shah (BSIP, Lucknow)** and Anup Saikia, Geography Department, Gauhati University, Assam registered with Gauhati University, Assam. Status: In-Progress.
	**Yubraj Dhakal (2023).** Response of forest to climate change in Karnali region of Nepal Himalaya and past climate reconstruction, under the supervision of **SK Shah (BSIP, Lucknow)** and Narayan P. Gaire, Department of Environmental Science, Patan Multiple Campus, Tribhuvan University, Lalitpur, Nepal registered with Tribhuvan University, Lalitpur, Nepal. Status: In-Progress (Scholar works at Tribhuvan University)
	**Khushboo Kashyap (2024).** Assessing climate driven growth patterns in conifer species in Central-Western Himalaya: A Dendroecological Approach, under the supervision of **SK Shah (BSIP, Lucknow)** and Satish Chandra Garkoti, School of Environment Sciences, New Delhi, India registered with Jawaharlal Nehru University, New Delhi. Status: In-Progress (Scholar works at Jawaharlal Nehru University)
	**Ravi Shankar Maurya (2020).** Tree-ring based climate reconstruction from Himachal Pradesh, western Himalaya and its association with glacial dynamics, under the supervision of **KG Misra (BSIP, Lucknow)**, registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.
	**Sadhana Vishwakarma (2020).** Development of multi-century long climate records using tree-rings from Uttarakhand, India, under the supervision of **KG Misra** and Nandita Ghosal, BHU registered with Banaras Hindu University, Varanasi. Status: in progress.
	**Bency David Chinthala (2019).** Thesis entitled "Analyzing Tree-growth Response, Past Hydroclimate Variability and Related Geohazard Activities in the Western Himalayas using Dendroecological and Dendrogeomorphological Approaches, under the supervision of **Parminder Singh Ranhotra (BSIP, Lucknow)** and Achim Bräuning (Department of Geography, FAU, Germany) registered with Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU), Germany. Status: Awarded (August 26, 2024).
	**Nidhi Tomar (2021).** Late Quaternary vegetation and hydroclimatic variabilities in the western Himalaya, under the supervision of **Parminder Singh Ranhotra (BSIP, Lucknow)** registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.

	**Pushpendra Pandey (2023)**. Analyzing the extreme climatic events in the western Himalaya using tree-rings, under the supervision of **Parminder Singh Ranhotra (BSIP, Lucknow)** registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.
	**Arya Pandey (2020).** Climate-induced Holocene vegetation response and anthropogenic impact in upper Brahmaputra Valley of Assam, northeast India: signatures of global climatic events under the supervision of **Swati Tripathi**, BSIP, Lucknow and Hema Singh (BHU), registered with Department of Botany, Banaras Hindu University, Varanasi. Status: In -Progress.
	**Ajay Kumar (2025).** Climate and vegetation dynamics in the Eastern Himalayan foothill region of India during the Holocene: a multiproxy assessment, under the supervision of **Swati Tripathi**, **(BSIP, Lucknow)**, registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.
	**Prachita Arora (2020).** Timing, extent, and sensitivity of the glaciers to the Late Quaternary climate variability in the Higher Sikkim Himalaya, under the supervision of **S. Nawaz Ali (BSIP, Lucknow)**, registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.
	**Mitra Rajak (2024).** Investigating the glacier dynamics and climate change induced glacial hazards in the Indian central Himalaya, under the supervision of **S. Nawaz Ali (BSIP, Lucknow)** registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.
	**Shubhajit Ghosh (2024).** Spatiotemporal distribution of forest fire and their impact on central Himalayan cryosphere, under the supervision of **S. Nawaz Ali (BSIP, Lucknow)** registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In-progress.
	**Nishant Minz (2025).** Transitional Himalayan glaciers: characteristics, mechanism and implications of paradigm shift, under the supervision of **S. Nawaz Ali (BSIP, Lucknow)** registered with KSKV Kutch University. Status: In Progress.
	**Benjamin Sam (2025).** Understanding community perceptions of Natural Hazards and climate change for evidence-based policy making in the Bhagirathi Valley, Central Himalaya, under the supervision of **S. Nawaz Ali (BSIP, Lucknow)** registered with KSKV Kutchh University. Status: In-progress.

including constrained redundancy analysis (RDA). The RDA analysis revealed the impact of bioclimatic variables on the pollen record, such as isothermality, precipitation in the warmest quarter and annual precipitation. The most significant variable was isothermality (bio_3) which indicated the dominance of anthropogenically impacted sites on the species distribution. It has been identified that an interplay of climate- and anthropogenic-driven forcing were primarily controlling the modern vegetation and pollen-rain across Mizoram.

CP 6.4: S.K. Basumatary & Swati Tripathi [Navneet Singh, Dipayan Mitra (ZSI, Kolkata)]

Analysed the role of hawkmoths in pollination ecology, which is surprisingly understudied in tropical Asia and most of the studies related to flower visitation recordings lack a robust assessment. Considering the scenario of the declining global pollinators, largely affecting crop production, moths are the least concerned insects for conservation and management. The outcome of the present study will help in strengthening the baseline information for expanding plant-moth interaction network-related studies and considering the least concerned groups of insects in the conservation policies (Fig. CP 6.4). (MS published in 'Arthropod-Plant interactions' journal).

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Tripathi S, Garg A, Pandey A, Singh P, Singh A & Sharma A 2024 - Micro-morphometry of cereal and non-cereal pollen using LM, CLSM and FESEM: Implications to decipher past anthropogenic activities in the Central Ganga Plain. 29th ICMS, 2024, DU, New Delhi during October 17-19, 2024 (Abstract- Page no-197).
2. Pandey A, Tripathi S & Singh H 2024 - Modern pollen analogue from Majuli Island (the world's largest river island) in Assam, northeast India: Implications for Palaeoecology. 29th ICMS, 2024, DU, New Delhi during October 17-19, 2024 (Abstract- Page no-31).
3. Tripathi S & Basumatary SK 2024 - Biotic and abiotic analogue of endangered Red Panda dung from India: palaeodietary and palaeoecological implications. Indian Wildlife Ecology Conference-2024, NCBS, Bengaluru, June 14-16, 2024 (Abstract- Page no-49).
1. Pandey A, Tripathi S, Thakur B & Singh H 2024 - Climate-induced vegetation alterations during early-mid Holocene in Garamur wetland of Majuli Island (the world's largest river island) northeast India: an interpretation based on multiproxy records. Shodh Sangam, BHU, Varanasi, during February 21-23, 2024 (Abstract- Page no-18).
2. Pandey A, Tripathi S, Singh H & Thakur B 2024 - Vegetation vis-à-vis climatic alterations during Mid-Late-Holocene in Garamur wetland of Majuli Island, northeast India: a multiproxy assessment. 40th Convention of Indian Association of Sedimentologists (IAS-2024) & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research, Lucknow during December 11-13, 2024 (Abstract- Page no-150).
3. Tripathi S, Pandey A, Basumatary SK, Khan S, Singh H, Thakur B & Sharma A 2024 - Hydroclimatic variability and vegetation response in the Indo-Burma region over the past four millennia: a multiproxy assessment from Majuli Island (world's largest river island), northeast India. 40th Convention of Indian Association of Sedimentologists (IAS-2024) & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research, Lucknow during December 11-13, 2024 (Abstract- Page no 91).
4. Ranhotra PS, Chinthala BD, Shekhar M, Tomar N, Pandey P & Jain S 2024 - Climate change perspective based on sediment and tree-ring archives from north-west Himalayas. National Conference on Ladakh climate change scenario and environmental sustainability. University of Ladakh, Leh September 12-13, 2024 (Abstract-page no 36).
5. Ranhotra PS, Chinthala BD, Jain S, Grießinger J & Bräuning A 2024 - Spatial Hydroclimatic variability in the western Himalayan region during Little Ice Age. The 8th Asian Dendrochronology Conference, Chungbuk National University, Cheongju, Republic of Korea, October 14-18, 2024 (Abstract 2-17, D-1-02).

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

SK Shah

- Attended PAGES2k Network Workshop on "Global-scale hydroclimate synthesis of the Common Era" from September 8-12, 2024, University of Nottingham, UK.
- Attended online Conference "ECUADENDRO 2025: The 1st Ecuadorian Dendrochronology Conference "Unlocking the Secrets of Time from Tree Rings" from January 23-24, 2025.

PS Ranhotra

- Attended National Conference on Ladakh climate change scenario and environmental sustainability. University of Ladakh, Leh September 12-13, 2024.
- Attended The 8th Asian Dendrochronology Conference, Chungbuk National University, Cheongju, Republic of Korea, October 14-18, 2024.

Swati Tripathi

- Indian Wildlife Ecology Conference 2024 (IWEC'24) at the TIFR-NCBS, Bengaluru (Karnataka) during June 14-16, 2024.
- 29th ICMS, 2024, Delhi University, New Delhi, India during October 17-19, 2024.
- 40th Convention of the Indian Association of Sedimentologists (IAS-2024) & National Conference on 'An Odyssey of sedimentology from Precambrian to Anthropocene: Significant Contributions in Environmental, Climatic and Energy Research' at the DST-BSIP, Lucknow, during December 11-13, 2024.

TRAINING/STUDY VISITS

SK Shah

- Training imparted to Shivani Gautam, Department of Chemistry, University of Lucknow, Lucknow for M.Sc. Dissertation entitled "Tree-ring $\delta^{18}O$ of *Cedrus deodara* reflects vapour pressure variations and indicates atmospheric aridity in the Gharwal-Kumaun Himalaya since the 17th Century". April-May, 2024.
- Training imparted to Basunandan Handique, Department of Geology, Babasaheb Bhimrao Ambedkar University, Lucknow for M.Sc Dissertation entitled "Recent warming trend in tree-ring based August-September temperature reconstruction from North Sikkim, eastern Himalaya" April-May, 2024.
- Training imparted to Smriti Pandey, Department of Geology, University of Lucknow, Lucknow for M.Sc Dissertation entitled "Tree-ring $\delta^{18}O$ based streamflow reconstructions in the Karnali River Basin, Nepal for 223-year (1778-2000 CE)". April-May, 2024.
- Training imparted to Tanu Soni, Department of Geology, University of Lucknow, Lucknow for M.Sc Dissertation entitled "Assessment of tree-ring $\delta^{18}O$ as a record of multi-century streamflow reconstruction in Punantsang Chhu Basin, Bhutan Himalaya". April-May, 2024.
- Taught course work of Research Methodology and Dendrochronology for AcSIR Ph.D. students of BSIP, Lucknow.
- Attended training on "PAGES Databases: Creation and Analysis, Linked PaleoData (LiPD) and creating LiPD datasets, and LiPDverse compilations, querying and data exploration at PAGES 2k Workshop held at School of Geography, University of Nottingham, UK (September 9-12, 2024).
- Attended 16 online training lectures under the banner of Karmayogi certified courses.

KG Misra

- Training imparted to Ayushi Gupta for M.Sc Dissertation in Environmental Science, Department of Botany, University of Lucknow entitled "High resolution climate records from cold desert northwestern Himalaya: A Dendroclimate perspectives" from 31st January to 31st March, 2025.

PS Ranhotra

- Training imparted to Shivakshi Awasthi for M.Sc. Dissertation from Department of Botany, JNPG College, Lucknow entitled "Applications of Palynology and Understanding the Modern Pollen-Vegetation Relationship from Central Ganga Plain India", during 1st June to 31st August, 2024.

Swati Tripathi

- Training imparted to Anshika Singh M.Sc. Dissertation (Environmental Science), University of Lucknow, Lucknow entitled "Pollen morphology of grass pollen samples from the Ganga Plain, India" during the months of April to July, 2024.
- Training imparted to Afis Mahamood M., M.Sc. (Environmental Science), Department of Environmental Science, Central University of Kerala, Kerala, and Summer Research Fellow-2024 (Indian Academy of Science, Bengaluru) entitled "Palynology of honey samples from different regions of Meghalaya" during April to July 2024.
- Training on palynology of honey and sediment samples was imparted to Ms. Anshika Upadhayay, M.Sc. (Botany; pursuing), University of Lucknow during the months of June to September, 2024, which led to her M.Sc. Dissertation.

LECTURES DELIVERED

Ratan Kar

- Series of ten lectures in 'Geoarchaeology' for the Post Graduate students of Archaeology at the Indian Institute of Heritage (IIH), Noida, 22-25 April 2024.

- Delivered a lecture entitled-Palynology and its application in climate change studies as part of training for Early Career Scientists in the Conference of Indian Association of Sedimentologists, BSIP, December 12, 2004.

Sadhan K. Basumatary

- Delivered a lecture on topic "Modern pollen deposition in relation to vegetation and climate variability and its implication of palaeoclimate analysis" on August, 22, 2024 at BSIP, Uttar Pradesh (AcSIR course work).
- Invited Hindi talk on "पुरापारिस्थितिकी व पुराशाकाहार विश्लेषण हेतु वैकल्पिक आधार" on September 12, 2024 at BSIP, Lucknow, Uttar Pradesh.

SK Shah

- Delivered invited online talk entitled "Climate change its ecological influence" Summer School for orphanage school children of Abakan Russia organised by Khakass Technical Institute, Siberian Federal University, Abakan, Russia (on 8 August 2024).
- Delivered invited online talk entitled "How to track our past climate" Refresher Course on Climate Change & Sustainable Development (IDC), Gauhati University, Guwahati, Assam, India (on 30 August 2024).
- Delivered invited online Keynote talk entitled "Status of Dendrochronological studies on tropical tree taxa of India" in ECUADENDRO 2025: The 1st Ecuadorian Dendrochronology Conference "Unlocking the Secrets of Time from Tree Rings" (on 23 January 2025).

PS Ranhotra

- Delivered a lecture on topic "Dendrochronology and its applications: Emphasis on tree-growth and climate change relationship". Online Refresher Course at North-Eastern Hill University, Shillong, 5th September, 2024.
- Delivered a lecture on topic "Palynology and its importance in vegetation and climate studies of present and past". Online Refresher Course at North-Eastern Hill University, Shillong, 9th September, 2024.
- Delivered a lecture on topic "Dendrochronology: Applications in Climatology, Ecology and Geohazards", Popular Lecture and hands-on training of tree-ring core sample collection from trees of *Pinus kesia* to students/researchers of the Department of Environment Science, Geology and Botany, at North-Eastern Hill University, Shillong, 13th February, 2025.

Swati Tripathi

- Biotic and abiotic analogue of endangered Red Panda dung from India: palaeodietary and palaeoecological implications. Indian Wildlife Ecology Conference-2024, NCBS, Bengaluru, June 16, 2024.
- Writing of an abstract for scientific community and common men. AcSIR course work Module 5: Writing & Communication of Research Results and Inferences, BSIP, September 12, 2024.
- Palaeoclimatology through pollen proxy: case studies from northeast India, AcSIR course work 'Botany for Geologists', BSIP, April 2, 2024.

ACCOLADES RECEIVED

SK Shah

- Guest of Honour as Judge for 'Debate' in Program Sciencia, Seth M.R. Jaipuria School, Gomti Nagar, Lucknow (on 23 August, 2024).
- Keynote Speaker in ECUADENDRO 2025: The 1st Ecuadorian Dendrochronology Conference "Unlocking the Secrets of Time from Tree Rings" (on 23 January, 2025).
- Scientific Committee Member in ECUADENDRO 2025: The 1st Ecuadorian Dendrochronology Conference "Unlocking the Secrets of Time from Tree Rings"; January 23-24, 2025.

PS Ranhotra

- Keynote Speaker, National Conference on Ladakh Climate change scenario and environmental sustainability, University of Ladakh, Leh, 13 September, 2024.

Sadhan K. Basumatary & Swati Tripathi

- The research entitled 'New study tracking pollen from soil of Kaziranga National Park can interpret climate & vegetation change & help inform National Biodiversity Mission' has been released in the 'Public Information Bureau' (the authorised channel of the Government for information dissemination) in the year 2024 (Published under the DST-Science & Technology Articles, and published in DST Newsletter (Strides, Vol. 5).

Swati Tripathi

- Invited Speaker in an open session entitled 'Learning from the past: collaborating across times for landscape management for conservation' during the Indian Wildlife Ecology Conference 2024 (IWEC'24) at the NCBS-TIFR, Bengaluru, India, during June 14-17, 2024
- नगर राजभाषा कार्यान्वयन समिति (ग्रह मंत्रालय) द्वारा दिसम्बर 26, 2024 को छमाही हिंदी बैठक में बीएसआईपी की राजभाषा पत्रिका 'पुराविज्ञान

स्मारिका' अंक 3 (सह-संपादक) को प्रथम पुरस्कार से सम्मानित किया गया।

Sheikh Nawaz Ali

- Session chair, National Seminar on "Natural Hazards in the Anthropocene: Mitigation, Resilience and Sustainability, February 27-28, 2025 at Conference Centre, University of Delhi.

REPRESENTATION IN COMMITTEES/ BOARD

Swati Tripathi (Assistant Editor)

Edited Volumes:

- Journal of Palaeosciences (BSIP-in house journal), Vol. 73 No. 1 (2024), Published June 2024.
- Journal of Palaeosciences (BSIP-in house journal), Vol. 73 No. 2 (2024), Published December 2024.
- पुराविज्ञान स्मारिका (राजभाषा पत्रिका), अंक 3 (2024), Published September 2024.

Ratan Kar

- Member, State Level Expert Appraisal Committee (SEAC), Ministry of Environment, Forest and Climate Change.
- Coordinator, Academy of Scientific and Innovative Research (AcSIR), Ghaziabad.

Sadhan K. Basumatary

- Member, Editorial Board, Bio-Science Letters (an e journal of Bodoland University, Assam, India).
- Member -Editorial Board, Journal wGeophytology.

SK Shah

- Coordinator, Project 2k Network Phase 5 under PAGES Programme
- Group Leader, Wood archive team in Project 2k Network Phase 5 Programme
- Associate Editor, Dendrochronologia (since October, 2023)
- Member, Topical Advisory Panel, Quaternary (since January, 2024)
- Guest Associate Editor, Frontiers in Earth Science (since, 2016)
- Treasurer, Association of Quaternary Researchers (AOQR) for 2024-2027

PS Ranhotra

- Editorial Board, Journal of Geophytology (Palaeobotanical Society of India).

KG Misra

- Member AcSIR Academic Committee

Swati Tripathi

- Convener, Media & Press Release Committee, 40th Convention of the Indian Association of Sedimentologists (IAS-2024).
- Council Member, Association of Quaternary Researchers (AOQR), India.

Sheikh Nawaz Ali

- Member of RGIK Rock Glacier Inventory (RoGI) Working Group.
- Member of Bureau of Indian Standards, Panel on GLOFs, Bathymetry
- Member of International Permafrost Association: India.

Project 7: Reconstructing Human-Environment Interactions, Agricultural Strategies and Archaeo-Chemical imprints using Macrobotanical, Geochemical, Isotopes and Ancient DNA (aDNA)

Coordinator: Anil K Pokharia (Scientist F)

OBJECTIVES

- *To understand the early agricultural management, and cropping strategies/intensity during Prehistoric and Historic times.*
- *Characterise the paradigm-shift/transitions in lifestyles, with adoption of farming, and emergence of new technologies such as metal-working (Chalcolithic) and writing (Early Historic onwards).*
- *To assess impact(s) of geological climatic episodes (e.g. 4.2ka BP, the initiation of Meghalayan Era, MWP (~900-1450 AD), LIA (~1500-1850 AD), MW (1850 AD onwards) on human habitations.*
- *To understand the past population dynamics, domestication strategies and adaptation of human population using state of the art ancient and modern genomics.*

1st Row (L to R): Rashmi, Mansi Swaroop, Snigdha Konar; 2nd Row (L to R): Shristee Gupta, Ruchita Yadav, Anil.K. Pokharia, Niraj Rai, Aparna Dwivedi, Madhuri Chauhan

PREAMBLE

The first component deals with analyses of carbonised samples from Kaserua Khera (KSK) (27°59'58.79"N - 77°17'36.78"E), District Palwal, and quantification of retrieved data from a Bara culture site, District Kurukshetra in Haryana. The region of Palwal is part of the Braj Kshetra, and Mathura - which is one of the biggest archaeological settlements of India, particularly of the pre Mahajanapada, the Maurya, Sunga and Kushana periods. Several archaeological sites belonging to Indus Valley Civilization also known as the *Harappan Civilization* have been explored and agricultural models have been made from time to time in this region. Agriculture based on double cropping (rabi & kharif) was extensively and intensively practiced throughout the region, and played an important role in the rise and characterisation of civilization. However, the agricultural strategies adopted by settlers during 1700 BC to 1200 AD are wanting. The new excavation at the site Kasera Khera has revealed cultural deposits from Painted Gray Ware (PGW) onwards. In order to understand the agricultural practices during Early Historic to Medieval times in semi-arid tropics, the samples were collected during the course of excavation with the Archaeological Survey of India, New Delhi. Besides, quantification of plants remains recorded from Bara culture site (Jogna Khera), District Kurukshetra, Haryana, was done for interpretation of the data retrieved in relation to previously studied Indus site to reconstruct the plant-based subsistence economy during last 5000 yrs in the semi-arid tropics.

The second component deals with Palaeogenomics or ancient DNA to understand the demographic history of South Asia. Genomic data and archaeological records are the key components to understand past population dynamics, migrations and mixing events. New genetic data from Ladakh, Vadnagar (Gujarat), Pattanam (Kerala) and Sri Lanka added up significant information in the existing genetic literature of South Asia.

PERSONNEL INVOLVED

Team Member: Niraj Rai (Scientist D)
Technical Support: Nandita Tiwari (Technical Officer A)
Research Scholars: Ruchita Yadav, Mansi Swaroop, Aparna Dwivedi, Snigdha Konar, Rashmi, Shristee Gupta

SIGNIFICANT FINDINGS

Archaeobotany: Continuity and predominance of large-grained cereals and pulses

The quantification of data from Jognakhera, a Bara culture settlement in Ghaggar (vedic Saraswati?) Basin, north-western India, highlights a cropping system that aligns with the Indus agricultural system, showcasing continuity even after the Meghalayan drought (4.2 ka) in the upper Indus region. The predominance of the Indus crop package (both winter and summer crops) at the site, suggests the continuity of agricultural practices and cropping system from the preceding Indus Civilization (Fig. 1). The recorded crop assemblage shows the significant contribution of legumes to the diet of Baran's from both cropping seasons, surmise rotation of crops. The crop package at the site closely resembles those of upper Indus, suggesting continuity during late Holocene rather than their decline.

Cropping pattern during Painted Grey Ware onwards

In all forty-three samples were studied from Painted Grey Ware (PGW) to Medieval times from over 27 layers up to the depth of 12.2 meters deep trenches. Charred grains, seeds and fruits have been found mixed with small bits of wood charcoal. The identified botanical remains represent cereals, such as *Hordeum vulgare* (barley), *Triticum aestivum* (wheat), *Oryza sativa* (rice), *Setaria italica* (foxtail/Italian millet); pulses, viz. *Vigna* sp. (urd/mung), *Macrotyloma uniflorum* (horse gram), *Cicer arietinum* (chick pea); oil-fibre crops, viz. *Sesamum indicum* (sesame), *Linum usitatissimum* (linseed) and *Gossypium* sp. (cotton) along with weeds and wild taxa, viz. *Ziziphus nummularia* (jujube), *Trianthema triquetra*, *Polygonum* sp. (knot weed) and *Vicia sativa* (common vetch) surmising double cropping and the evidence of the rotation of crops (Fig. 2).

Archaeogenomics

The research work carried out in this year represents extensive studies focusing on ancient DNA and population genetics analysis of human skeletal remains. We have analyzed extensive ancient genomic data and uncovered different questions related to Indian archaeology and past demography of India. Working on some very interesting historical context, we have successfully completed following projects-

Reported linguistic and genetic shifts in East Indian tribal groups:

Previous studies of linguistic and genetic affiliations of Indian populations suggest that the formation of these distinct groups was a protracted and complex phenomenon involving multiple waves of migration, cultural assimilation, and genetic admixture. The evolutionary processes of migration, mixing and merging of populations thus impact the culture and linguistic diversity of different groups, some of which may retain their linguistic affinities despite genetic admixture with other groups, or vice versa. Our study examines the relationship of genetic

and linguistic affinities between Austroasiatic and Indo-European speakers in adjacent geographical regions of Eastern India. We analysed 224 mitogenomes and 0.65 million SNP genotypes from 40 unrelated individuals belonging to the Bathudi, Bhumij, Ho, and Mahali ethnic groups from the Eastern Indian State of Odisha. These four groups are speakers of Austroasiatic languages who have adopted elements from Indo-European languages spoken in neighbouring regions. Our results suggest that these groups have the greatest maternal genetic affinity with other Austroasiatic-speaking groups in India. Allele frequency-based analyses, genome-wide SNPs, haplotype-based methods and IBD sharing, further support the genetic similarity of these East Indian groups to Austroasiatic speakers of South Asia rather than regional populations speaking Indo-European and Dravidian languages. Our study shows that these populations experienced linguistic mixing, likely due to industrialization and modernization that brought them into close cultural contact with neighboring Indo-European- speaking groups (Fig. 3). However, linguistic change in these groups is not reflected in genetic mixing in these populations, as they appear to maintain strict genetic boundaries while simultaneously experiencing cultural mixing.

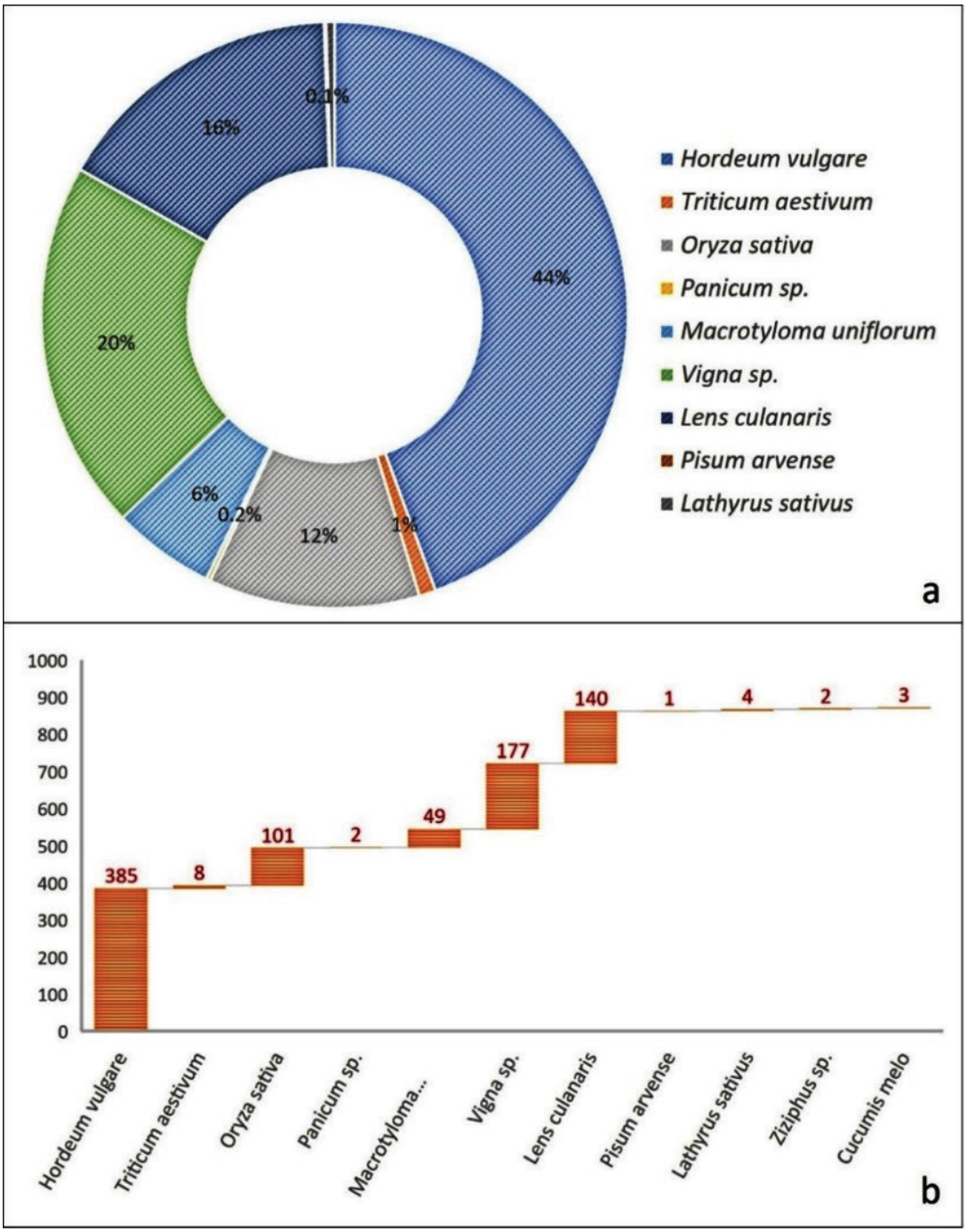


Fig. 1 - (a) Doughnut chart showing relative proportion of the crop remains, (b) Distribution of absolute count of crop and fruit remains at the site of Jogna Khera, Haryana, India.

The genetic admixture and assimilation of Ahom: a historic migrant from Thailand to India:

The Northeastern region of India is considered a gateway for modern humans' dispersal throughout Asia. This region is a mixture of various ethnic and indigenous populations amalgamating multiple ancestries. One reason for such amalgamation is that South Asia experienced multiple historic migrations from various parts of the world. A few examples explored genetically are Jews, Parsis and Siddis. Ahom is a dynasty that historically migrated to India during the 12th Century. However, this putative migration has not been studied genetically at high resolution. Therefore to validate this historical evidence, we genotyped autosomal data of the Modern Ahom population residing in seven sister states of India. Principal Component and Admixture analyses have suggested a substantial admixture of the Ahom population with the local Tibeto-Burman populations. Moreover, the haplotype-based analysis has linked these Ahom individuals mainly with the Kusunda (a)

Fig. 2 - Macrobotanical remains from Kasheru Khera: (a-b) *Hordeum vulgare* (Ventral and dorsal view), (c) *Gossypium arboreum/ herbaceum*, (d-e) *Triticum* sp (f) *Oryza sativa*, (g) *Vigna* sp (h) *Setaria* sp (i) *Trianthema triquetra*, (j) *Linum usitatissimum*, (k) *Sesamum indicum*, (l) *Ziziphus nummularia*, (m) indeterminate, (n) *Cicer arietinum*

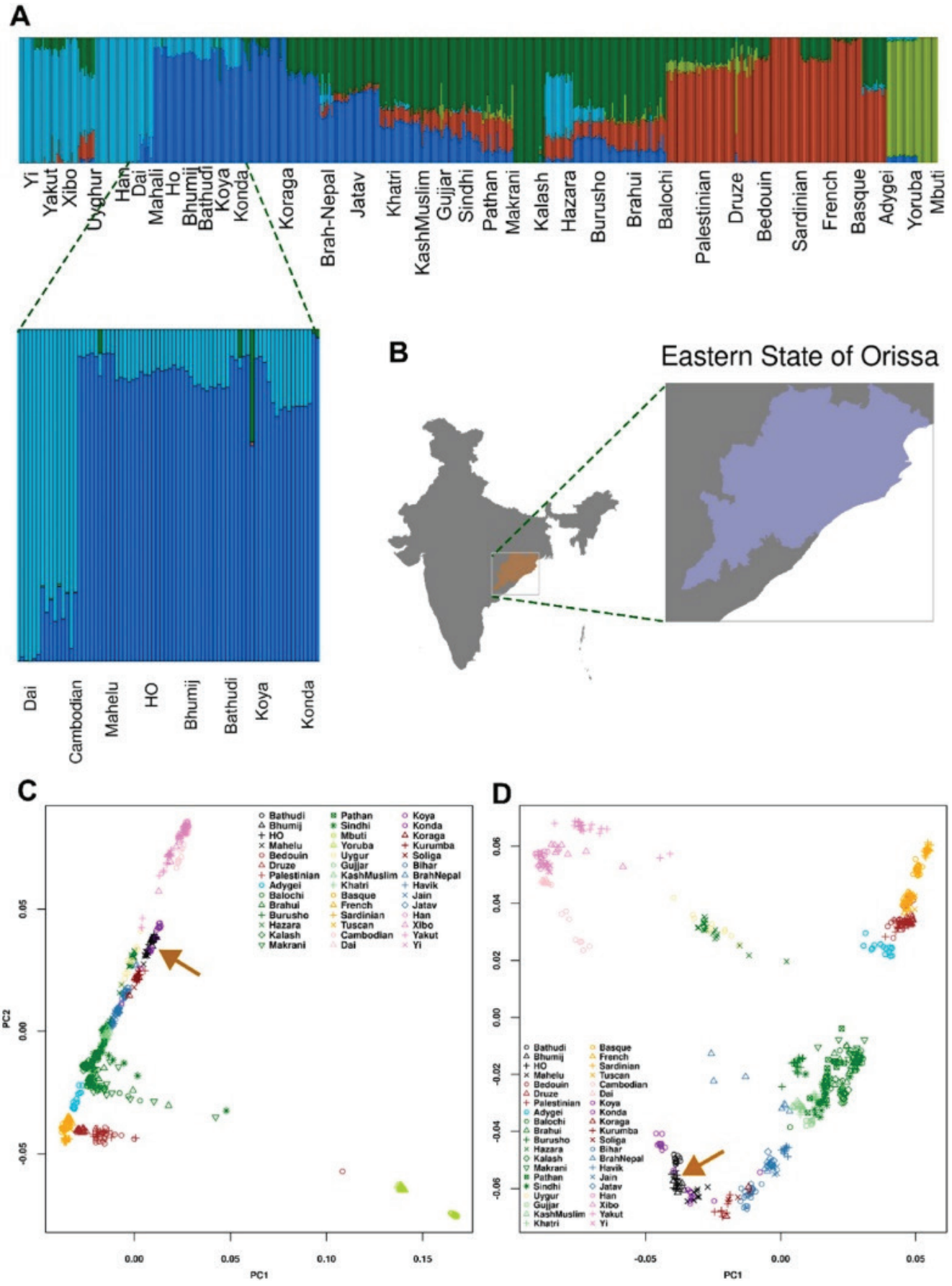


Fig 3 – (A) Admixture bar plot with modern references, distinct colors represent putative ancestral sources and populations are arranged from right to left, upper panel is continental or linguistic groups (AFR: Africa, NWI: Northwest India, IEU: India Indo-European, DRA: Dravidian, AAS: Austroasiatic), (B) Sample location map, inset show the Eastern State of Odisha in India, (C) PCA biplot using first two principal components with African populations and (D) without African populations.

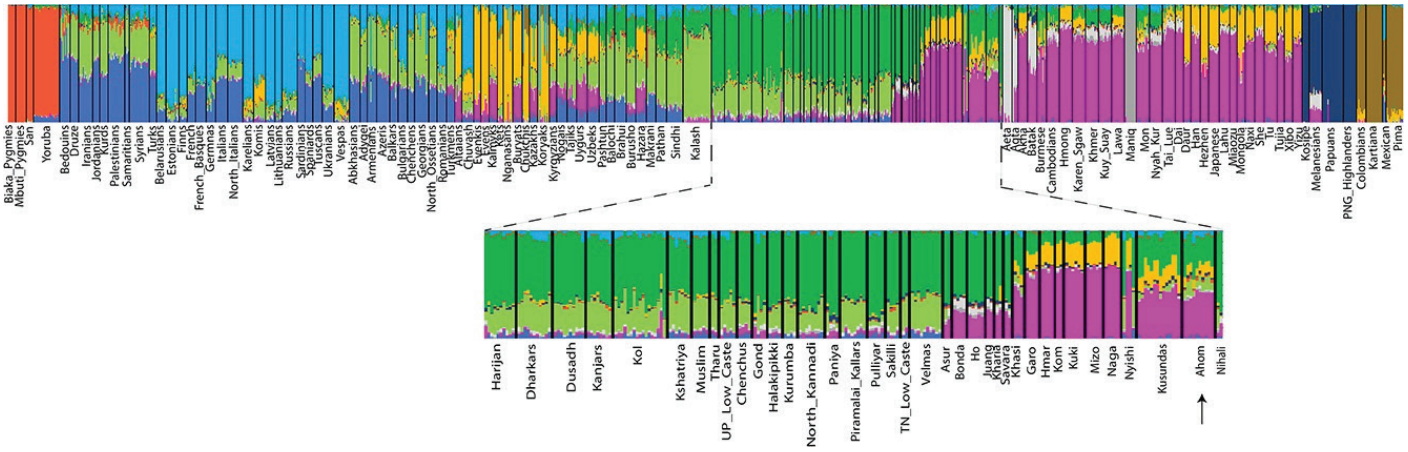


Fig. 4 - The bar plot of Admixture analysis shows the ancestral genetic component sharing of studied populations. The Indian and Ahom ethnic groups are zoomed-in.

language isolated from Nepal) and Khasi (an Austroasiatic population of Meghalaya). Such unexpected presence of widespread population affinities suggests that Ahom mixed and assimilated a wide variety of Trans-Himalayan populations inhabiting this region after the migration. In summary, we observed a significant deviation of Ahom from their ancestral homeland (Thailand) and extensive admixture and assimilation with the local South Asian populations (Fig. 4).

SPONSORED PROJECT (SP)

SP 7.1. Reconstructing population history of Vadnagar, using ancient DNA; Human Population Genomics (Sponsored by Directorate of Archaeology & Museums, Government of Gujarat. Project No. SHL/42/22-23, w.e.f Jan. 4, 2023 –Jan. 3, 2025)

Investigators: Niraj Rai

Ancient DNA analysis on human skeletal remains excavated from different localities of Vadnagar has been done and published in international peer reviewed journal "Mitochondrion", a reputed journal in the field of biology and genetics. Initial findings clearly suggest Vadnagar as a cosmopolitan settlement over the last two millennia. The results also provide hints of post-Harappan migration to this region being the fact that the entire North West of

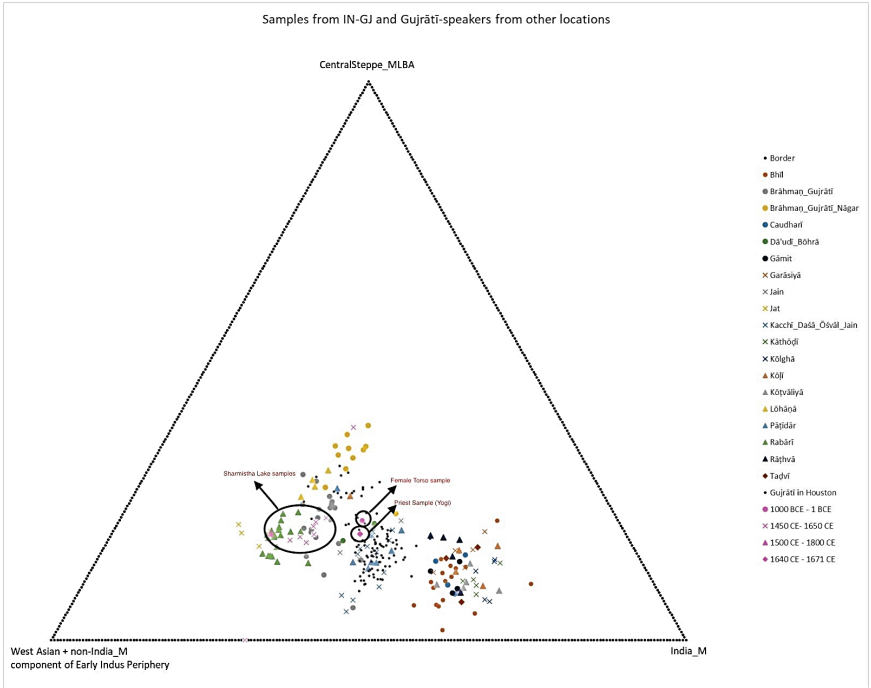


Fig SP 7.1 - A comparative study of Vadnagar archeological samples with modern sources of ancestry.

PH.D. PROGRAMMES

	**Richa (2020)**. The peopling of old-world South Asia: From Modern to Ancient genome, under the supervision of **Niraj Rai (BSIP)** and Maanasa Raghavan (The University of Chicago), registered with Academy of Scientific and Innovative Research (AcSIR), New Delhi. Status: Thesis Submitted
	**Aparna Dwivedi (2021)**. Reconstructing Neolithic and Megalithic populations of South Asia using Ancient DNA and Stable Isotope Analysis, under the supervision of **Niraj Rai (BSIP)**, registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In Progress
	**Ruchita Yadav (2022).** Palaeoethnobotanical investigation of Lower Ganga Plain, with reference to Uren, Bihar, under the supervision of **Anil K. Pokharia (BSIP)** and Alka Srivastava (CSJMU), registered with Chhatrappati Sahu Ji Maharaj University, Kanpur. Status: In Progress.
	**Mansi Swaroop (2023)**. Cultural response to Mid-Late Holocene climate variability in semi-arid N-W India: An archaeobotanical approach under the supervision of **Anil K. Pokharia (BSIP)**, registered with Academy of Scientific and Innovative Research (AcSIR), Ghaziabad. Status: In Progress.

India was heavily affected by the severe drought about 4000 years ago (Fig 5). The genetic data is very crucial to understand the driving force of prehistoric settlement at Vadnagar. Results observed a significant level of genetic diversity coming from different geographical sources such as middle Ganga Valley, Middle East and majority from local prehistoric Harappan settlements.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Niraj Rai - Presented paper entitled: "Reconstructing the peopling of Old-World South Asia" at ADNAT International Conference held at BHU, Varanasi during 28th-November 30, 2024.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Niraj Rai

- A talk entitled "Reconstructing the Demographic History of South Asia: Insights into Ancient to Modern Genome" at American Association of Biological Anthropology International Conference (AABA-2025) held at Baltimore, USA on March 13, 2025.
- Lecture entitled "Gut microbiomes" at Workshop organised by Anthropological Survey of India on June 21, 2025.
- Invited Keynote Lecture entitled "Advances of ancient DNA research in Archaeological Sciences and Its implications" at Department of Ancient History and Archaeology, Allahabad University on November 7, 2025.

Project 8: Quaternary Monsoon/Climate reconstruction through High-Resolution Multi-Proxy studies of Lacustrine Archives from Central India (Core Monsoon Zone and Indo-Gangetic Plain)

Coordinator: Anupam Sharma (Scientist G)
Co-coordinator: Binita Phartiyal (Scientist F)

OBJECTIVES

- *To reconstruct the palaeoclimate and hydroclimate variability during the late Quaternary using multi-proxy records, and spatio-temporal mapping of abrupt and extreme climate events.*
- *To assess chronological lag and disparity in long term records and ascertain the causal mechanisms of climate vs. vegetation.*
- *To study climate-culture interaction in these regions and social response variables.*
- *Palaeoclimate modelling*
- *Creation of awareness and outreach for dissemination of knowledge to the society.*

1st Row (Sitting L to R): Arvind Tewari, J Jayabharati, Nagendra Prasad, Sourav Hazra, Jereem Thampan, Shivansh Saxena, Maneesha Muraleedharan, Sarvendra Pratap Singh, Anupam Nag; 2nd Row (Standing Front L to R): Mayank Shekhar, Shailesh Agrawal, Sheikh Nawaz Ali, Anupam Sharma, Manoj MC, Anurag Kumar, Kamlesh Kumar, S K Basumatary; 3rd Row (Standing Middle L to R): Trina Bose, Niteshkumar Narendra Khonde, P. Morthekai, Anjali Trivedi, Binita Phartiyal, Jyoti Srivastava, Biswajeet Thakur, M. Firoze Quamar; 4th Row (Standing Back L to R): Mohd Ikram, Prasanna K, Debarati Nag, Swati Tripathi

Lake coring operation at Surha Tal and Bakhira Tal

PREAMBLE

India, as an agrarian nation, relies heavily on the monsoon for agricultural productivity, economic stability, and societal well-being. Approximately 64% of the population (around 80 million people) depends on agriculture, with many still engaged in subsistence farming. Agriculture contributes about 14% to India's GDP (Ministry of Agriculture, 2013–14). The Indian Summer Monsoon (ISM), occurring from June to September, delivers roughly 80% of the annual rainfall, while along the eastern coast the Northeast Monsoon is active from October to December, and contributes around 50% of the annual precipitation. Due to variations in geography—latitude, altitude, and proximity to the sea—the ISM's impact is uneven across the country's river basins. Its fluctuations can lead to droughts and floods, significantly affecting agricultural yields, economic development, and social stability across South Asia. However, our understanding of ISM rainfall variability over space and time remains limited, primarily due to a lack of long-term, high-resolution proxy records. To bridge this knowledge gap, this project focuses on generating new data from lake sediment records, aiming to extend our understanding of ISM variability beyond the reach of historical and instrumental records. Both biotic and abiotic proxies preserved in lacustrine sediments serve as valuable archives for reconstructing past monsoonal patterns. Despite logistical and technical challenges, the Institute has initiated the Quaternary Lake Drilling Programme (QLDP) to obtain long sediment cores from lakes in the Indo-Gangetic Plain, the Central Indian Core Monsoon Zone, and Western India. Sediment cores from Surha Tal and Bakhira Tal in the Central Ganga Plain (CGP) are being analysed through multi-proxy approaches to develop high-resolution reconstructions of ISM variability during the Quaternary Period. These findings are expected to enhance our understanding of spatio-temporal monsoon dynamics and support climate models for future monsoon predictions. A few key components such as tree ring studies from selected sites which can provide data on annual basis will also be integrated with other proxies' data to calibrate them for more accurate results. Similarly, the modern pollen as well as other proxies' analogues are also the part of it to apply transfer function analysis for reconstruction of the palaeoclimate data. To facilitate this, the South Asian Biodiversity Portal (SABDP) has been developed, aimed at consolidating modern and palaeo datasets from the region. The SABDP is aligned with the NEOTOMA palaeoecology database structure and is governed by a Council of South Asian Stakeholders, ensuring open access and standardisation across regional studies.

PERSONNEL

Core Team Members–Srinivas Bikina (Scientist F), Anjali Trivedi (Scientist E), P.S. Ranhotra (Scientist E), Kamlesh Kumar (Scientist E), Shailesh Agrawal (Scientist E), Jyoti Srivastava (Scientist E), Md. Firoze Quamar (Scientist E), Paulramasamy Morthekai (Scientist D), Prasanna K (Scientist D), Trina Bose (Scientist C), Anurag Kumar (Scientist C), Mayank Shekhar (Scientist C)

Associate Members–Sadhan Kumar Basumatary (Scientist E), Biswajeet Thakur (Scientist E), Santosh K, Shah (Scientist E), Swati Tripathi (Scientist-E), Shilpa Pandey (Scientist E), Sheikh Nawaz Ali (Scientist E), Manoj M.C. (Scientist D), Runci Paul Matthews (Scientist-D), Niteshkumar Khonde (Scientist D), Mohammad Arif (Scientist C)

Research Scholars– Arvind Tewari, Pooja Nitin Saraf, Md Ikram, Nazakat Ali, Nagendra Prasad, Jereem Thampan, Mohammad Javed, Maneesha M ET

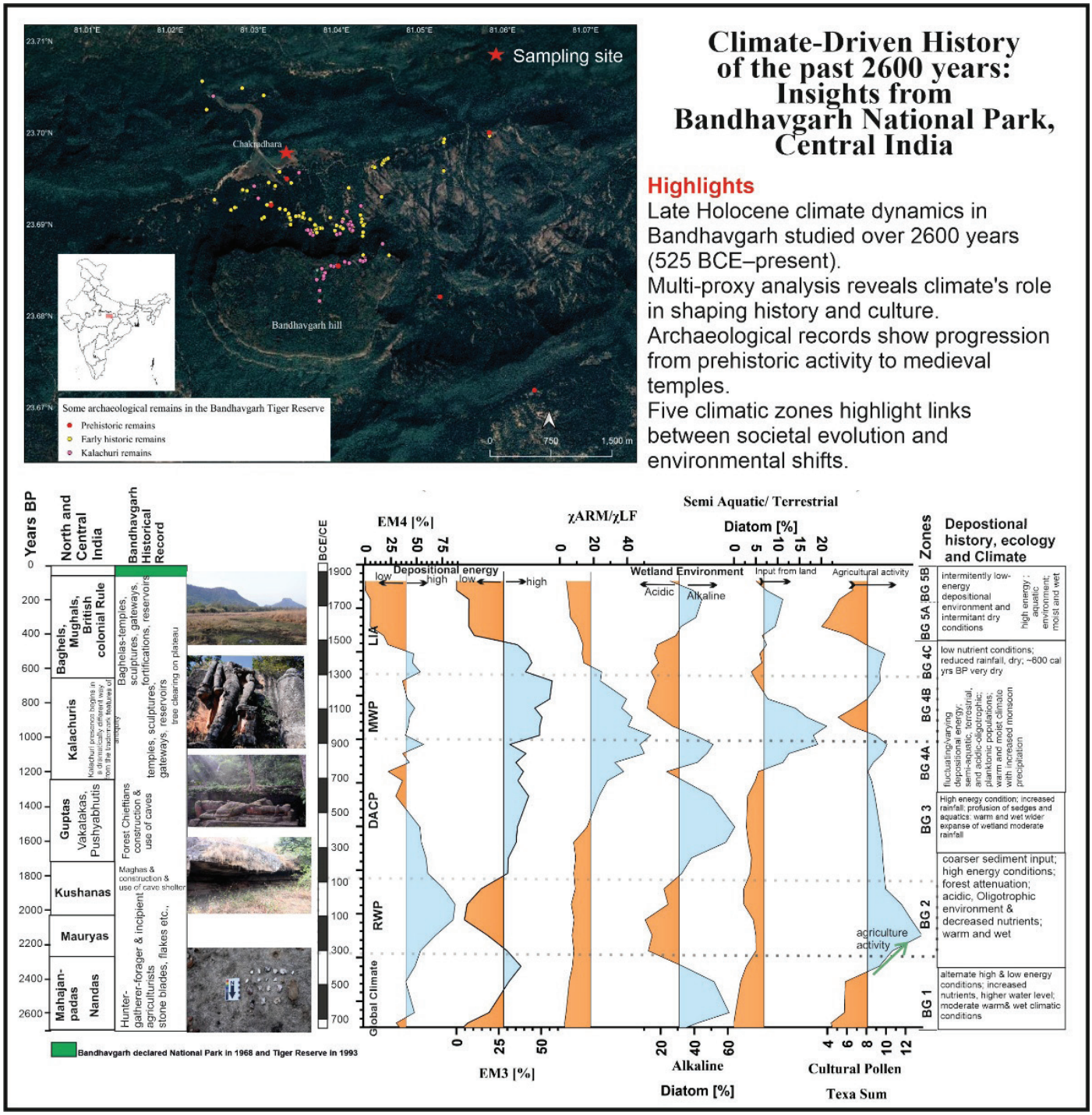


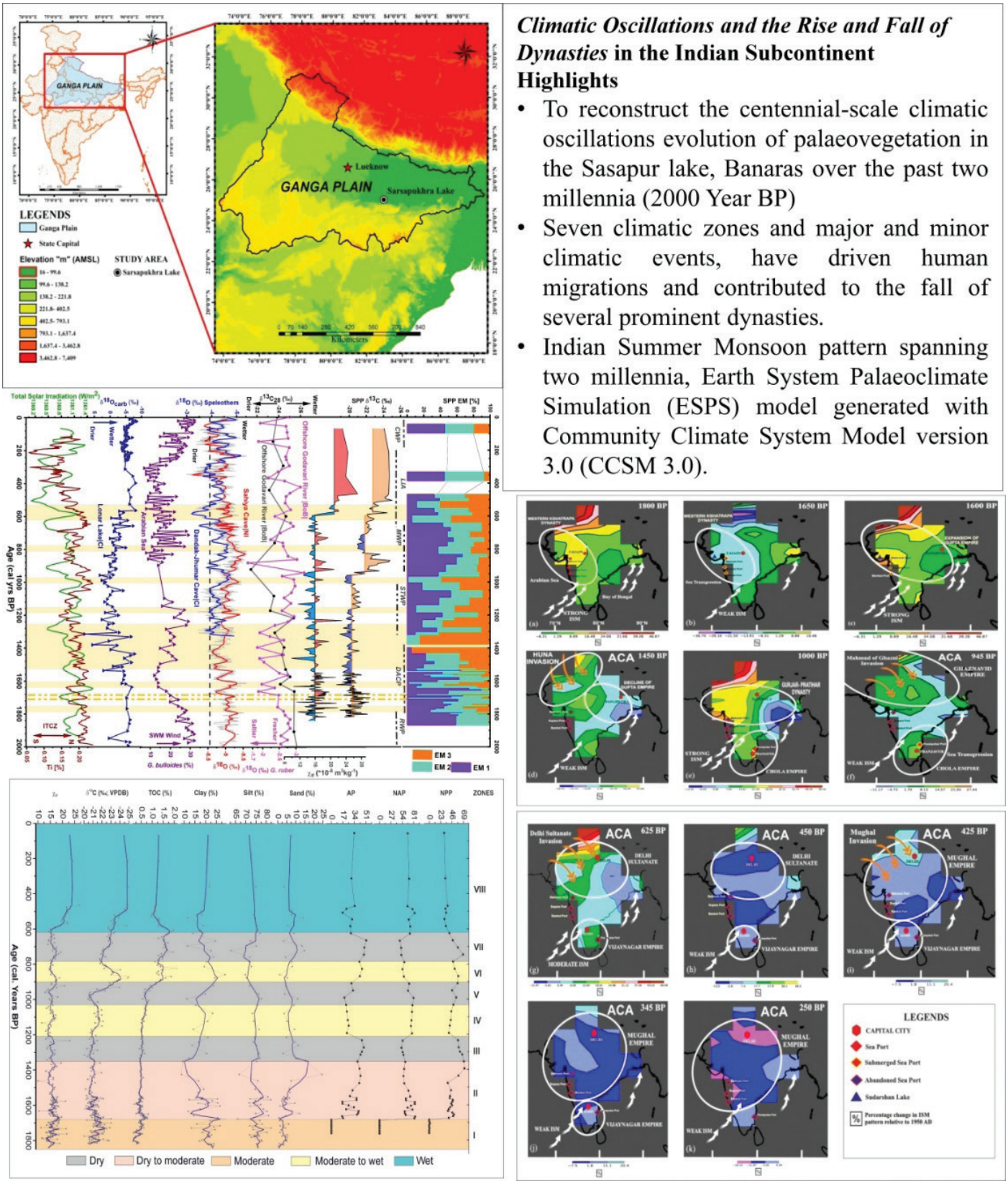
Fig. 1 - Climate-driven history of the past 2600 years from Bandhavgarh National Park, Central India.

SIGNIFICANT FINDINGS

The study in Surha, Bakhira and Kanwar in Central Ganga Plain shows that apart from global climatic events, there are multiple episodes when the monsoon behaved differently, resulting in relatively dry and humid conditions. The dataset of pollen-spore, diatoms, stable isotopes, mineralogy and geochemistry, which is now almost complete, will allow us to refine our record and provide a holistic picture of palaeoclimate. Besides, the surface sample studies from the project clearly show that in the foothill region, the tree taxa dominate compared to the plainer regions. The tree ring, species distribution and short sediment cores from Chhattisgarh provide important results. Some of the results are published in national and international journals, and the remaining are in the process of publication. Some important findings are as follows:

Climatic influence on landscape and culture

Research at Bandhavgarh revealed how climatic shifts shaped prehistoric settlements, medieval architecture, and socio-cultural adaptations recorded in sediment and



***Climatic Oscillations and the Rise and Fall of Dynasties* in the Indian Subcontinent**

Highlights

- To reconstruct the centennial-scale climatic oscillations evolution of palaeovegetation in the Sasapur lake, Banaras over the past two millennia (2000 Year BP)
- Seven climatic zones and major and minor climatic events, have driven human migrations and contributed to the fall of several prominent dynasties.
- Indian Summer Monsoon pattern spanning two millennia, Earth System Palaeoclimate Simulation (ESPS) model generated with Community Climate System Model version 3.0 (CCSM 3.0).

Fig. 2 - Multiproxy study of sediments from Sasapur Lake, Banaras (Uttar Pradesh), illustrating the influence of climate variability on prominent dynasties during the last two millennia.

wetland ecology. Five climatic phases were identified in Bandhavgarh sediment core, highlighting the interplay between environmental conditions and human adaptations over millennia (Fig. 1).

Climatic oscillations and the rise and fall of dynasties in the Indian subcontinent

Research conducted in the Banaras region of the Central Ganga Plain has revealed how climatic shifts have

Palaeoclimatic Signatures based on Pollen Fingerprints: Reconstructing Mid-Late Holocene Climate Dynamics in Northwestern Himalaya, India

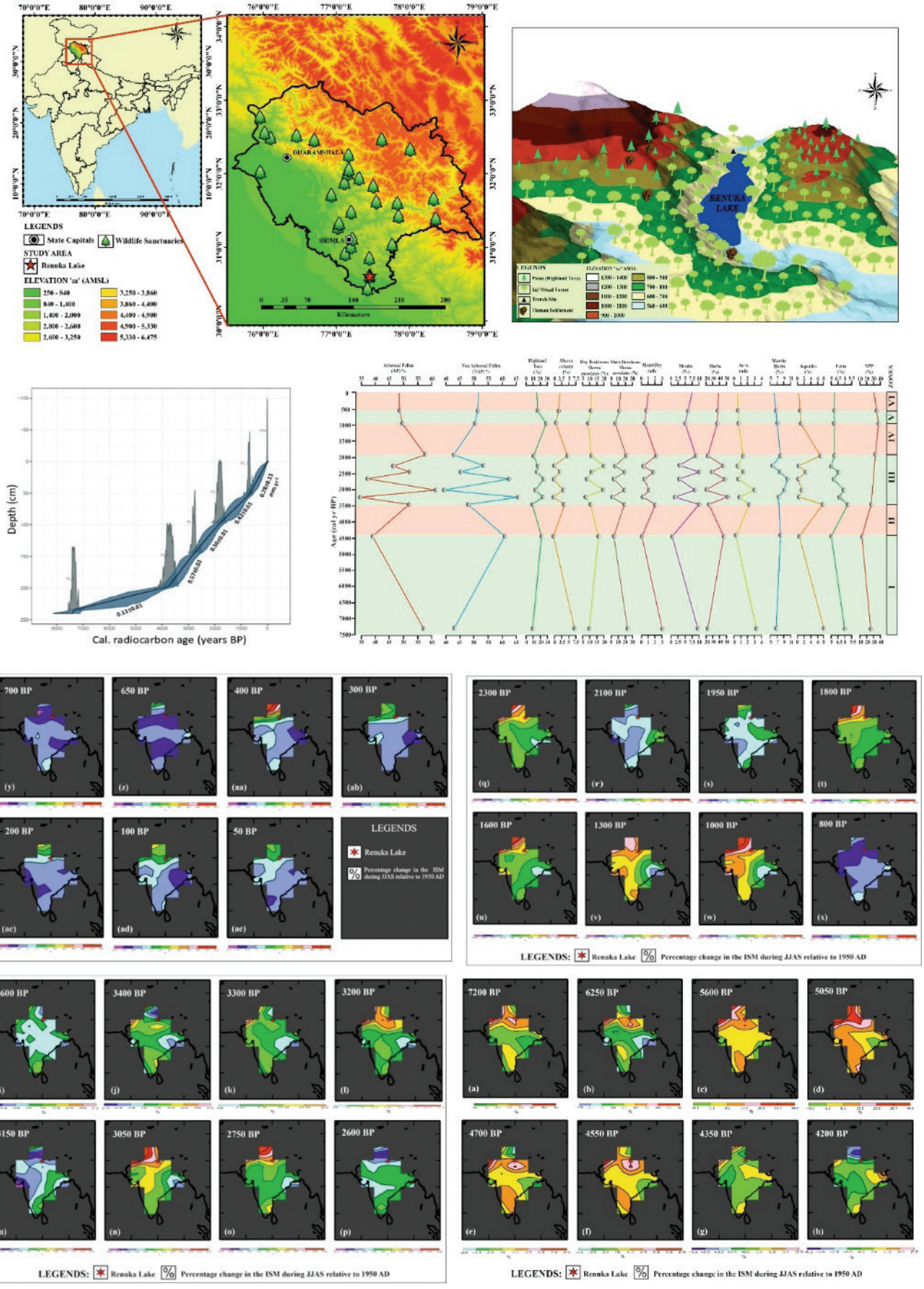


Fig. 3 - Holocene climate change at Renuka Lake in northwestern India, based on insights from palynological analyses and the application of the ESPS model.

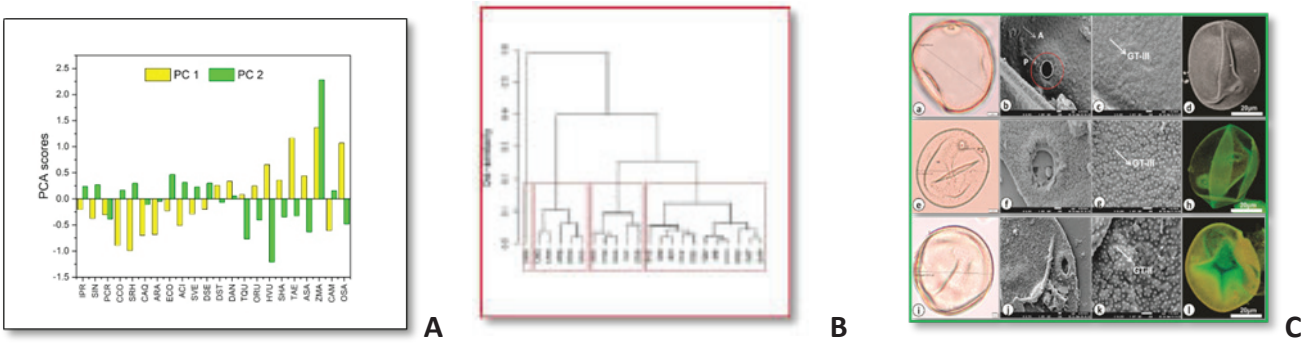


Fig. 4 - (A) PCA scores of Poaceae species (formally known as site scores) of the first two PCA axes are plotted; (B) Results of hierarchical cluster analysis (HCA) are shown as dendrogram considering 22 Poaceae species. The HCA suggests three cluster with 0.255 dissimilarity value (56.9% information remaining to be explained); (C) LM & FESEM micrographs showing pollen taxa (Poaceae) with monoporate aperture and annulus along with sexine pattern.

profoundly influenced prehistoric settlements impact on ancient dynasties adaptations. The multiproxy study transformations are documented in the region's sediment layers and wetland ecology. A detailed analysis of the Sasapur Lake sediment core, Banaras identified seven distinct climatic phases, illustrating the intricate interplay between environmental conditions and ancient dynasties shifts across two millennia (Fig. 2).

Pollen fingerprints and palaeoclimate shifts: Unravelling Mid–Late Holocene climate dynamics in the Northwestern Himalaya, India

This study reconstructs the palaeoclimate history of Renuka Lake, NW Himalaya, over the last ~7500 cal yr BP, using a 240 cm deep trench profile. We explored climate-driven vegetation responses, particularly in *Shorea* and associated taxa, documenting hydroclimatic variations linked to the Indian Summer Monsoon (ISM). Limited vegetation and climate records for NW Himalaya and South Asia over this period hinder a complete understanding of ISM fluctuations and their ecological impacts (Fig. 3).

Key findings include:

- ~7500–4460 cal yr BP: Strong ISM indicated by aquatic weeds, dense vegetation, expansion of *Shorea robusta*, a high Moist/Dry Deciduous ratio (3.08), and Ar/A ratio (3.18), aligning with the Holocene Climate Optimum.
- ~4460–3480 cal yr BP: Weakest ISM phase with reduced *Shorea* presence, low Moist/

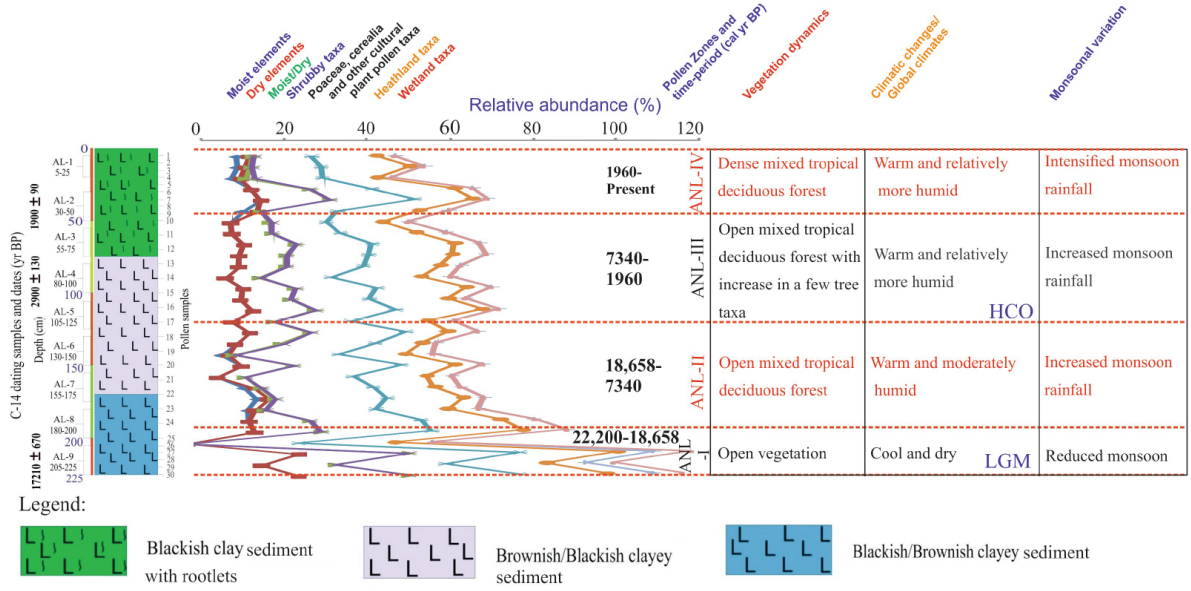


Fig. 5 - Summary pollen diagram of tree taxa, shrubs, and herbaceous taxa from Anandpur Nursery Lake (ANL) sediment profile, Koriya District. The pollen zones are designated with the initials 'ANL' after the name of the site of investigation Anandpur Nursery Lake (ANL).

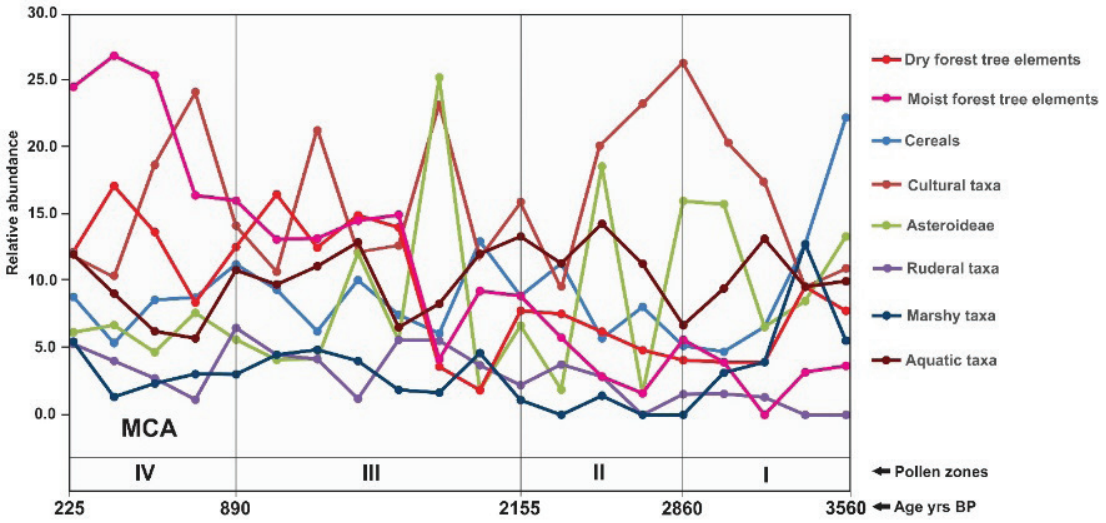


Fig. 6 - Major pollen taxa groups recovered from the RRL sedimentary profile, demonstrating their relative abundance over the past 3560 years.

Dry Deciduous (0.11) and Ar/A (0.46) ratios, coinciding with the Meghalayan event (~4.2k).

- ~3480–1965 cal yr BP: Alternating warm/humid and cold/dry phases, marked by three major vegetation declines (~3240–3060, 2680–2480, 2270–1965 cal yr BP), indicating ISM variability.
- ~1965–940 cal yr BP: Strengthening ISM, reflected by re-expansion of *Shorea* and moist deciduous taxa.
- ~940–540 cal yr BP: Weaker ISM phase, evident from increased non-arboreal pollen (NAP).
- ~540 cal yr BP–present: Intensified ISM, indicated by enhanced wetlands and herbaceous vegetation.

The ESPS model, spanning ~7500 cal yr BP to present, corroborates the palynological evidence of ISM oscillations, highlighting severe drought events around ~4460–3480 cal yr BP (Meghalayan event) and ~2100 cal yr BP.

Morphometric analysis of cereal and non-cereal pollen from the Ganga Plain

A biometric threshold has been established to identify and distinguish fossil cereal and non-cereal pollen (Poaceae) in sediment samples by examining the detail morphometry of 22 grass pollen taxa from the Ganga Plain (Fig. 4). Thus, the inception and subsequent pace of agricultural activities in the past could be well deciphered through this approach.

Palynological assessment of sedimentary section from Kanwar Lake

An initiative has been taken to understand the ISM variability during the Holocene using fossil pollen records from the 300 cm deep sedimentary section from the Kanwar Lake in Begusarai District of Bihar. The study suggests five phases of vegetation and climatic alterations based on different palynozones (I-V) during 13,885 to 2,729 cal. yrs. BP., with dominance of non-arboreal taxa over arboreal taxa.

ISM variability since the Last Glacial Maximum (LGM) from the central Indian Core Monsoon Zone

Signatures of the Last Glacial Maximum [LGM; (cool–dry climate and weak monsoon] between ca. 22,200 and 18658 cal yr BP, and Holocene Climate Optimum [HCO; (warm and humid climate; increased monsoon)] between 7340 and 1960 cal yr BP have been found in the Koriya District of Chhattisgarh State, central India (Fig. 5).

Late Holocene monsoonal climates from the central Indian Core Monsoon Zone

Signature of the global warm Medieval Climatic Anomaly (MCA) during ca. 890 to 225 cal yr BP (CE 1060–1725) has been recorded from the Raja Rani Lake area of Korba District, Chhattisgarh, central Indian Core Monsoon Zone (CMZ) (Fig. 6).

Tree-ring study from Chhattisgarh, Central India

Based on the composite tree-ring chronology of Teak (*Tectona grandis*) developed from Chhattisgarh, average February-October soil moisture was reconstructed from 1857 to 2022 CE. This is a first long-term soil moisture reconstruction using teak tree rings in central India. The reconstruction showed linkages with the sea surface temperature from Nino3.4 region. In addition to tree-

ring width chronology (TRW), Basal Area Index (BAI) chronology of teak from two sampling sites of northern Chhattisgarh was developed. The correlation with climate showed similar correlations pattern but are stronger in BAI, indicating a more sensitive response to climate variability.

South Asian Biodiversity Portal, GIS-LULC studies, dendro-isotopic analysis, Heritage trees, Impact petrography, Geophysical Surveying and Engineering work for QLDP

The governing council representing institutions throughout the Subcontinent of the South Asian Biodiversity Portal (SABDP), hereafter SABDC, was formed in conjunction with the Association of Quaternary Researchers (AOQR). The executive team of SABDC has been formed.

Geographical Information System (GIS) Landcover-Landuse (LULC) mapping 30 years apart in historically forested areas of south Bundelkhand, India, shows that the forest patches separating large agricultural villages are not seen at present. Though the total agricultural areas and settlement areas increased against the sparse forest, the dense forest area remained the same till 2011 and then increased (Fig. 7). This probably reflects the plantations by the forest department succeeding in restoring the dense forests, but the sparse forests need more focus in the near future.

Multi-species dendro Isotope studies continue with samples from eastern UP, north-western Bihar, eastern Maharashtra, and south Bundelkhand in MP. Teak tree-ring chronologies from the U.P. region show growth decline linked to monsoon moisture. The final dating report for the Munger ITC Banyan, establishing it as the oldest dated *Ficus benghalensis* in the world.

Geochemistry and st able isotope ($\delta^{13}C$ & $\delta^{18}O$) signatures of Calcrete in the Ganga Plains: Implications for palaeoclimate and palaeovegetation patterns

The $\delta^{13}C$ and $\delta^{18}O$ values in nodules from Hamirpur ranged from -5.26 to -3.18‰ and -6.42 to -5.56‰, respectively. In nodules from Lucknow, $\delta^{13}C$ and $\delta^{18}O$ values ranged from -1.64 to -1.28‰ and -7.47 to -5.14‰, respectively. Mollusc specimens from the same horizon in Lucknow showed $\delta^{13}C$ and $\delta^{18}O$ values of -3.2‰ and -5.7‰, respectively. The co-variation of $\delta^{13}C$ and $\delta^{18}O$ values suggests a significant influence of palaeoclimate and palaeovegetation. FTIR and XRD analyses of soil carbonate nodules indicate that the majority composition is calcite, with minor occurrences of quartz. Geostatistical evaluations, including multiple correlation, cluster analysis, and principal component analysis (PCA) of major, trace and rare earth elements geochemistry, reveal interrelationships and affinities among the elements within the calcretes. The reconstructed water isotopes from Hamirpur and Lucknow align with isotopic signatures from Betwa River water and rainwater, respectively. Similarly, palaeowater isotopes from co-occurring molluscs at Lucknow support these findings. The carbon isotope data suggest that C3 and C4 plants co-existed during calcrete deposition at Hamirpur, while C3 plants dominated in Lucknow during the same period. Overall, the proxies from major, trace and rare earth elements, alongwith stable isotope signatures in calcrete deposits, indicate arid to semi-arid climatic conditions.

Geospatial contouring of gridded samples in Central Ganga Plain (CGP)

Geospatial contouring of tree and terrestrial taxa from gridded samples in the Central Ganga Plain (CGP) reveals distinct vegetation-environment relationships across different geomorphic surfaces. The T2 surface is marked by the dominance of non-arboreal taxa, indicating open landscapes or upland surfaces, and is further supported by palynological evidence pointing toward human-associated activities. In contrast, the T1 surface occasionally records a high percentage of fungal spores, which signifies the influence of hinterland aquatic realms. Both T1 and T2 surfaces also exhibit notable assemblages of wetland and marshy taxa, typically associated with low-lying geomorphic features such as ox-bow lakes, abandoned channels, and meander cut-offs. Additionally, the presence

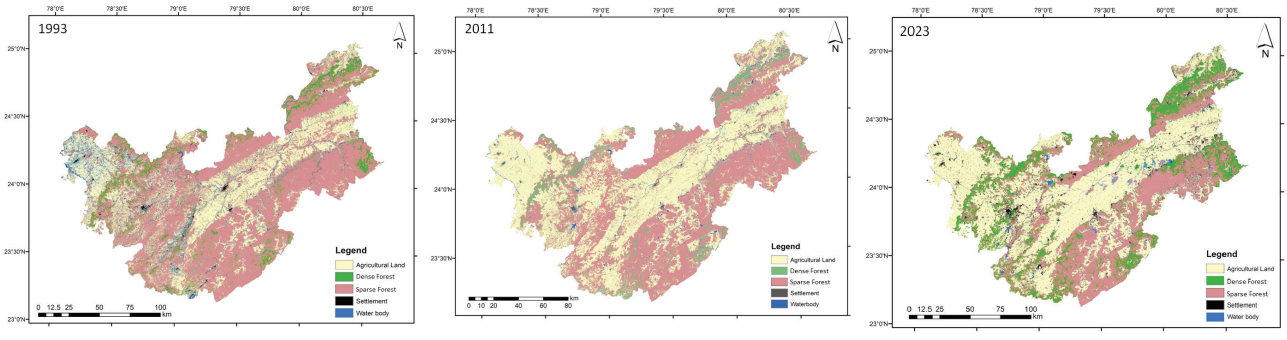


Fig. 7 - Land Cover changes seen in LANDSAT images for South Bundelkhand area.

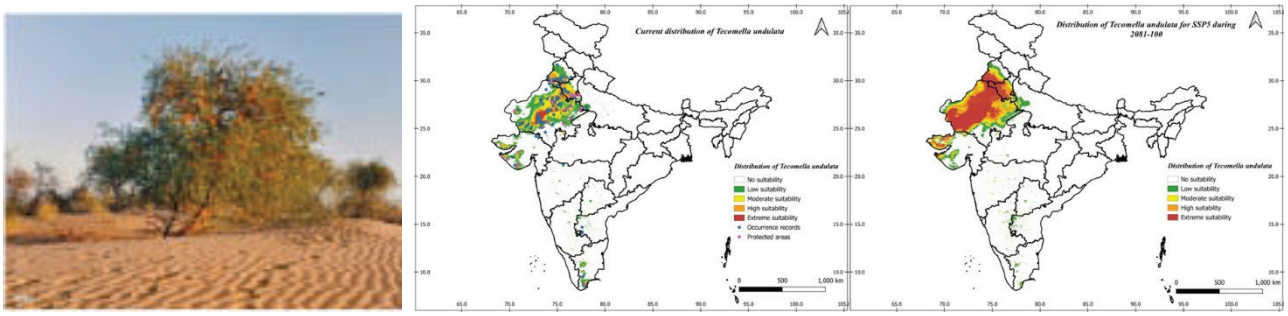


Fig. 8 - Surviving *Tecomella undulata* in northwest India, current distribution of *Tecomella undulata* in the Indian Subcontinent based on occurrence records and species distribution modelling, distribution map of *T. undulata* for SSP5 scenario in 2081-100.

of drifted or extra-regional pollen taxa highlights the role of long-distance riverine transport and/or aeolian deposition in shaping the palynological spectrum. Collectively, the integration of pollen/spore records with geomorphic features underscores a coherent relationship between vegetation patterns and the depositional environment across the Ganga Plain.

Palynofacies of Kanwar Lake, Begusarai

The palynofacies and grain size analysis of the Kanwar Lake core, as shown in the CONISS-based zonation, reveals five distinct palaeoenvironmental phases. Zone I reflects a high-energy fluvial setting with coarse sand and degraded organic matter, suggesting active channel flow. Zone II marks a transition to a marshy floodplain with increased aquatic indicators and finer sediments. Zone III indicates stable, low-energy lacustrine or swamp conditions, dominated by silts, clays, and amorphous organic matter. Zone IV shows renewed fluvial activity with mixed grain sizes and increased terrestrial input, suggesting episodic flooding. Finally, Zone V returns to calm, waterlogged conditions with high organic preservation and clay dominance, likely representing the modern wetland phase. The CONISS statistical clustering highlights significant transitions in sedimentary and biological input across these zones, reflecting dynamic shifts in depositional energy and hydrology over time. This succession outlines a clear environmental evolution from riverine to lacustrine systems.

Modelling the potential response of an endangered arid land tree *Tecomella undulata* to past and future climate change scenarios in the Indian Subcontinent

Dryland ecology has changed significantly due to climate change and human activities, impacting agropastoral communities and biodiversity. The endangered *Tecomella undulata*, or 'desert teak,' adapted to extreme climates, provides fodder, timber, medicinal products, and supports soil fertility and desertification control. Its reduced distribution, now mainly in north-western India, Saurashtra, and southern coastal Tamil Nadu, affects local ecology and agropastoral communities. Research using Species Distribution Modelling (MaxEnt) studied its historical changes and future responses to climate change. Findings suggest increased future distribution with higher temperatures and erratic rainfall. Conservation efforts should minimize human interference and establish protected areas in north-western India and Saurashtra to support *Tecomella undulata*'s survival (Fig. 8).

SPONSORED PROJECT (SP)

SP 8.1: **Fluid-rock interaction at shallow subsurface level in the upper continental crust and its implications in altering the textural, mineralogical and geochemical characteristics of host rocks** [Sponsored by MoES, Govt. of India (MoES/P.O.(Seismo)/1(374)/2019]

Investigators: Anupam Sharma, Scientist-G, BSIP, Lucknow (PI), Kamlesh Kumar, Scientist-D, BSIP, Lucknow (CO-PI 1), Matsyendra Kumar Shukla, Scientist-C, MoES-BGRL (CO-PI 2), Piyal Halder (SRF, SAGE-MoES)

As a part of the extramural project sponsored by MoES, Govt. of India, the core samples of basement granitoids, were collected from the Core Repository of the Borehole Geophysics Research Laboratory, Karad (MoES-BGRL). The holistic overview of the different analyses carried out in the last few years reveals that the altered zones in the granitoids underlying the Deccan Volcanic Province have interacted with the fluid and undergone propylitic grade of hydrothermal alteration. Most intriguingly it has been found that the newly formed chlorite in the faults and fractures has the potential to accommodate strain as a function of the strength of its internal Hydrogen bonds. As a consequence, chlorite promotes creep motion in the fault zone. Thus, the outcomes emanated from this study successfully explain why the Koyna-Warna region in Maharashtra has been experiencing recurrent tremors

for the last six decades. Furthermore, it sheds light on how the atomic level parameters of the minerals (such as bond strength) govern the physical properties of the host rocks as well as regulate response to increasing stress conditions, thereby controlling the motion of faults and the occurrence and magnitude of the earthquakes in a region. The outcomes of this study can be pathfinder, particularly when the recent earthquake in Delhi on 17th February 2025 has been attributed to similar fluid-filled weak lineaments. These significant insights have been disseminated in two journals of international repute and presented at various national and international conferences including International Geological Congress at Busan, South Korea (Fig. SP 8.1).

SP 8.2: **Microbe assisted recovery of rare earth elements laterite badlands, coal and lignite mines overburden** (CRG/23/005851) (Sponsored by ANRF, Govt. of India]

Investigators: Anupam Sharma, Scientist-G, BSIP, Lucknow (PI), Manoj MC, Scientist-D, BSIP, Lucknow (CO-PI 1), Yusuf Akhtar and Digvijay Verma, Assistant Professors in BBAU, Lucknow (CO-PIs 3 and 4), Roshni Sharma (JRF, BBAU, Lucknow)

Field visits for the collection of samples were conducted in two geologically different terrains namely the open cast lignite mines in and around Barmer District of Rajasthan and open cast lignite mines near Asansol City in West Bengal. The lignite mines visited include Kapurdi, Jalipa, Sonari and Giral mines and coal mines were Sonpur Bajari and Chapapur. Sample collection has been performed from these mines which include lignite/coal, grey shale, carbonaceous shale, clay, sand and other lithological units considered as overburden. Besides, some additional potential sites in the adjoining areas were also visited, e.g. Gangani badlands, all having potential REE contents. The samples collected are under process for estimating their bulk chemistry including the REE content and experiments are designed to study the microbial communities, and their influence on the rare earth element (REE) possible enrichments. In addition, the sediment samples from badlands in Gangani (geotourism and geoheritage site) located close to Durgapur was also sampled for microbial community and geochemistry of REE studies.

SP 8.3: **Quantification of vegetation using pollen in the present and past landscapes of Core Monsoon Zone using a novel approach** [Sponsored by CSIR, New Delhi. Project No. 37WS (0087)/2023-24/ EMR-II/ ASPIRE].

Investigator: Anjali Trivedi (Scientist E); Anupam Nag, JRF (joined on 03-03-2025).

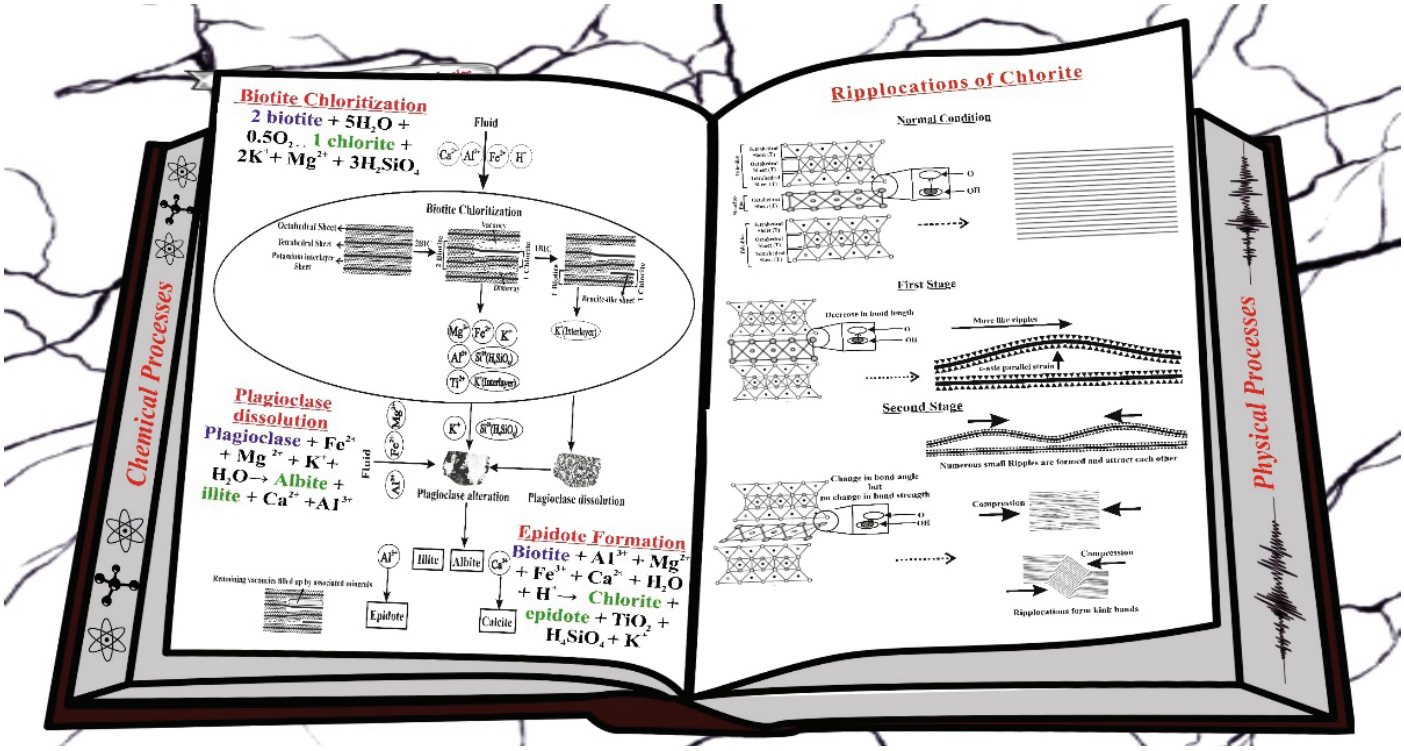


Fig. SP.8.1 - The figure demonstrates how the coupling of physical and chemical processes in the fluid-mediated faults govern the nucleation of earthquakes. The flow diagram on the left-hand page in the opened book illustrates the chemical processes producing the clay minerals and the phase diagram in the right-hand page represents the intracrystalline deformation in the neoformed mineral affecting the fault slip behaviour.

An extensive 17-days fieldwork was conducted across selected forested regions of Chhattisgarh to evaluate vegetation structure and species composition under the sponsored project. The REVEALS (Regional Estimates of Vegetation Abundance from Larger Sites) method was employed for systematic data collection and ecological classification. Stratified sample plots were established across various forest types to quantify tree density, canopy cover, and regeneration patterns. GPS mapping and photographic documentation were also carried out to support spatial analysis and ecological interpretation of the forest landscape.

SP 8.4: Reconstruction of Arabian Sea coastal upwelling conditions and seawater temperature gradient during Miocene (Burdigalian), India: Insights from Stable and Clumped isotope analysis of otoliths and molluscan fauna (Sponsored by SERB-CRG/2022/003341).

Investigators: Prasanna K, Scientist-C, BSIP, Lucknow (PI), Vivesh V Kapur, Scientist-D, BSIP, Lucknow (CO-PI), Amal MS (JRF, SERB, CRG)]

The Quilon section that lies in the southern part of the onshore Kerala Basin at the base of sea cliffs extending into Ashtamudi Lake (N 08°58'36", E 076°38'08") was studied. This place is part of Padappakkara Village, 5.4 km west–northwest of Kundara, and locally known as 'Channa Kodi'. It corresponds to the outcrop studied by Dey (1961) and Menon (1967a, b) and is the type locality of the Quilon Limestone. The Cenozoic sedimentary succession in the onshore part of the Kerala Basin is dominated by siliciclastic sediments with interbedded lignite seams. Elevation and denudation of the Western Ghats at the rift shoulder was the source for siliciclastics (Campanile *et al.*, 2008). Ostracod faunas and palynofloras from these deposits document deposition in marginal marine brackish lagoons as well as brackish and freshwater swamps (Rao & Ramanujam, 1975; Rao, 1995). The samples of the carbonaceous shale of Quilon beds in Pozhikkara cliff section were analysed to derive fossil microfauna, dominated by benthic foraminifers, ostracods ad fish otoliths mainly gobiids (Fig. SP 8.3(a)).

Studies of the oxygen isotopes of the growth bands of three specimens of bivalve *Corbulidae* cf. *L. trigonalis* (Sowerby, 1840) from Kutch, Gujarat State, western India, was conducted. The shell length was ~40 mm and the seasonal growth rate was deduced to an average of 2 mm/month based on the Corbulidae *Corbula trigona* species which has a reported lifespan of 2 years (Kidwell & Rothfus, 2010). This sample had $\delta^{18}O$ shell values that indicated a strong seasonality. In the present investigation, the $\delta^{18}O$ values for the bivalve *Corbulidae* cf. *L. trigonalis* range from -2.6‰ and 1.23‰ VPDB while the $\delta^{13}C$ values for this taxon vary from -2.9 to -0.8‰ VPDB (Fig. SP 8.3(b)).

The analysed section of the shells recorded a two-year cycle of $\delta^{18}O$, reflecting the seasonal temperature change. When plotted on a $\delta^{13}C$ vs $\delta^{18}O$ cross-plot (Fig. SP 8.3(c)), samples cluster together, irrespective of the sampling depth. Elemental analysis of the sample is done using the Inductively Coupled Plasma - Optical Emission Spectrometry (ICP-OES) facility at the Birbal Sahni Institute of Palaeosciences, Lucknow, India. The seasonal range in Lower Miocene (Burdigalian) water temperature in the Indian Ocean is calculated from different samples using different Mg/Ca-temperature equations. Mg/Ca ratios from the specimen display a cyclic pattern. The Mg/Ca ratio values for a specimen range from 1.12 to 10.23 mmol/mol. Mg/Ca – Temperature calibration for an

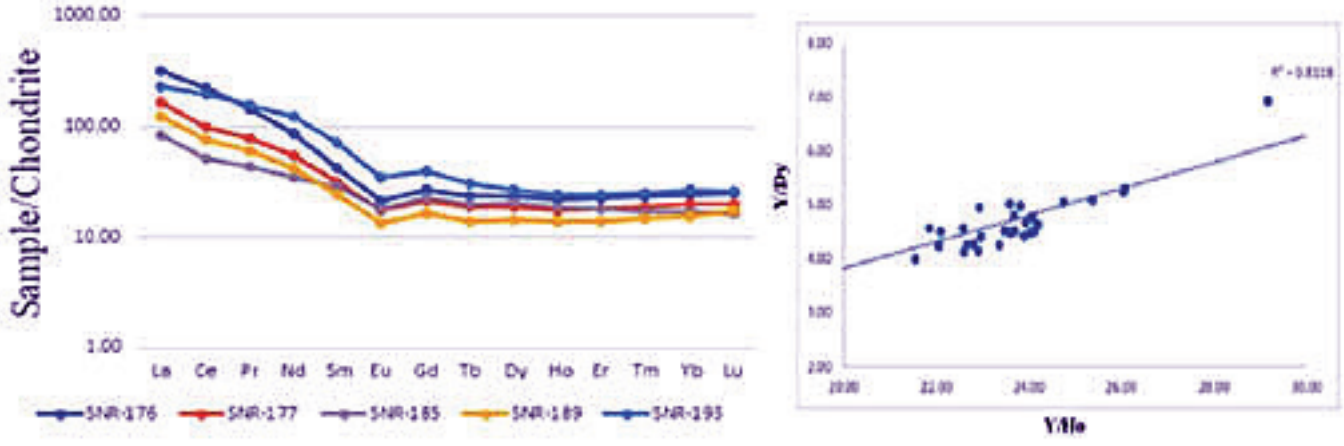


Fig. SP 8.2 - The Chondrite normalized REE plot of samples collected from the Sonari Lignite mines in Barmer, Rajasthan. A few samples show significant enrichment of LREE. Also, the Y/Dy and Y/Ho cross plot indicate a shallow marine oxidizing environment of deposition, which is an important factor in determining the mobility of REEs.

Fig. SP 8.3(a) - The samples of the carbonaceous shale of Quilon beds in Pozhikkara cliff section where analysed to derive fossil microfauna, dominated by benthic foraminifers, ostracods ad fish otoliths mainly gobiids

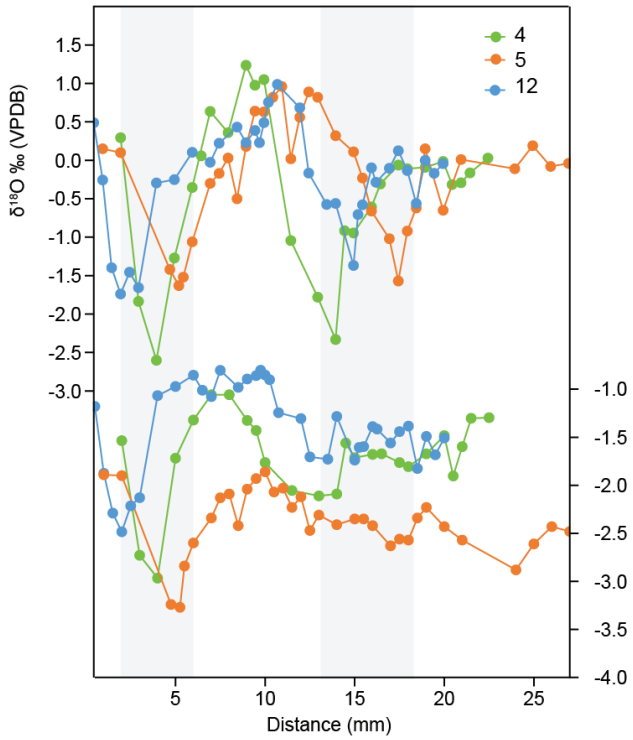


Fig. SP 8.3(b) - $\delta^{18}O$ and $\delta^{13}C$ data from the shell of a bivalve *Corbulidae* cf. *L trigonalis* collected from Chhasra Formation, Kachchh, India. The bivalve provides an insight into annual temperature cycles during the Burdigalian.

estuarine oyster, *Crassostrea gigas* from marine settings (SST = 3.77 × Mg/Ca +1.88; T in °C and Mg/Ca in mmol/mol; Mouchi *et al.*, 2013). By using this equation we got a temperature range which is comparable with Seawater temperatures calculated from the δ^{18}Osw values of sharks, rays and fish (Cappetta, 1987; Nelson *et al.*, 2016). The temperature for the locality of Mendouillet and Monbalon-Miron, respectively in France during the Miocene ranges from 14 °C to 29 °C with a mean value of 23 ± 4 °C and from 15 °C to 30 °C with a mean value of 24 ± 4 °C (Goedert *et al.*, 2017).

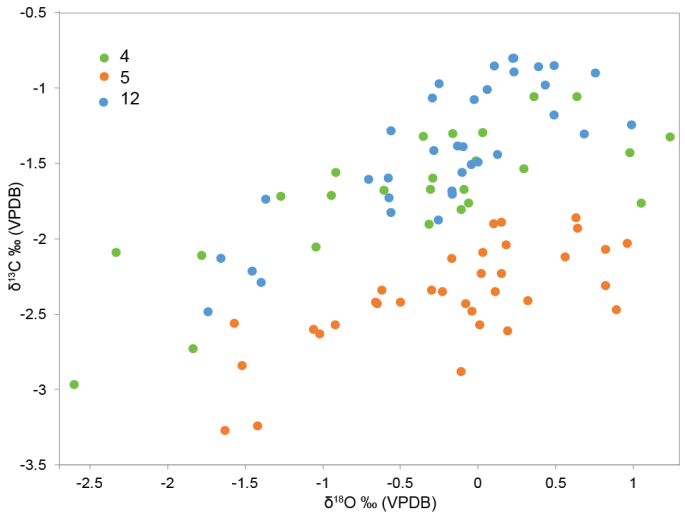


Fig. SP 8.3(c) - $\delta^{13}C$ vs. $\delta^{18}O$ cross-plot. Cross-plot of carbon and oxygen isotopic ratios for all three (namely 4, 5, 12) *Corbulidae* cf. *L trigonalis* samples analysed in this study.

COLLABORATIVE PROJECTS (CP)

CP 8.1: Morphometry of the spores of *Adiantum* spp. from India.

Swati Tripathi & Arya Pandey [& Achuta Nand Shukla, Brijesh Kumar & Arti Garg, BSI, Allahabad]

The detailed investigation of spore morphology of 21 species of genus *Adiantum* (commonly known as "Maiden Hair Fern) growing in tropical and subtropical regions of India has been studied using LM and FESEM. The generated database would highlight the taxonomic characterisation of these species with finer morphometrical variations that would be useful to correlate the studied species with other *Adiantum* species growing around the world. The study of their spore variability would provide an aid for understanding their adapting characters towards the changing climate and reflect the environmental implications of the respective area where these species are

growing (MS published in 'Palynology' journal).

CP 8.2: To study the history of Indian Baobabs (Indo-French interdisciplinary MANDU Project).

Trina Bose [& Avanish Mishra, Project Assistant, joined on 20.1.2025]

The Project began in October 2024 to study the history of Indian Baobabs. Two field trips were conducted during October and November 2024 to Mandav and Dhar in Madhya Pradesh, where Baobab samples were collected. These samples were extracted from their casings, dried, and mounted in specially designed frames to accommodate the thicker specimens. Preliminary assessments were carried out to evaluate their potential for dendrochronological study.

CP 8.3: Chronology of Munger ITC Banyan tree (project from Forest Department, Bihar State).

Trina Bose

The Munger ITC Banyan has now been established as the oldest dated *Ficus benghalensis* in the world. The research employs a combination of dendrochronology and radiocarbon dating techniques to determine the age of heritage trees. The innermost pith layers were carefully isolated and processed to extract alpha-cellulose, which was then analysed using radiocarbon dating to determine the tree's earliest growth phase. In conjunction with this, sediment samples were collected from the Sitamarhi Site near the tree for carbon isotope analysis and pollen studies, the latter carried out by Dr. Sadhan Basumatary.

OTHER ACADEMIC WORKS

RESEARCH PAPERS PRESENTED

1. Tripathi S, Garg A, Pandey A, Singh P, Singh A & Sharma A – Micro-morphometry of cereal and non-cereal pollen using LM, CLSM and FESEM: Implications to decipher past anthropogenic activities in the Central Ganga Plain. 29th ICMS, 2024, DU, New Delhi. October 17-19, 2024: Page 197.
2. Quamar MF – Vegetation and climate change since the LGM from the central Indian CMZ. IWEC'24, TIFR: NCBS during June 14-17, 2024.
3. Quamar MF, Banerji US, Thakur B & Kar R – An overview of the pollen-based hydroclimatic changes in the Core Monsoon Zone of India since the Last Glacial Maximum. 29th ICMS, 2024, DU, New Delhi. October 17-19, 2024: Page 102.
4. Quamar, MF – Vegetation and climate change over the past 8.4 kyr: Core Monsoon Zone lake sediments pollen records and signatures of global climatic events. 40th Convention of the Indian Association of Sedimentologists (IAS-2024) & National Conference on 'An Odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental, Climatic and Energy Research'. BSIP, Lucknow. December 11-13, 2024: Page 142.
5. Mishra A, Bose T, Kumar A, Shekhar M & Sharma A – Landcover changes seen in Landsat and Google Earth images 25 years apart in historically forested areas of south Bundelkhand, India. Indian Quaternary Conference (IQC) – 2024, IISER-Mohali. June 3-5, 2024.
6. Bose T – Integration of biological data across archives for identification of interconnections. National Conference on "Advancements and Innovations of Biological Sciences in Researches and Sustainable Development" AIBSBRSD-2025, Institute of Sciences, SAGE University, Indore. March 27-28, 2025.
7. Srivastava J – Predictive models for climate change impact on tropical deciduous and evergreen forests of India. Lake 2024: Wetlands for Human Well-being (The 14th Biennial Lake Symposium) at Alva's Institute of Engineering & Technology, Moodubidire. October 19, 2024: Abstract Page No. 81.
8. Srivastava J – Mangrove forest dynamics in response to climatic and sea level changes along the Indian coastline. 4th International Conference on Geology: Emerging Methods and Applications (GEM-2025) to be held at Christ College Autonomous, Irinjalakuda, Thrissur, Kerala. January 28-30, 2025: Abstract Page No. 17-18.
9. Srivastava J & Thampan J – Ecological niche models for rare keystone species of drylands to identify priority conservation sites using environmental and landcover variables. International Conference on ecosystem functioning & sustainability in changing environment" scheduled from February 6-8, 2025 at Banaras Hindu University, Varanasi: Abstract Page No. 51.
10. Halder P, Sharma A, Kumar MK & Kumar K – Decoupling the chemico-physical processes in fluid-mediated faults and its implications for seismicity in the Koyna-Warna Seismogenic Region, western India. 8th National Geo-Research Scholars Meet (NGRSM-2024), Wadia Institute of Himalayan Geology (DST, Govt. of

India) and Shree Mata Vaishno Devi University in Katra, Jammu and Kashmir. November 22-25, 2024: Abstract Page No. 61-62.

11. Halder P & Sharma A – Decoding the role of clay mineralization in the landslides of the Lesser Himalayas: A rheological perspective of the Himalayan landslides. National Seminar on Disaster Risk Reduction in the Himalayas: Recent Advancements, Center for the Study of Regional Development (CSRD), Jawaharlal Nehru University (JNU), Delhi. September 20-21, 2024: Abstract Page No. 45.
12. Halder P, Shukla MK, Kumar K & Sharma A – Intracrystalline deformation may explain the recurrence of small-magnitude tremors in an intraplate region- A case study from the Koyna-Warna Seismogenic Region, western India. 37th International Geological Congress, Busan, South Korea. 25-31 August, 2024: Abstract Page No. 596-597.
13. Halder P, Shukla MK, Kumar K & Sharma A – Biotite alteration in the basement faults- a plausible cause of earthquake recurrence at the Koyna-Warna Seismogenic Region, Maharashtra, India. 2nd Indian Quaternary Congress (IQC) Association of Quaternary Researchers (AOQR), IISER Mohali. June 3-5, 2024.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Binita Phartiyal

- Climatic variations across the last 2.6 millennia in central India: Bandhavgarh a case study. Ashoka University, Sonipath, Haryana Workshop on-Archaeology and Ecology of Bandhavgarh Tiger Reserve during November 22, 2024.

Anjali Trivedi

- Ecological Vulnerability and Socioeconomic Resilience: Assessing the Multidimensional Impact of Climate Change on Tribal Workshop organised by Niti Ayog, New Delhi and Aranya Bhawan Chhattisgarh during March 28, 2025.
- Monsoons, dynasties and vegetation: Reconstructing climate-dynasty interactions in Medieval South Asia. 55th Annual Archaeological Conference, The Indian Archaeological Society (New Delhi), and Pt. RSSU University, Raipur, Chhattisgarh during March 5-7, 2025.
- Quaternary climate, vegetation dynamics, and archaeobotanical insights: A review from the Indian Subcontinent. JMAU (KOTA), Indian Archaeological Society (New Delhi), Indian Society for Prehistoric and Quaternary Studies (Pune), and History and Culture Society, (New Delhi) during July 25-27, 2024.

Anupam Nag, Anjali Trivedi & DP Tewari.

- Variable monsoons and human adaptations: palaeobotanical and climate records in northwestern India during the past 2000 years (Organised by: JMAU (KOTA), Indian Archaeological Society (New Delhi), Indian Society for Prehistoric and Quaternary Studies (Pune), and History and Culture Society, New Delhi during July 25-27, 2024.

Savita Awasthi & Anjali Trivedi

- Quantitative reconstruction of palaeoclimate and vegetation of the central India through pollen proxy records presented by (Organised by: JMAU (KOTA), Indian Archaeological Society (New Delhi), Indian Society for Prehistoric and Quaternary Studies (Pune), and History and Culture Society, New Delhi during July 25-27, 2024.

Anjali Trivedi, R Shivanatham, K Ranjan, M. Ramesh & P Morthekai

- Climate and Culture in Ancient Keezhadi: Linking Sangam Settlements to Holocene Climate Changes (Presented at: 40th Convention of Indian Association of Sedimentologists). Birbal Sahni Institute of Palaeosciences, Lucknow during December 11-13, 2024.

Anupam Nag & Anjali Trivedi

- Characterising modern pollen rain and vegetation relationships in the northwestern Himalayas, India (Presented at: 40th Convention of Indian Association of Sedimentologists). Birbal Sahni Institute of Palaeosciences, Lucknow during December 11-13, 2024.

Savita Awasthi, Anjali Trivedi & Dhruv Sen Singh

- Impact of urbanization expansion and climate change on the nectar collection preferences of honey bees: A pilot study (40th Convention of Indian Association of Sedimentologists, Birbal Sahni Institute of Palaeosciences, Lucknow) during December 11-13, 2024.

Mohd Ikram, Anjali Trivedi & Shailesh Agrawal

- Pollen-vegetation and stable carbon isotope analogues from the Central Ganga Plain, India: Implications for palaeoecological reconstruction. (40th Convention of Indian Association of Sedimentologists, Birbal Sahni Institute of Palaeosciences, Lucknow) during December 11-

13, 2024.

Swati Tripathi

- Indian Wildlife Ecology Conference 2024 (IWEC'24) at the TIFR-NCBS, Bengaluru (Karnataka) during 14-16 June 14-16, 2024.
- 29th ICMS, 2024, Delhi University, New Delhi, India held during October 17-19, 2024.
- 40th Convention of the Indian Association of Sedimentologists (IAS-2024) & National Conference on 'An Odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental, Climatic and Energy Research' at the DST-BSIP, Lucknow during December 11-13, 2024.

MF Quamar

- Indian Wildlife Ecology Conference 2024 (IWEC'24) at the TIFR-NCBS, Bangalore (Karnataka) held during June 14-16, 2024.
- 29th ICMS, 2024, DU, New Delhi, India during October 17-19, 2024.
- 40th Convention of the Indian Association of Sedimentologists (IAS-2024) & National Conference on 'An Odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental, Climatic and Energy Research' at the DST-BSIP, Lucknow during December 11-13, 2024.

Jyoti Srivastava

- 14th Biennial Lake Symposium at Alva's Institute of Engineering & Technology, Moodubidire during October 17-20, 2024.
- 4th International Conference on Geology: Emerging Methods and Applications (GEM-2025) at Christ College (Autonomous), Irinjalakuda, Thrissur, Kerala during January 28-30, 2025.

Trina Bose

- Indian Quaternary Conference (IQC) - 2024 in IISER-Mohali during June 3-5, 2024.
- Attended a Meeting in New Delhi regarding the two field proposals submitted for INQUA 2027 during March 22-23, 2025.
- National Conference on "Advancements and Innovations of Biological Sciences in Researches and Sustainable Development" AIBSBRSD-2025, Institute of Sciences, SAGE University, Indore during March 27-28, 2025.
- International Conference on Ecosystem Functioning & Sustainability in Changing Environment" at Banaras Hindu University, Varanasi during February 6-8, 2025.

Anupam Sharma

- दिसंबर 20, 2024 को विज्ञान और प्रौद्योगिकी विभाग द्वारा आयोजित एक दिवसीय राजभाषा कार्यशाला-सह-प्रशिक्षण सत्र में संस्थान का प्रतिनिधित्व करने हेतु नियुक्त किया गया.

TRAINING/STUDY VISITS

Jyoti Srivastava

- Participated in DST training programme on "Advanced technologies for Urban Development" in National Institute of Advanced Studies, IISc campus, Bengaluru" during February 17-21, 2025.

Anupam Sharma

- Summer Internship to Darshana O, from Manipal Institute of Technology, Manipal, Karnataka under the IASc-INSA-NASI Summer Research Fellowship, 2024, on "Major, Trace and REE Geochemistry of Ganga Plain Sediments: Implication for Provenance and Weathering".

Binita Phartiyal

- Training to Siddharth Pratap Singh of BBAU, Lucknow on "Mineral magnetic mapping of the interfluves between Ghaghra and Ganga rivers, Central Ganga Plain, India" during January-June 2024.
- Training to Xavier Thomas of SAS SNDP Yogam College, Konni, Kerala on "Environmental Magnetic variation in Dhobia Tal lake site of Bhandavgarh, MP, during February April 2024.
- Training to Sona S of SAS SNDP Yogam College, Konni, Kerala on "Environmental Magnetic variation in the sediment core of Chakradhara meadow, MP" during February April 2024.
- Training to Saumya Pathak of Department of Environmental Studies, Lucknow University on "Magnetic analysis of surface sediment samples from western Vidarbha, Maharashtra", during April –July 2024.
- Training to Garvit Sahai graduate student from Department of Botany, Lucknow University on "Environmental Magnetism of Sasoma, Ladakh and Pollen Analysis of Dhobia Tal, Bandhavgarh, Madhya Pradesh" during April –July 2024.
- Training to Vishesh Vanjani, graduate student from IISER, Bhopal on "Applications of geomorphology in the analogue studies: Ladakh an example", during July-August 2024.
- Training to Lazi Bhutiya of AMITY, Mumbai on "Relevance / Significance / Importance of Tsokar and Tso Moriri regions of Ladakh in Analogue

studies", during July-August 2024.

- Training to Ajith Kumar of K Periyar University (PG Extension Centre), Tamil Nadu on "Relevance/Significance/Importance of Tsokar and Tso Moriri regions of Ladakh in Analogue studies", during January – April 2025 as a part of his Phd under supervision of Dr. Vidyasakar Anburaj.

MF Quamar

- Guided M.Sc. Dissertation of Varsha Maharana, from Department of Geology, The Maharaja Sayajirao University of Baroda, Vadodara, Gujarat entitled "The palynology of surface samples from the Rann of Kuchchh, Gujarat, India", during October 2023 to February, 2024.
- Training to Mr. Ayush Shukla, (pursuing B.Sc. Geology), Department of Geology, B.B.A.U., Lucknow on "The palynology of surface samples from the Hoshangabad District, Madhya Pradesh, India", during March-April, 2024.
- Guided M.Sc. Dissertation of Sakshi Awasthi, Department of Chemistry, University of Lucknow, Lucknow, India on "Modern pollen deposition pattern around the Amjhera Swamp of the Hoshangabad District, Madhya Pradesh, India" during April-May, 2024.
- Guided M.Sc. (Environmental Science) Dissertation of Swati Singh, M.Sc. (Environmental Science; 4th Semester), Department of Botany, University of Lucknow, Lucknow, India on "Modern pollen vegetation relationship from the Reasi area of Jammu region, J & K, India", during April-June, 2024.
- Training to Anant Kushwaha B.Sc. (Geology), Department of Geology, B.B.A.U., Lucknow on "The basic know-how of pollen extraction protocol on the surface samples from the Korba District of Chhattisgarh State, India", during March-April, 2024.
- Guided M.Sc. (Botany) Dissertation of Bhargavee Pandey, M.Sc. (Botany; 4th Semester), Department of Botany, University of Lucknow, Lucknow on "The pollen heteromorphism of *Schleichera oleosa*", during July 1-30, 2024.

Swati Tripathi

- Guided M.Sc. (Environmental Science) Dissertation of Anshika Singh, University of Lucknow, Lucknow on "Pollen morphology of grass pollen samples from the Ganga Plain, India", during April-July, 2024.
- Guided M.Sc. (Environmental Science) Dissertation of Afis Mahamood M. Department of Environmental Science, Central University of Kerala, Kerala, and Summer Research Fellow-2024 (Indian Academy of Science, Bengaluru) on "Palynology of honey samples from different regions of Meghalaya" during April- July 2024.
- Guided M.Sc. (Botany) Dissertation of Anshika Upadhayay, University of Lucknow, Lucknow on "Palynology of honey and sediment samples" during June-September, 2024.

Kamlesh Kumar

- Guided M.Sc. Dissertation of Pranjali Sharma from School of Earth Sciences, Banasthali Vidyapith, Rajasthan on "Late Holocene paleoclimatic study of lacustrine sediment in Central Ganga Plain" during June 2024.

LECTURES DELIVERED

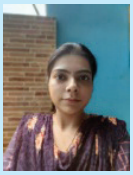
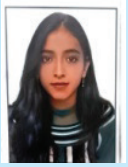
Anupam Sharma

- Invited as an Inaugurating Speaker for the Certificate Course on *"Antarctica: Exploring a continent of wonders"* organised by the Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia. The course is scheduled to be held in hybrid mode from October 21–30, 2024.

Binita Phartiyal

- Prospects of astrogeology and astrobiology in Ladakh, Trans Himalaya. Space Instrumentation and Payload Development Workshop, IIT Kanpur; 29th March, 2024.
- Keynote -Taking the road Less Travelled - From Nainital to the North and South Pole - uncovering mysteries of the universe #ChooseToChallenge, Uttarakhand Council for Science and Technology (UCOST) and VigyanShaala International - 'She for STEM' initiative in Uttarakhand. 10th August, 2024.
- Ladakh as a Martian analogue site in the Indian subcontinent: A testbed for space science research and instruments IISc, Banglore Education Center (online). 31st August, 2024.
- Red Planet in the Himalayas: Leveraging Ladakh's Unique Environment for Martian Research, Amity University, Mumbai's AMASE-2024 participants during the expedition in Ladakh (online) 1st September, 2024.
- Two lectures-Part 1: Scientific Scope, Challenges and Opportunities; Part 2: Evolution of landscape and climatic variations in the Schirmacher Oasis, East Antarctica during Holocene Department of Geology & IQAC. Kabi Jagadram Roy Government General Degree College, Mejia,

PH.D. PROGRAMMES

	**Tarasha Chitkara (2015).** Quaternary palaeoclimatic studies using multi-proxy approach around Kurukshetra, Haryana, India, under the supervision of **Anupam Sharma (BSIP, Lucknow)** and O.P. Thakur (Kurukshetra University), registered with Kurukshetra University. Status: Awarded.
	**Mr. Mukesh Yadav (2017)**, Secondary mineralization in Central Ganga Plain: implications to climate and earth surface processes, under the supervision of **Anupam Sharma (BSIP, Lucknow)** and U.K. Shukla (Banaras Hindu University), registered with Banaras Hindu University. Status: Submitted.
	**Harshita Srivastava (2018).** Mineralogical, geochemical and sedimentological aspects of Late Quaternary palaeolake deposits of Ladakh, NW, India, under the supervision of **Anupam Sharma (BSIP, Lucknow)** and Prof. U.K. Shukla (Banaras Hindu University), registered with Banaras Hindu University, Status: In progress.
	**Ishwar Chand Rahi (2019).** Geochemical aspects of lignite bearing deposits of Bikaner and Barmer basins of the western Rajasthan, India, under the supervision of **Anupam Sharma (BSIP, Lucknow)** and A.S. Naik (Banaras Hindu University), registered with Banaras Hindu University. Status: In progress.
	**Arvind Tewari (2020).** Variability of Indian summer monsoon during Late Quaternary in Central Ganga Plain, under the supervisor of **Binita Phartiyal (BSIP, Lucknow)**; registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress**.**
	**Shirish Verma (2021).** Sediment Characterisation and palaeoclimatic reconstruction of the Karewas, Kashmir Valley, India under the supervision of **Binita Phartiyal (BSIP, Lucknow)** and Rakesh Chandra, registered with registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.
	**Piyal Halder (2021)**. Fluid-rock interaction in the pre-Deccan basement rocks and its implications for seismicity at the Koyna-Warna Intraplate region, western India, under the supervision of **Anupam Sharma (BSIP, Lucknow)** and **Kamlesh Kumar (BSIP, Lucknow)**, registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.
	**Md. Ikram (2022)**. Reconstruction of vegetation succession, climate change and human habitation imprints on lacustrine system in the Ganga plain during late Pleistocene-Holocene Period, under the supervision of **Anjali Trivedi (BSIP, Lucknow)** and **Shailesh Agarwal (BSIP, Lucknow)**, registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.
	**Naushi Aneez (2019)**. A study on geoenvironmental status of Kukrail Reserve Forest, Lucknow, Uttar Pradesh with special reference to its soil properties' under the supervision of **Swati Tripathi, (BSIP, Lucknow)** registered with Lucknow University, Lucknow. Status: Awarded.
	**Nagendra Prasad (2020).** Reconstruction of vegetation dynamics, climate change and the Indian Summer Monsoon variability during the Holocene from the central Indian Core Monsoon Zone, under the supervision of **Md. Firoze Quamar (BSIP, Lucknow)** registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.

	**Mohammad Javed (2022)**. Vegetation and climate change during the Holocene from the central Indian core Monsoon Zone, under the supervision of **Md. Firoze Quamar (BSIP, Lucknow)**, registered with University of Lucknow, Lucknow. Status: In progress.
	**Maneesha M. ET (2023)**. Hydroclimate change and corresponding vegetation response from the central Indian Core Monsoon Zone, under the supervision of **Md. Firoze Quamar (BSIP, Lucknow)**, registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.
	**Amal MS (2023).** Reconstruction of Arabian Sea coastal upwelling conditions and seawater temperature gradient during Miocene (Burdigalian), India: Insights from Stable and Clumped isotope analysis of otoliths and molluscan fauna, under the supervisor of **Prasanna K (BSIP, Lucknow)** and **Vivesh V Kapur (BSIP, Lucknow)**, registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.
	**Adhra Renny (2023).** Reconstruction of the late Quaternary monsoon variability and associated sediment provenance, productivity, and water mass from the Arabian Sea, under the supervision of **Manoj MC (BSIP, Lucknow)** and **Srinivas Bikkina (BSIP, Lucnow)**, registered with Academy of Scientific & Innovative Research, Ghaziabad (AcSIR). Status: In progress.
	**Jereem Thampan (2022).** Modelling the potential response of natural vegetation to past and future climate change scenarios in Rajasthan, western India, under the supervision of **Jyoti Srivastava (BSIP, Lucknow)** and Mahesh Sankaran, registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad. Status: In progress.
	**Sourav Hazra (2025).** Quantitative Holocene landcover reconstruction based on pollen records from Southwest India, under the supervision of **Jyoti Srivastava (BSIP, Lucknow)**, registered with Academy of Scientific & Innovative Research (AcSIR), Ghaziabad. Status: In progress.
	**Aishwarya Gupta (2022).** Species distribution models for medicinal mangroves facing habitat loss due to Climate change and Sea level Fluctuations, under the supervision of **Jyoti Srivastava (BSIP, Lucknow)** and Ratna Katiyar Department of Botany, Lucknow University, registered with Lucknow University, Lucknow. Status: In progress.

Bankura, WB-for students of B.Sc Certificate course on Antarctica (online). 23rd October, 2024.

Jyoti Srivastava

- Invited lecture on "Predictive models for climate change impact on tropical deciduous and evergreen forests of India" in Lake 2024: Wetlands for Human Well-being (The 14th Biennial Lake Symposium) on 19th October 2024 at Alva's Institute of Engineering & Technology, Moodubidire.
- Invited lecture on "Mangrove forest dynamics in response to climatic and sea level changes along the Indian coastline" in the 4th International Conference on Geology: Emerging Methods and Applications (GEM-2025) to be held at Christ College Autonomous, Irinjalakuda, Thrissur, Kerala during January 28-30, 2025.
- Special talk on "Ecological niche models for rare keystone species of drylands to identify priority conservation sites using environmental and landcover variables" in the International Conference on ecosystem functioning & sustainability in changing environment" scheduled from February 6-8, 2025 at Banaras Hindu University, Varanasi.

CONSULTANCY/TECHNICAL SUPPORT RENDERED

Trina Bose

- Samples were analysed under the Geochemical

and TL-OSL laboratory of the Institute. The total consultancy amount during 2024-25 was Rs. 12,21,762.00 only. Apart from consultancy, other in-house project samples were also analyzed in the geochemistry laboratory.

- Submitted the final dating report for the Munger ITC Banyan to the Forest Department, Bihar State, and received an additional ₹4,00,000/- to continue the study on the Panthpakar Site in Sitamarhi.

ACCOLADES RECEIVED

Binita Phartiyal

- Plaque of Honour for women excelling in STEM, from Honourable Governor, Uttarakhand for STEM initiative of Vigyanshala International and UCOST, Dehradun- 2024

Anjali Trivedi

- Councillor, The Geophytology (2025- till date)

Swati Tripathi

- नगर राजभाषा कार्यान्वयन समिति (गृह मंत्रालय) द्वारा दिसम्बर 26, 2024 को छमाही हिंदी बैठक में बीएसआईपी की राजभाषा पत्रिका 'पुराविज्ञान स्मारिका' (सह-संपादक) को प्रथम पुरस्कार से सम्मानित किया।

REPRESENTATION IN COMMITTEES/ BOARD

Anupam Sharma

- National Advisor, Upper Indus Basin Network India Chapter, ICIMOD, 2024
- Member, Geochemical Society, USA (2024-25)
- Convener, Field Program Organising Committee, International Union for Quaternary Researchers-2027
- Convener, Post Field Excursiopn Committee, Member- Scientific Advisory Committee and Session Chair of Quaternary Sedimentary System, 40th Convention of Indian Association of Sedimentologists (IAS) and National Conference -An odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research (2024)
- Session Convener, 40th Convention of Indian Association of Sedimentologists (IAS) and National Conference -An odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research (2024)

Binita Phartiyal

- Member, National Committee for the International Union of Geological Sciences (IUGS) and International Quaternary Research (INQUA), 2024-2026
- Member, Board of Studies, Department of Geology under the School of Natural Resource Management (SNRM), Central University of Jharkhand CUJ, Ranchi, India (2024 onwards)
- Member, Organising Committee, Indian Quaternary Congress-2024
- Member, Research Advisory Committee, Wadia Institute of Himalayan Geology, Dehradun (2022-24)
- Expert Member, Subject Expert Committee (SEC) on Earth and Atmospheric Sciences under 'WISE-KIRAN-Post Doctoral Fellowship (WISE-PDF)' Program of Department of Science and Technology, India (2021-24)
- Member, Scientific Committee, 40th Convention of Indian Association of Sedimentologists (IAS) and National Conference -An odyssey of sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climatic and Energy Research (2024)
- Member, National Advisory Committee, 29th Indian Colloquium on Micropaleontology and Stratigraphy (ICMS) (2024)
- Councillor, Central Himalayan Environment Association (2024-2027)
- Member, Organising Committee, 2nd Indian Quaternary Congress (2024)

MF Quamar

- Guest Editor, Quaternary International (Elsevier).
- Guest Editor, Quaternary (MDPI).

Swati Tripathi

- Assistant Editor, Journal of Palaeosciences.
- सह-संपादक, पुराविज्ञान स्मारिका (राजभाषा पत्रिका).

Jyoti Srivastava

- Member, Conservation Paleobiology Network
- Member, Association of Quaternary Researchers (AOQR)
- Member, Editorial Board, Quaternary Chronicle (under Association of Quaternary Researchers (AOQR)) (Continuing)

CSIR Emeritus Scientist Project

Project: Neogene climate change vis-à-vis major climatic events: a quantitative reconstruction from Northeast Indian Ocean (CSIR Emeritus Project No. ES2021Y8027) [21(1143)/22/EMR-II).

Investigator: Amit K. Ghosh (Emeritus Scientist-CSIR)

Marine phytoplankton and zooplankton have been taken into consideration from the sediments of Northeast Indian Ocean ranging in age from ~16.4 Ma (Miocene) to ~4.19 Ma (Pliocene). Morphometric analysis of selected seven species of the significant phytoplankton - calcareous nannofossils has been performed. Twenty randomly selected specimens of *Calcidiscus leptoporus, Coccolithus pelagicus, Helicosphaera carteri, Reticulofenestra haqii, Reticulofenestra minuta, Sphenolithus abies* and *Umbilicosphaera rotula* have been done in each sample. The data set were imported into the software PAST, where boxplot diagrams were created in order to observe possible variations in the size of the specimens. Several climatic events during Miocene to Pliocene have been earmarked. It has been visualized that at least seven

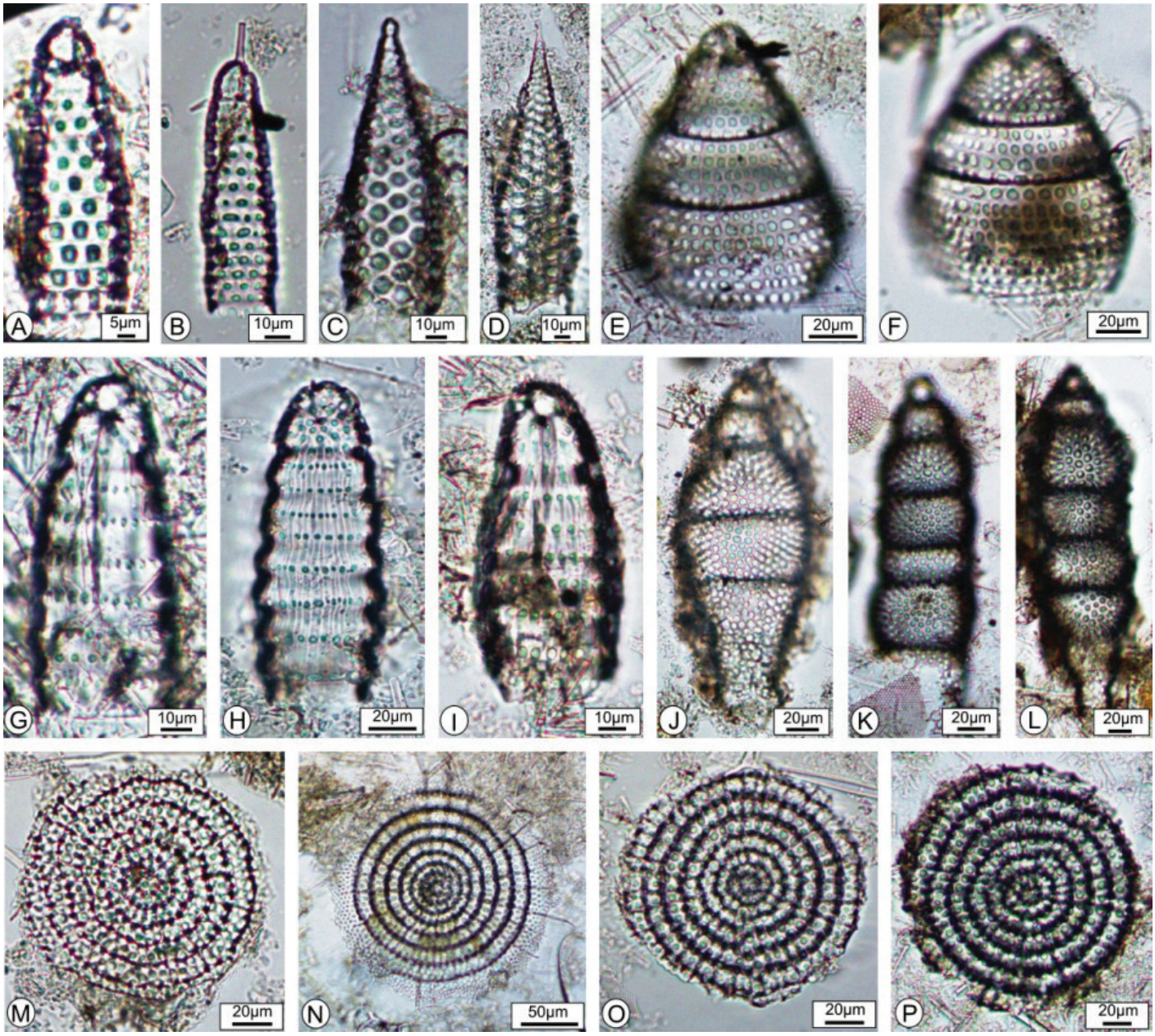


Fig. 1 - Zooplankton radiolarian species showing variation of size in the same species at different ages demarcated by the sequence in the sediment core of NGHP–01–17A. (A, B) *Artostrobus annulatus*, (C, D) *Cornutella profunda* (E, F) *Phormostichoartus doliolum*, (G–I) *Siphocampe lineate,* (J–L) *Stichocorys delmontensis*, (M–P) *Stylodictya validispina*.

different species of calcareous nannofossils continued their existence during this period. However, variations in size have been observed in those species and their gradual change in size have been studied. The shells of marine zooplankton radiolarians are composed of opaline silica and their shell volume plays an important role for their adaptation and diversity. The shell volumes of selected five suitable nassellarian (*Artostrobus annulatus, Cornutella profunda, Phormostichoartus doliolum, Siphocampe lineate* and *Stichocorys delmontensis*) and one spumellarian (*Stylodictya validispina*) radiolarian species (Fig. 1) recovered from the sediments of deep-sea drill core of NGHP–01–17A have been measured from two dimensional microscopic studies using the following mathematical formulae:

For nassellarian radiolarian species:

$$V_{nass} = \frac{1}{3}\pi(1-A)\left(\left(\frac{W}{2}\right)^2 L - \left(\frac{W-2T}{2}\right)^2 (L-T)\right)$$

For spumellarian radiolarian species:

$$V_{spum} = \frac{4}{3}\pi(1-A)\left(\left(\frac{W}{2}\right)^3 - \left(\frac{W-2T}{2}\right)^3\right)$$

For nassellarians Length (L) is from the upper edge of the cephalis to the termination of the last segment. Width (W) is across the broadest shell segment. The thickness of the shell wall (T) was measured at several locations and averaged. The pore area (A) was measured by measuring fractional area of pores within a rectangular area. The inner (hollow) volume was subtracted from the outer volume by using the measured parameters W (width), L (length), and T (shell thickness), then multiplied by the interpore area (1-A, where A is pore area) (Fig. 2).

The volume of silica used by individual radiolarian species was estimated by considering as hollow spheres or cones (Fig. 2).

Both the studies on phytoplankton and zooplankton from the northeast Indian Ocean was attempted earlier from this region. The changes observed both in phytoplankton size and zooplankton volume can be attributed to different climatic events as well as their evolution in time and space.

PUBLICATIONS IN SCI (SCIENCE CITATION INDEX) JOURNALS

1. Roy L, Ghosh AK & Bhaumik AK 2025. Tortonian–Messinian radiolarian events from Northeast Indian Ocean – diversity analysis, palaeogeographic distribution and depositional environment. Journal of Earth System Sciences 134: 1-25. https://doi.org/10.1007/s12040-024-02481-2 **(IF: 1.3)**.
2. Bhaumik AK, Chaudhuri S, Kumar S, Mohanty S, Roy L, Ghosh AK, Chowdhury S & Behara T 2024. Biostratigraphy and sedimentation rate estimation of Quaternary sediments of the Krishna-Godavari Basin, Bay of Bengal: Evidence from NGHP-01 Holes 10D, 5C and 3B. Micropaleontology 70(3): 239-252. http://doi.org/10.47894/mpal.70.3.03 **(IF: 1.3)**.
3. Sagar R, Kapur VV, Kumar K, Morthekai P, Sharma A, Shukla SK, Ghosh AK, Chauhan G & Thakkar MG 2024. First record of Chelonian coprolites from the Early-Middle Miocene Kutch Basin, western India, and their palaeodietary and palaeobiological implications. Geobios 84: 83-101. https://doi.org/10.1016/j.geobios.2023.12.004. **(IF: 1.6)**.

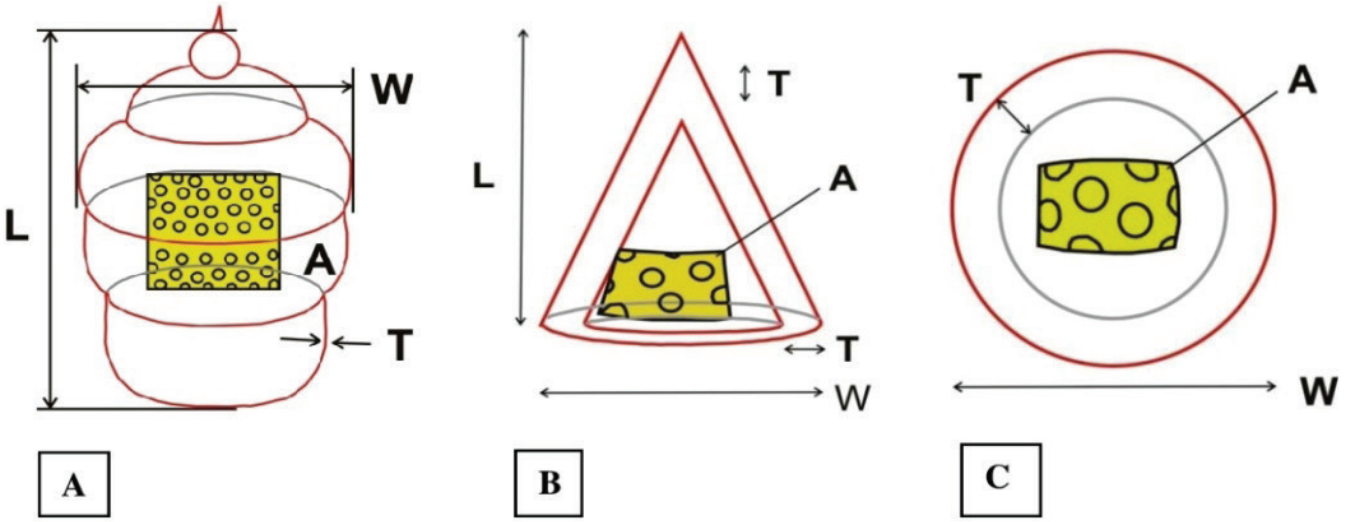


Fig. 2 - Measured attributes of radiolarians. (A-B) Hollow cones of nassellarians, (C) hollow sphere of spumellarians.

BOOK CHAPTER

1. Ghosh AK, Roy L & Saxena S 2024. Mathematical attributes applicable on the evolution of life forms and their adaptation with changing climate in the geologic past. *Mathematical Analysis and Applications in Biological Phenomena through Modelling*, Springer, pp. 369-392, doi: 10.1007/978-981-97-9194-1.

RESEARCH PAPERS PRESENTED

1. Ghosh AK 2024. Algal buildups in the marine Neogene to Quaternary sediments of Andaman-Nicobar Basin, Northeast Indian Ocean: A comprehensive account from the onshore sequence. *13th International Symposium on Fossil Algae,* Le Castella (KR), Italy: 2-6, September 2024 (Keynote Address).
2. Ghosh AK 2024. Impact of changing Neogene climate on the plankton community: evidence from the Northeast Indian Ocean (Andaman & Nicobar Basin). *29th ICMS* to be held during 17-19 October, 2024, Department of Geology, University of Delhi (Keynote Address).
3. Roy L & Ghosh AK 2024. Estimation of sedimentation rates during late Miocene to Pleistocene in the Northeast Indian Ocean derived from the biostratigraphy of deep sea sediment core (NGHP-01-17A). *40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climate and Energy Research* held during 11-13 December, 2024, Birbal Sahni Institute of Palaeosciences, Lucknow.

DEPUTATION TO CONFERENCES/ SEMINARS/WORKSHOPS

Amit K. Ghosh

- *13th International Symposium on Fossil Algae,* Le Castella (KR), Italy, 2-6 September 2024.
- *29th ICMS,* 17-19 October, 2024, Department of Geology, University of Delhi.
- *40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climate and Energy Research,* 11-13 December, 2024, Birbal Sahni Institute of Palaeosciences, Lucknow.

LECTURES DELIVERED

Amit K. Ghosh

- Ghosh, A K. 2024. Algal buildups in the marine Neogene to Quaternary sediments of Andaman-Nicobar Basin, Northeast Indian Ocean: A comprehensive account from the onshore sequence. *13th International Symposium on Fossil Algae,* Le Castella (KR), Italy, 2-6 September 2024.(**Keynote Address**)
- Ghosh, A K. 2024. Impact of changing Neogene climate on the plankton community: evidence from the northeast Indian Ocean (Andaman and Nicobar Basin). *29th ICMS* to be held during 17-19 October, 2024, Department of Geology, University of Delhi. (**Keynote Address**)
- Roy L. & Ghosh, A K. 2024. Estimation of sedimentation rates during late Miocene to Pleistocene in the northeast Indian Ocean derived from the biostratigraphy of deep sea sediment core (NGHP-01-17A). *40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climate and Energy Research* held during 11-13 December, 2024, Birbal Sahni Institute of Palaeosciences, Lucknow.

REPRESENTATION IN COMMITTEES/ BOARDS

Amit K. Ghosh

- Chairman: One scientific session in *13th International Symposium on Fossil Algae,* Le Castella (KR), Italy, 2-6 September 2024.
- Chairman: Two scientific sessions (11/12/2024) in *40th Convention of Indian Association of Sedimentologists & National Conference on An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant contributions in Environmental Climate and Energy Research* held during 11-13 December, 2024, Birbal Sahni Institute of Palaeosciences, Lucknow.
- Advisory Editor, Journal of Environmental Biology (Palaeobiology & Past Climatology).

Research Publications

IN SCI (SCIENCE CITATION INDEX) JOURNALS

- Adhikari P, Bhatia H, Khatri DB, Sadanand, Srivastava G, Mehrotra RC & Paudayal KN 2024. Fig leaf from the Middle Siwalik sediments of eastern Nepal with implication on biogeography and palaeoclimate. Journal of the Palaeontological Society of India 69: 64–79. https://doi.org/10.1177/05529360241258246 **(IF: 0.6).**
- Adhikari P, Rai LK, Sadanand, Bhatia H, Srivastava G, Thakuri NS, Mehrotra RC & Paudayal KN 2024. New records for the Middle Siwalik flora of eastern Nepal and their climatic significance. Earth History and Biodiversity 1: 100003. https://doi.org/10.1016/j.hisbio.2024.100003.
- Adhikari P, Srivastava G, Farnsworth A, Bhatia H, Sadanand, Poudel S, Spicer RA, Rai LK, Tao Su, Valdes PJ & Paudayal KN 2025. Late Miocene weakening of the South Asian Monsoon: Insights from the Siwalik of Nepal. Palaeogeography, Palaeoclimatology, Palaeoecology. 664: 112789. https://doi.org/10.1016/j.palaeo.2025.112789 **(IF: 2.7)**.
- Agarwala M, Ramya Bala P, Kulkarni C, Sukumar R, Quamar MF, Tripathi S, Karthick B & Anupama K 2024. Learning from the past: collaborating across times for landscape management for conservation. Current Science 127(8): 893-994 **(IF: 1.0)**.
- Aggarwal N, Mishra D, Srivastava S & Mathews RP 2025. Unraveling the charred past: Microscopic insights and advanced techniques in understanding Permian palaeofires. ACS Omega Article ASAP, doi: 10.1021/acsomega.4c08281 **(IF: 4.3)**.
- Agnihotri D, McLoughlin S & Srivastava AK 2024. Satpuraphyllum furcatum—a new genus and species of Peltaspermaceae foliage from the mid-Permian Barakar Formation of India. Alcheringa 49: 40−50. DOI: 10.1080/03115518.2024.2415097 **(IF: 1.2)**.
- Agnihotri P, Singh H, Subramanian KA, Vishwanathan J & Sahni A 2024. A new genus and species of fossil pseudoscorpion (Arachida: Pseudoscorpiones) from the Eocene amber of western India. Palaeontologia Electronica 27 (2): a26. https://doi.org/10.26879/1276 **(IF: 1.7)**.
- Ahlawat B, Dewangan H, Pasupuleti N, Dwivedi A, Rajpal R, Pandey S, Kumar L, Thangaraj K & Rai N 2024. Investigating linguistic and genetic shifts in East Indian tribal groups. Heliyon 10(14). https://doi.org/10.1016/j.heliyon.2024.e34354 : **(IF: 3.6)**
- Ahlawat B, Kumar L, Ambekar A, Sehrawat JS, Rawat YS & Rai N 2024. Ancient mitogenomes suggest complex maternal history of one of the oldest settlements of western India. Mitochondrion 76: 101871 **(IF: 4.4)**.
- Ahmad S, Ansari AH, Sharma M & Pandey SK 2024. The palaeoproductivity signals chronicled from the Buxa Formation, North-East Lesser Himalaya, India. Journal of the Geological Society of India 100(9): 1263-1270. https://doi.org/10.17491/jgsi/2024/173980 **(IF: 1.2)**.
- Ahmad S & Pandey SK 2025. Ediacaran fossils from the Sonia Sandstone, Jodhpur Group, India: New Discoveries and Interpretations. Journal of the Palaeontological Society of India. **(IF: 0.6)**.
- Al Khamisi SSA, Mandal S, Mazumder R & Bauer W 2025. Mesoarchaean tidal deposits from the Western Iron Ore Group of rocks, Singhbhum Craton, India. Al Hajar Magazine. Al Hajar 39: 11-22.
- Ali SN, Dubey J, Arora P, Sharma S, Morthekai P, Sharma M, Kumar P & Srivastava V 2025. Glacier sensitivity to climate variability since MIS-2: Insights from monsoon dominated north-eastern Himalaya. Geografia Fisica e Dinamica Quaternaria (GFDQ) 47: 161–173. doi:10.4454/ki45dfv4 **(IF: 0.5)**.
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- Nandaa S, Goswami S, Aggarwal N & Das D 2025. Reconstructing ancient vegetation, climate, depositional setting and ecology of the West Bokaro Coalfield: Insights from megafloristics and palynofacies. Geosystems and Geoenvironment 4: 100334, DOI.: 10.1016/j.geogeo.2024.100334. **(IF: 3.782).**
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A general view of the Kaziranga National Park
Photo Courtesy: Dr. S.K. Basumatary, BSIP

FACILITIES

FIELD EMISSION ELECTRON SCANNING MICROSCOPY (FESEM) & EDAX UNIT

The Field Emission Scanning Electron Microscope (FESEM) at BSIP is equipped with Field FESEM - JEOL 7610F, facilitating researchers to analyse the morphological aspects of their specimens at high resolution. Unlike optical microscopy, this enables them to understand the ultrastructures of objects up to the nano scale. The facility also conducts elemental analysis of their samples during the FESEM observation. EDAX uses a peltier-cooled EDS spectroscopic detector and a microphotograph to aid them characterise their specimens. The unit supports frontline research in the Palaeosciences, Geology, Biology, and Materials Science, among other areas, for the Institute's scientists and research scholars.

Through the fiscal year 24-25, the FESEM and EDAX facilities at BSIP were utilised by several scientists and research scholars at the Institute to analyse materials from numerous fields. The FESEM facility has also been made available to researchers from other Indian universities, academic institutions, and colleges through consultancy services.

The following are the list of institutions that had utilised the FESEM facility at BSIP:

- University of Lucknow, Lucknow (Nano materials, powder, insects)
- CSIR-Advanced Materials and Processes Research Institute (AMPRI), Bhopal (Powder)
- IT College , Lucknow (Powder)
- Saraswati Dental College (Tooth samples)
- Career PG Institute of Dental Sciences and Hospital, Lucknow (Tooth samples)
- CSIR-NBRI, lucknow (Rice, Leaf)
- Guru Ghasi Das Central University, Bilaspur (leaf samples)
- Integral University, Lucknow (Powder Sample)
- Baba Bhimrao Ambedkar University, Lucknow

Total consultancy money received around Rs. 2,66,090/- (Rs. Two Lac Sixty Six Thousand and Ninety only).

CONFOCAL LASER SCANNING MICROSCOPE AND RAMAN SPECTROSCOPY LABORATORY

Confocal Laser Scanning Microscope (CLSM):

Confocal Laser Scanning Microscope (CLSM) has proven to be a valuable tool for generating three-dimensional representations of fossil material, which is frequently encountered in two-dimensional form. Three-dimensional reconstructions are crucial in elucidating the structure and function of numerous fossilised species, as they reveal key microfossil characteristics. The optical sectioning capability inherent in CLSM enables the precise generation of high-resolution, high-contrast reconstructions of three-dimensional structures. This is achieved through the acquisition of a series of images at varying depths, which are subsequently integrated to produce an accurate representation.

Raman Spectroscopy:

Raman Spectroscopy has been instrumental in advancing scientific research and analysis. Our laboratory is at the forefront of employing state-of-the-art equipment and methodologies to investigate molecular structures, chemical compositions and material properties. By providing accurate molecular fingerprinting and characterisation, Raman Spectroscopy continues to significantly enhance our understanding of complex systems and facilitate ground breaking discoveries.

During the reporting period of 2024–25, a total of 88 specimens were processed using CLSM, while Raman Spectroscopy analysis was conducted on 307 sample points. Researchers from diverse scientific backgrounds utilised these techniques for both morphological studies and chemical analyses. The facility supports not only in-house research initiatives but also extends its services to external academic institutions. It offers consultancy and technical assistance to researchers from universities and research organisations across India.

The facility's contributions have been widely acknowledged by various institutions / organisations during the year 2024–2025. Its interdisciplinary applicability has been particularly noted in advancing research across biosciences, dental sciences, and medical disciplines, further underscoring its value as a national research resource.

CONFOCAL LASER SCANNING MICROSCOPE AND RAMAN SPECTROSCOPY

VERTEBRATE PALAEONTOLOGY AND PREPARATION LABORATORY

The Institute's "Vertebrate Palaeontology and Preparation Laboratory" (VPPL-BSIP) aims to prepare and analyse fossil micro- and mega-vertebrates, associated microfauna and ichnofossils (such as coprolites). To clean and prepare fossil remnants, the facility has an ultrasonic cleaner, pneumatic tools (e.g., air scribes), and a dual-tank sandblaster unit. A stereoscopic microscope (linked to a camera and a computer system) in the VPPL-BSIP is utilised to photo-document and analyse microfaunal remains. Additionally, the laboratory is equipped with software for studying (both morphometrically and phylogenetically) vertebrate fossils. Further, in the last few years, the VPPL-BSIP facility has successfully demonstrated the utilisation of an automated slide scanner (linked to a computer system) to digitally preserve and microscopically inspect thin-section slides of coprolite ichnofossils. Following health and safety regulations, preparation work is carried out in a specifically made dust collector safety box in addition to employing international standards for dust, eye, and ear protection.

ADVANCED COAL PETRO-GEOCHEMICAL LABORATORY

The Advanced Coal Petro-Geochemical Laboratory is a state-of-art laboratory meant for studying coal, lignite, and carbonaceous shales and its characteristics to understand the depositional environments, source inputs, physical and elemental composition, geochemical character, thermal maturity and related aspects catering palaeoenvironmetal research and the industrial requirements. The laboratory is equipped with advanced instrumentation facility for studying organic-rich sedimentary rocks. During this year, the facility has been upgraded by increasing man-power, purchase of reference materials, and establishment of protocols, SOP for different analysis, maintenance of work records, log books and calibration performed. A training on 'Lab Quality Management System and internal auditing as per ISO/IEC 17025:2017' from 19-22 August 2024 was organised for the lab members. The facility has been utilised by researchers from the institute as well as from other research organisations and universities across the country. This year, seven (7) students from various universities across the country did their Masters Dissertation work from the lab. The total consultancy generated is approximately INR. 60,080/- in the current year from Petrography and FTIR analysis (details as follows).

1. Petrography, Rajesh Sharma (IIT Roorkee), INR 31,860/-
2. Petrography, Madhurima Mazumdar (IIT ISM Dhanbad), INR 17,700/-
3. Petrography, Dr. Vikram Pratap Singh (CIMFR Dhanbad), 11,800/-
4. FTIR, Dr. Osama Bin Shams (CPGIDMS Lucknow), INR 4,720/-

INDUSTRIAL MICROPALAEONTOLOGY LABORATORY

The Industrial Micropalaeontology Laboratory at the Birbal Sahni Institute of Palaeosciences focuses on analysing palynological and palaeontological proxies for hydrocarbon exploration. Its primary functions include age determination and correlation through biostratigraphy and the creation of depositional palaeoenvironmental models using foraminifera, calcareous nannofossils, dinoflagellate cysts, and spore-pollen analysis. The Palynological Marine Index (PMI) calculations are used to interpret sea level changes, identify marine flooding surfaces, demarcate palaeoshorelines, and prepare ecological charts. Studying benthic and planktic foraminifera data aids in reconstructing shallow-marine to deeper palaeoenvironments and providing palaeobathymetric data. The lab features various units for the preparation and extraction of microfossils, along with sophisticated microscopes, including a Leica M205 C stereo microscope, a Leica DM3000 LED light microscope, and a Leica DM2500 polarising microscope, as well as necessary camera attachments and other essential micropalaeontological and palynological equipment.

In the year 2024, the Industrial Micropalaeontology Laboratory completed the successful BSIP-RGL, ONGC Vadodara project titled 'Palaeobathymetric variations through time from middle to late Eocene and reconstruction of Palaeogeographic Maps of Cambay Basin.' Commended by the sponsoring agency, the project report incorporated studies based on foraminifera, calcareous nannofossils, dinoflagellate cysts, and spore-pollen. A total of 1404 sediment samples and several palaeontological slides from 30 wells from the Cambay Basin of Gujarat were analysed to develop integrated biostratigraphy and palaeobathymetric analysis. The stage boundaries for the middle Eocene were identified in a few wells. Additionally, palaeoenvironmental interpretations for each well were conducted based on variations in palynological assemblages. Reconstructions of palaeobathymetry and palaeogeography were derived using the fossil micro-faunal and floral data from the middle and late Eocene.

During the years 2024-2025, the contractual consultancy project, entitled "Biostratigraphic analysis of the sub-surface samples of Exploratory/Development wells of Oil India Limited," funded by Oil India Limited, Assam, which commenced in July 2023, continued. The purpose of the project is to carry out detailed biostratigraphic studies of the well-cutting/core samples recovered while drilling/coring Exploratory/Development wells in OIL's operational areas. The project employs the study of foraminifers, calcareous nannofossils, dinoflagellate cysts (dinocysts), and spore-pollen to provide age and palynofacies analysis, thereby providing insights into the basinal correlation and palaeoenvironmental interpretations. Under this project, the Geology & Reservoir division of OIL, Duliajan, Assam, Centre of Excellence for Energy studies (CoEES), Guwahati, Krishan Godavari Basin Project, Kakinada, A.P. supplied 221 drill-cutting/core/outcrop samples from various basins of India for micropalaeontological studies under this project. In accordance with the consultancy services of the project, the technical reports pertaining to the given work orders were submitted to the indenting agency in a timely manner.

DENDROCHRONOLOGY LABORATORY

The dendrochronology lab at BSIP studies annual growth rings in trees and shrubs. Researchers use methods on both conifers and broad-leaved species to build tree-ring chronologies. These chronologies help reconstruct past climate, droughts, streamflow, and vegetation indices beyond the instrumental record.

The Dendrochronology unit has facilities for processing tree-ring samples. The laboratory currently has a Velmex Measuring Machine, a Lintab Measuring Tool connected to a Stereozoom Microscope, and a computer system along with scanner. The Dendrochronology group is skilled in using advanced statistical methods to analyze tree-ring data.

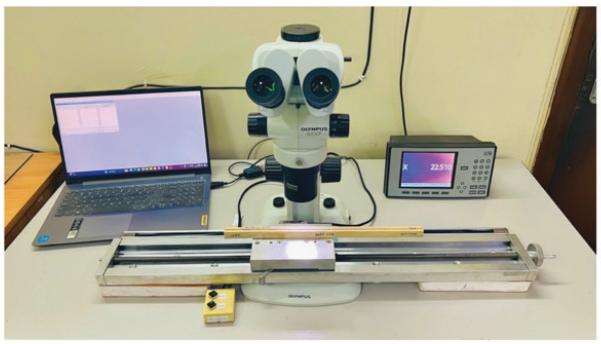
Tree core

Tree core collection using increment borer

Collection of samples from left over tree stump

Sample processing

Sample analysis



Analysis of ring ring samples and measurements

GEOCHEMISTRY AND TL/OSL UNIT

The Geochemistry and TL/OSL Unit at the Birbal Sahni Institute of Palaeosciences (BSIP) is equipped with state-of-the-art facilities designed to support conventional (major, trace, and REEs), advanced geochemical methods (stable isotopes), mineralogical, sedimentological, and thermoluminescence methods for research and development in multiple disciplines of geosciences. The geochemical facility is functioning as a core analytical facility offering comprehensive analytical services and expert guidance to researchers, academicians, and government and non-governmental entities on a fee-for-service basis. After the establishment in year 2014, it has seen substantial growth, both in infrastructure and capabilities, with the acquisition of state-of-the-art analytical instruments such as Inductively Coupled Plasma Mass Spectrometer (ICP-MS), Inductively Coupled Plasma Optical Emission Spectrometer (ICP-OES), Isotope Ratio Mass Spectrometers (IRMS; MAT253, Delta Q, Delta V advantage, and MAT 253Plus), X-Ray Diffraction, X-Ray Fluorescence, High Purity Germanium Detectors for Thermo Luminescence Optically Stimulated Luminescence Properties, Laser Diffraction Particle Size Analysers, UV-Vis Spectrometer and Nutrient Analyser. The facility recently expanded for core splitting and archiving, cold storage, and physical property measurements.

In addition, recently, our lab has been equipped with the Fusion Bead Laboratory at BSIP, featuring the Claisse M4 fusion bead machine, which has significantly enhanced our capability for high-precision major oxide geochemical analysis. The Claisse M4 was configured for the automated preparation of glass beads using lithium borate flux, ensuring consistent fusion and homogeneity essential for accurate XRF measurements. In parallel, the WROXI software was installed and calibrated within the XRF Laboratory to enable standardised measurement of major oxides. Calibration procedures were rigorously carried out using certified reference materials (CRMs), achieving analytical accuracy within less than 1% relative error for key oxides such as SiO_2, Al_2O_3, TiO_2, Na_2O, K_2O, Mn_2O_3, Fe_2O_3, CaO, MgO, and P_2O_5. This integrated infrastructure now provides a robust platform for the rapid and reliable characterisation of sediments and rock samples on a Sophisticated WDXRF machine housed under the SAIF facility of BSIP. The facility has seen continuous upgradation of facilities with the acquisition of cutting-edge technology instruments, and methodological advancements to improve the data quality and to develop novel geochemical approaches for palaeoclimate and palaeoenvironmental reconstruction research.

Consultancy Services: The unit facilitated the services using different instruments such as TL/OSL, IRMS, ICPMS, ICPOES, XRF, XRD, Grain Size, etc. to various organisations for the year 2024-2025. The total consultancy amount during 2024-25 was Rs. 12,21,762.00. Apart from consultancy, other in-house and collaborative project samples were also analysed in the geochemistry laboratory.

Fig. - Fusion Bead Machine.

PALAEOMAGNETISM LABORATORY

Established in the year 2016, the Palaeomagnetism Laboratory of the Institute in its present context develops into a national facility and caters services for comprehensive palaeo/rock/ /environmental magnetic characterisation of soils, sediments and rocks of geological interest. The lab hosts all the desired instruments for the palaeomagnetic research starting from the field survey till the laboratory measurement. Apart from the routine magnetic measurements of Susceptibility, NRM, ARM, IRM, etc. the lab now has advanced instruments for measuring magnetic fabric, temperature variation of magnetic susceptibility. The complete facility includes the Bartington susceptibility meter (MS2B) and its sensors, the MFK2-FA Kappabridge (AGICO) coupled with high (CS-4) and low (CS-L) temperature sensors, JR-6 Spinner Magnetometer (AGICO), IM-10-30 Impulse Magnetiser (ASC Scientific), D2000T Alternating Field Demagnetiser (ASC Scientific) and TD-48 Thermal Specimen Demagnetiser (ASC Scientific). Field and sample preparation tools like the Pomeroy Rock drill, Dual-Blade Rock Saw and Laboratory Lapidary Core Drill system are also available.

Apart from in-house research projects, the lab also provides consultancy services to various industries, universities and other stakeholders and helps in resource generation. During the year 2024-25, the laboratory analysed a total of 3,300 samples for various magnetic proxies of 13 different researchers. The lab imparted summer internship and dissertation training to 10 postgraduate and undergraduate students of various universities during this time period. An eminent geologist, Dr. Saumitra Misra (School of Agricultural, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban, South Africa) has visited the lab for a possible collaboration and delivered a lecture on 'Hybrid volcanics from Jamjodhpur area, Saurashtra, western India – an underrated petrogenetic model of magma mixing for the Late Cretaceous Deccan Traps Volcanic Province' on 26th September 2024.

Fig. A. Kappabridge; B Alternating Field Demagnetiser; C. Impulse magnetiser; D. Magnetometer

RADIOCHRONOLOGY AND ISOTOPIC CHARACTERISATION LABORATORY

The Radiocarbon Laboratory continued to play a pivotal role in advancing research and providing precise radiocarbon dating services throughout 2024-25. As a central facility within the Institute, the laboratory supported a diverse range of projects, like archaeology, environmental science, geochronology, cultural heritage studies, etc.

The lab processed ~3,000 samples for C and N isotope measurement, ~250 samples for sulfur isotope measurements, and we have prepared and measured ~150 graphite targets for AMS radiocarbon measurement. These samples included organic remains, charcoal, soil sediments, and bone collagen materials sourced from in-house projects, sponsored government-funded projects and several government institutes and private industries. In addition, we have carried out two field trips to both Poles (Arctic and Antarctic) as part of the 15th Indian Scientific Expedition to Arctic (Ny-Alesund, Svalbard: 1-30 August 2024) and 44th Indian Scientific Expedition to Antarctica (Maitri Station, Schirmacher Oasis: 20 November 2024 – 15 February 2025) in order to understand the impact of regional wildfires through stable and radiocarbon isotopes and source-specific organic tracers. Our quality control measures remained robust, with continual participation in international inter-laboratory comparison programs. Results indicated high consistency and accuracy, maintaining our reputation for analytical excellence.

In this Financial Year 2024-2025, the C14 lab has contributed to both data analysis and interpretation in 6 peer-reviewed International publications in leading journals. Highlights include chronological models for human cultural settlements in the Indian subcontinent and high-resolution climate reconstruction from different parts of India. Our students have presented two papers in 2 conferences, one at IISER Mohali and another one at Physical Research Laboratory (PRL), Ahmedabad, mostly involving the data from the institute projects.

We expanded our partnerships with national and international institutions. Notably, we initiated a new joint project with the Department of Earth Sciences at [Partner University], focusing on Late Holocene sea-level fluctuations. The laboratory has enhanced its capability with the installation of a Rotary evaporator and a Soxhlet extraction unit, a Multicube 48 digestion block and the Ultrapure acid-distillation units for the processing of specific organic compounds. The lab has facilitated the training and dissertation work for 10 students from different universities and colleges on isotope geochemistry and Radiocarbon measurement.

During this Financial Year 2024-2025, the C14 laboratory has earned Rs. 17,37,750/- as consultancy charges for the measurement of stable isotope and radiocarbon measurement. Major clients outside the institute are Geological Survey of India (GSI)-Lucknow; GSI-Hyderabad; GSI- Nagpur; GSI- Chhattisgarh; GSI- Raipur; Archaeological Survey of India; Infantry units of Indian Army, Mewar; Kumaun University, Nainital; University College, Thiruvananthapuram; Suganthi Devadason Marine Research Institute, Tamil Nadu; Caius Research Laboratory, St. Xavier's College (Autonomous), Mumbai; TERI School of Advanced Studies; Pandit Ravishankar Shukla University, Raipur; New Delhi; Khattri Aroma LLP, Lucknow.

We thank all our collaborators, researchers, technical staff, and administrative personnel for their dedication and commitment. Special thanks to the Institute leadership for continued support and investment in radiocarbon science.

AMBER ANALYSIS AND PALAEOENTOMOLOGY LABORATORY

Amber is a polymerized resin secreted by a wide range of tropical-subtropical plant families preserved in sediments. It has the potential to exceptionally preserve life forms. Amber science is novel and important in understanding the eventual distribution of life forms during the Indo-Asia collision. Birbal Sahni Institute of Palaeosciences, Lucknow is the only institution in India to carryout research in this field of science thus including India among the few countries in the world where studies on amber and its preserved biota are being pursued. The Nation's first "Amber Analysis and Palaeoentomology Laboratory" focuses to recover remarkably preserved amber micro and macro organisms, which covers excellent faunal-floral biotic assemblages from the Palaeogene lignite deposits of Gujarat and Rajasthan basins and other relative sedimentary successions of India. The Indian amber has been secreted from the Sal trees which are the oldest known botanical source of resin. The lab seeks to use advanced analytical methods to interpret the ecological and biological data contained in amber and reconstruct complete forest ecosystem and palaeoenvironment. For this purpose, a series of preparatory steps are adhered to, beginning with a field excursion to potential amber-bearing lignite mines, followed by laboratory processing and imaging. Primarily, excavated amber nodules are rinsed with water to remove loose sediments. These are then slabbed via diamond faceting saw. The pieces are grounded and polished with emery sheets and chemical reagents on a Buehler flat lap wheel. This allows light to penetrate while looking for inclusions. Leica stereoscope M205, attached with a camera and desktop is used for observation and refined imaging of polished amber samples. If needed, inclusions are extracted from the amber by using dissolving reagents such as toluene. The amber department at BSIP continues to discover new fossils in amber which have significant impact on coevolution, biodiversity and dispersal routes of fauna and flora.

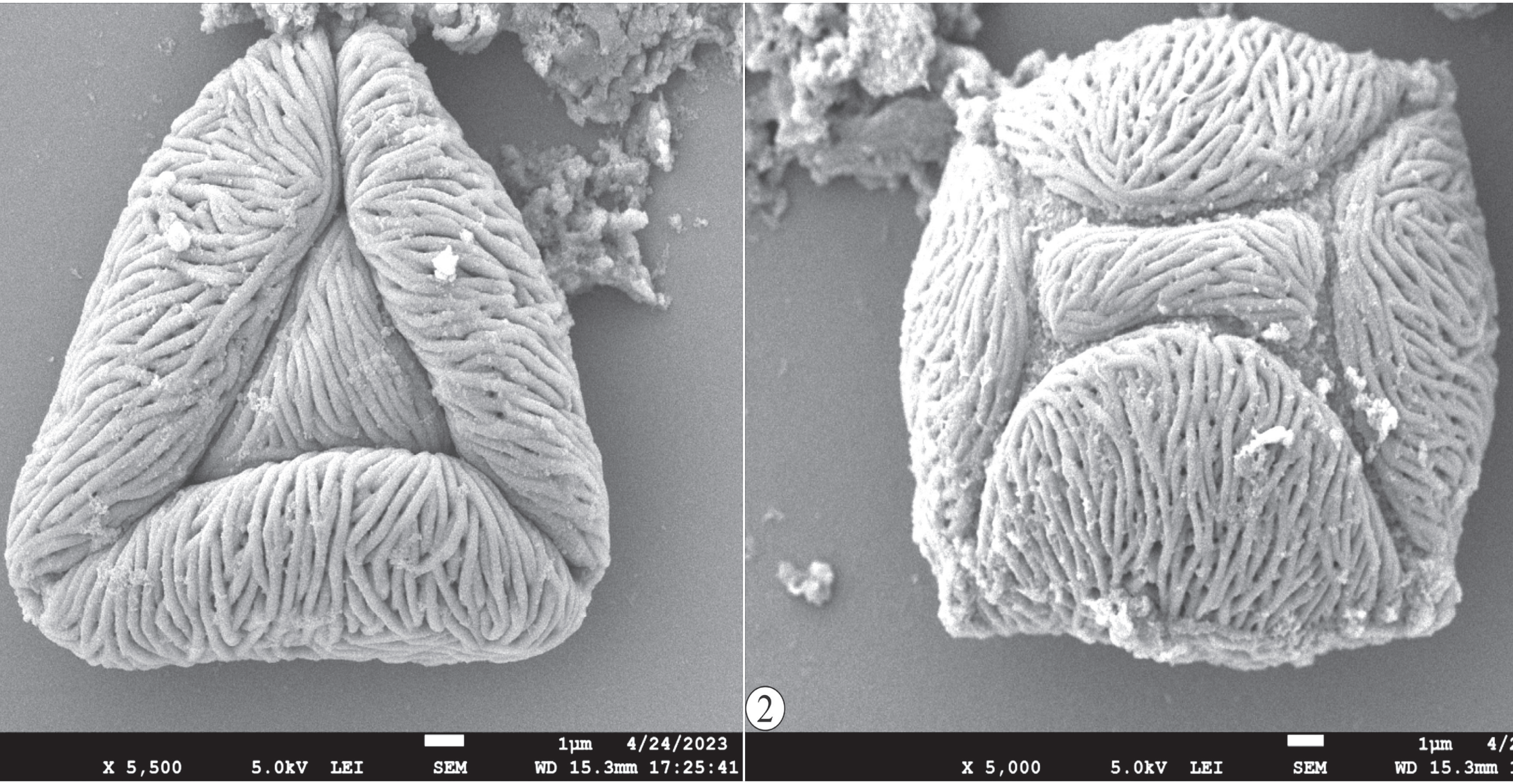
ANCIENT DNA LABORATORY

The Ancient DNA Laboratory applies state-of-the-art genomic technologies, molecular epidemiology, population genomics, computational and health informatic strategies to explore the molecular basis and evolution. Due to chemical alteration and highly fragmented nature of aDNA the laboratory maintains strict contamination control measures throughout all procedures. To prevent cross-contamination, it is physically isolated from modern DNA laboratories. All procedures are performed in cleanroom condition using sterile reagents, and full-body protective suits. The facility is equipped with advanced instrumentation, including specialised laminar flow hoods with UV sterilisation, Qubit fluorimeters, real time PCR system, TapeStation and high-speed centrifuges. In order to ensure authenticity and accuracy, we follow standard protocols that usually include sample decontamination, bone/tooth powdering, DNA Extraction and library preparation. Successively, NGS (next-generation analysis) is performed to generate high- throughput genetic data for comprehensive analysis.

The analysis of human and faunal remains from diverse archaeological context, such as Indus Valley Civilization (IVC), Megalithic sites, medieval periods and culturally significant regions like Ladakh, Ahom, Burzahom, and Vadanagar provides critical insights into biological, cultural, and environmental histories of South Asia. Ancient DNA studies of these remains help reconstruct population dynamics, migratory patterns, genetic continuity or shifts, and adaptations to environmental change. Remains from IVS and Megalithic sites shed light on early urbanism and social structures, while those from Ladakh and Ahom reflects genetic signatures shaped by altitude and historical exchanges. Faunal remains offer insight into dietary patterns and human- animal interactions, relationships, complemented by isotopic analysis, which sheds light on ancient nutrition, mobility, and environmental contexts. Thus, with state-of-the-art facilities, the Ancient DNA Laboratory offers a direct view into the genetic past, yielding vital insights into the biological histories of human, animals, and plants.

Image showing the process from field recovery to laboratory drilling of skeletal remains for ancient DNA research.

Image showing precise molecular work during ancient DNA analysis in a dedicated facility.



Field Emission Scanning Electron Microscope (FESEM) microphotographs of Schleichera oleosa (Lour.) Oken. (Sapindaceae), showing pollen aperture heteromorphism; (1) - Trizonoparasyncolporoidate pollen (Type I) (2) - Tetrazonoparasyncolporoidate pollen (Type II)
Photo Courtesy: Dr. Mohd Firoze Quamar, BSIP

UNITS

MUSEUM

Geological museums play a crucial role in advancing geosciences by safeguarding rare and significant specimens that serve both educational and research purposes. Through dynamic displays and interactive experiences, they bring Earth's geological evolution and natural diversity to life, inspiring a deeper understanding and respect for the planet. The museum at the Birbal Sahni Institute of Palaeosciences (BSIP) actively contributes to public engagement by offering informative videos, educational posters, brochures, and a range of outreach initiatives. Its well-curated exhibitions and fossil collections address both fundamental and advanced themes in Palaeosciences. In addition to regular displays, the museum frequently takes part in science fairs, expos, and community outreach, and also conducts internal events aimed at fostering fossil literacy and promoting scientific awareness among diverse audiences.

The BSIP-Museum actively participated in the 10th India International Science Festival (IISF-2024), held at IIT Guwahati from November 30 to December 4, 2024. It was organised by the Department of Science and Technology (DST). IISF is India's largest science outreach event, with the 2024 edition themed "*Transforming India into an S&T-driven Global Manufacturing Hub*". The festival aimed to integrate Science and Technology with societal development and industrial growth during the Amrit Kaal. It was coordinated by CSIR and convened by CSIR-NIIST in collaboration with Vijnan Bharati, the event saw participation from major government bodies including the Office of the Principal Scientific Advisor, DOS, DAE, DRDO, MNRE, MoHFW, DARE, MoEFCC, Ministry of Ayush, MeitY, and MoRD. At the BSIP stall, fossil exhibits attracted considerable interest, particularly from visiting dignitaries, such as Dr. Jitendra Singh (Union Minister of State for Science & Technology), Prof. Abhay Karandikar (Secretary, DST), Shri S. Somnath (Chairman, ISRO), and Smt. Nandita Gorlosa (Minister of Power Corporation, Mines, and Minerals, Assam), who interacted with BSIP staff and appreciated the fossil displays and exhibits.

The BSIP-Museum also participated in the 11th Bhopal Vigyan Mela held from December 27 to 30, 2024, at Jamboree Maidan, Bhopal. It was organised jointly by Vigyan Bharati Madhya Bharat Prant and the Madhya Pradesh Council of Science and Technology (MPCST), the event aimed to disseminate scientific knowledge and highlight India's advancements in Science and Technology. BSIP contributed to the exhibition segment, which featured prominent institutions, such as ISRO, DRDO, IIT, IISER, and BHEL. Through its dedicated pavilion, BSIP showcased key aspects of palaeosciences, including fossil specimens, outreach materials, and research highlights, thereby fostering scientific awareness and public engagement. The Mela also included thematic sessions, innovation displays, and dialogues between students and scientists, providing a multidisciplinary platform for knowledge exchange and outreach.

On National Science Day (NSD), celebrated annually on 28th February to commemorate Sir C.V. Raman's Nobel Prize-winning discovery of the 'Raman Effect', the BSIP-Museum conducted outreach activities for the students and faculty from multiple schools and colleges. Established by the Indian government in 1986, NSD promotes science activities nationwide, especially in educational institutions. The theme for NSD 2025, *"Empowering Indian Youth for Global Leadership in Science & Innovation for Viksit*

Museum Holdings:

Particulars	Addition during 2024-25	Totals
Type and Figured Specimens	167	9,976
Type and Figured Slides	186	16,822

Specimens/ Samples collected by the Scientists during the field work under various projects:

Project	Megafossil Specimens	Palynological Samples
Project-1	101	214
Project-2	149	870
Project-3	394	11,114
Project-4	…..	249
Project-5	…..	403
Project-6	…..	592
Project-7	…..	34
Project-8	…..	1238

Glimpses from the 10th India International Science Festival (IISF-2024) at IIT Guwahati. The BSIP Museum's exhibition drew enthusiastic engagement from visitors. Distinguished dignitaries including Dr. Jitendra Singh, Prof. Abhay Karandikar, Shri S. Somnath, Dr. Shiv Kumar Sharma and Smt. Nandita Gorlosa visited the BSIP stall and appreciated the Museum's fossil displays and exhibits.

Bharat", was announced by Dr. Jitendra Singh, Union Minister of State for Science & Technology. Nearly 120 students participated in these activities, with BSIP staff also visiting various institutions to promote the event. The Chief Guest of the event was Dr. Anil Kumar Rastogi, former Deputy Director and Chief Scientist of CSIR-CDRI, who commended BSIP and its museum for their efforts in inspiring young students and promoting scientific curiosity.

BSIP-Museum conducted an outreach activity at Rangjuli Higher Secondary School, located in Rangjuli, District Goalpara, and Assam. The program aimed to engage students with the fundamentals of palaeosciences through interactive sessions, fossil displays, and educational materials, fostering curiosity and awareness about Earth's deep history among young learners in the region.

Several dignitaries visited the BSIP-Museum and praised its fossil displays and collections. Dr. Sundar Manoharan (Director General, Pandit Deendayal Energy University) emphasised the museum's role in linking science and society. Prof. Jagat Bhushan Nadda (Director, Consortium for Educational Communication) appreciated its impact on science education. Prof. Pratibha Goyal (Vice Chancellor, Dr. RML Avadh University) acknowledged its valuable educational programs. Dr. Anil Kumar Rastogi, former CSIR-CDRI scientist and actor, commended the museum's efforts in inspiring young learners and promoting science awareness. A total of 15 schools, colleges, and various institutions also visited the museum, engaging with its scientific exhibits and fossil collections.

In the fiscal year 2024-25, the BSIP-Museum's repository acquired research materials, including megafossils and palynological samples from 223 localities across India. Additionally, type materials for 37 research papers were submitted to the repository.

Several dignitaries visited the BSIP Museum and appreciated its fossil displays and rich collections. Visitors included Dr. Sundar Manoharan (Director General, Pandit Deen Dayal Energy University), Prof. Jagat Bhushan Nadda (Director, Consortium for Educational Communication), Prof. Pratibha Goyal (Vice Chancellor, Dr. RML Avadh University), and Dr. Anil Kumar Rastogi, (former CSIR-CDRI scientist and noted film and theatre actor).

Some glimpses of students visiting the BSIP Museum as part of their educational trips. A total of 15 schools, colleges, and various institutions visited the museum, engaging with its scientific exhibits and fossil collections.

Samples deposited in the repository under Sponsored/ Collaborative Projects:

CRG/2022/000460	63-Samples
MOES/P.O.(GEO)/211/2019	182-Samples
(EPG) EARTH AND PLANETARY EXPLORATION GROUP PROJECT	15-Samples
SRG/2023/002252	400-Samples
(EPG) EARTH AND PLANETARY EXPLORATION GROUP PROJECT	64-Samples
EEQ/20213/000322	282-Samples
(EPG) EARTH AND PLANETARY EXPLORATION GROUP PROJECT	51-Samples
SERB/EEQ/000787	94-Samples
CRG/2023/005851	69-Samples
CRG/2023/005851	161-Samples
SCP/2022/000706	120-Samples
SPONSORED PROJECT- DST/WISE-PDE/EA-13/2024	393-Samples
CSIR ASPIRE 37WS(0087)/2023-24-EMR/-11/ ASPIRE	66-Samples

Institutional Visitors:

1. Acharya Narendra Deo Kisan P.G. College Babhnan, Gonda U.P.
2. Bharatoya Mahila Gramodyog Sansthan, Prayagraj, U.P.
3. Chinmaya Vidyalaya NTPC, Unchahar, Raebareli U.P.
4. Dayanand Post Graduate College, Bachhrawan, Rae Bareli U.P.
5. Department of Botany, Arya Vidyapeeth College, Guwahati, Assam
6. Dr. Rajendra Prasad Memorial Degree College, Rajajipuram, Lucknow, U.P.
7. Govt. Girls Inter College, Gilouli, Pandri Karpal, Gonda. U.P.
8. Greenland Public School, Vijayant Khand, Gomti Nagar, Lucknow, U.P.
9. K.N. Govt. P.G. College, Gyanpur, Bhadohi, U.P.
10. Mahamaya Govt. Degree College, Mahona, Lucknow, U.P.
11. Maharishi University of Information Technology, Lucknow, U.P.
12. Pandit Deen Dayal Upadhyay Govt. P.G. College, Sitapur, U.P.
13. PBRP Academy Muradganj, Auraiya, U.P.
14. Sri Ramswaroop Memorial University, Lucknow, U.P.
15. Techno Institute of Higher Studies, Lucknow, U.P.

COMPUTER SECTION

Official E-Mail accounts for BSIP Staff, Units/Sections and AcSIR Fellow/Research Scholars have on BSIP Domain (www.bsip.res.in). Video Conferencing System is functional in Committee Room and Online Interview, Video Conferencing through G-meet, Team, Webx etc. are also arranged as and when required. For internal file movement, File Tracking System (FTS) software has been successfully implemented. Now the location of the file can be known anytime from anywhere. Circular/Notices are circulated to everyone through Mail and WhatsApp Group This year New Wi-Fi zone (BSIP-Admin) has been created with 20 new Access Points. Now speed of Internet connectivity is up to the mark. Computer Section is maintaining NKN (National Knowledge Network) Internet connectivity in the Institute to provide 24 hours high speed Internet facility to the Institute employees and research scholars. All the Systems (around 199) are protected from viruses and worms by Anti Virus Program (Quick

Heal Endpoint Security 9.0 Business edition). Institute is fully covered with Wi-Fi and staff members are using Wi-Fi connectivity on their mobile also. This year Network Security Firewall Sophos - XGS-2300 has been replaced and is working with enhanced security.

Redesigning of the Institute website is done as per GIGW norms. Scientists can update their work and achievements on their webpage with more reach in the public. Computer Section is maintaining and updating the Institute's Website (www.bsip.res.in) regularly. Various utility forms are converted into bilingual and uploaded in PDF and Word format to facilitate easy download and usage. Intranet website has also been launched for Institute users/research scholars.

In addition, web based payroll, pension packages were also developed and modified as per the requirements of the Account Section, and Employees are receiving the pay slip by email. Computer Section is providing help to the scientists in preparing the multimedia presentations, charts, graphs, litho logs and diagrams for their scientific publications and documentation.

Deputation to Conferences/Seminars/Workshops

Nilay Govind

- Attended a One Day Seminar on "Manufacturing of Drone and Robotics in UP, their usage and the way forward", on 7th December 2024 (Saturday) held at Engineers' Bhawan, IEI, River Bank Colony, Lucknow
- Attend a One Day Conclave on "ET AI Vision Conclave 2024" held at The Centrum Hotel, Lucknow on 13th December 2024.

Lecture delivered

P S Katiyar

- Delivered a lecture on Karma yogi mission on 23rd October, 2024 at BSIP during the National Learning Week (NLW) under the mission Karma yogi from 19th – 25th October, 2025

Y P Singh

- Delivered a lecture on Progress of Karma yogi on 23rd October, 2024 at BSIP during the National Learning Week (NLW) under the mission Karma yogi from 19th – 25th October, 2025

KNOWLEDGE RESOURCE CENTRE

The Knowledge Resource Centre (KRC) is committed to providing the best information services and support to its users and fulfilling its mission to disseminate knowledge. The current holdings of the library are as under:

Particulars	Additions during 2024-25	Total
Books in English	3	6,426
Journals (bound volumes)	48	18,145
Reprints	-	40,179
Reference Books	-	356
Books in Hindi	38	981
Ph.D. Thesis	-	149
Reports	-	46
Maps & Atlas	-	61
Microfilm/ Fisches	-	294
Compact Disk	-	74

(Working hours 9.30-18.00 Mon-Fri)

Currently the library is receiving 130 journals (17 through subscription, 73 through ONOS and 40 through exchange). There are 182 registered card holders using the library facilities.

Many other Institutions/ Organisations availed the Library facilities.

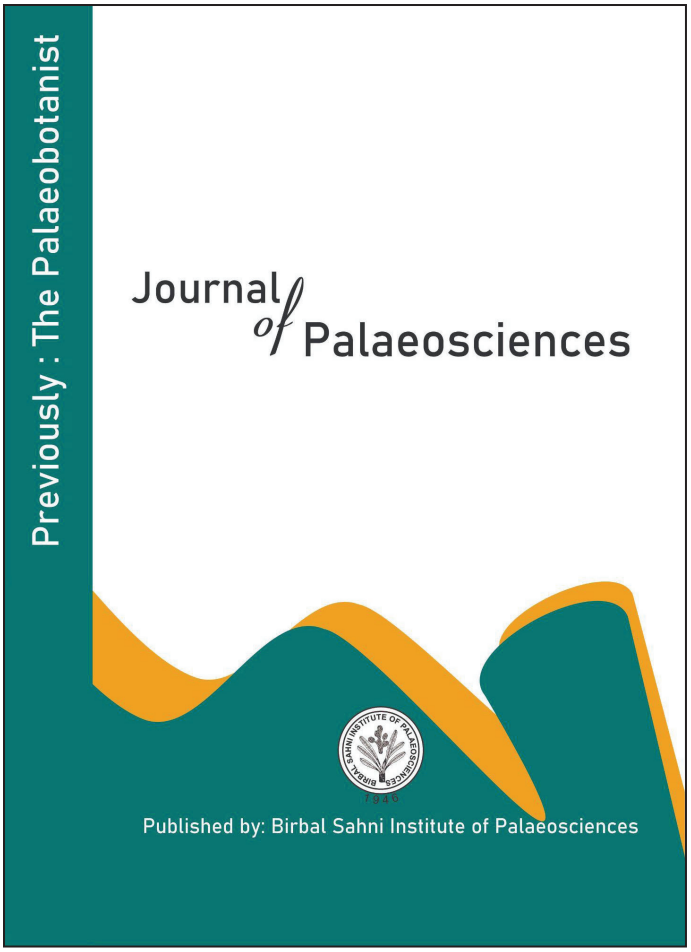
In addition, online access of e-journals and databases (viz. Scopus, Web of Science) is available over the Institute's LAN. KRC also provides plagiarism check of manuscripts through iThenticate software, reprography, weekly current awareness and daily local newspapers for reading

PUBLICATION

Journal of Palaeosciences

The past year witnessed the Publication Unit at the forefront of disseminating crucial palaeoscientific knowledge, spearheaded by the Institute's prestigious journal, now boldly titled the *Journal of Palaeosciences* (formerly a cornerstone publication since 1952 as *The Palaeobotanist*). This renaming in 2021 marked a significant step in the journal's evolution, embracing the ever-widening horizons of the discipline. The journal's success is driven by the dedicated Publication Team, led by Prof. Mahesh G. Thakkar, Editor-in-Chief, and Dr. Binita Phartiyal, Editor. Their expertise is further supported by the diligent work of Assistant Editors Deepa Agnihotri, Swati Tripathi, Prasanna K. and Suman Sarkar. The seamless technical execution is ensured by the committed Technical Team: Rattan Lal Mehra, Syed Rashid Ali, Sumit Bisht and Shivalee Srivastava.

Our unwavering commitment to open access empowered researchers globally to engage with groundbreaking discoveries published in the *Journal of Palaeosciences*. This pivotal platform serves as a nexus for diverse investigations spanning ancient environments, ecological history, past climate dynamics, and the Earth's changing geography across the entirety of geological time, from the dawn of the Precambrian to the recent Quaternary Period. Recognizing the digital imperative, the journal's seamless transition to its online home at *www.jpsonline.co.in* has amplified its reach and accessibility. The Publication Unit, under the guidance of the aforementioned team, diligently managed the intricate web of journal operations, ensuring its continued scholarly prominence.



Volume 73 (2024), Issues 1-2 of the **Journal of Palaeosciences** stands as a testament to the vibrant research landscape, featuring two impactful issues comprising 11 original research contributions and 4 concise reports, each pushing the boundaries of our understanding of Earth's history.

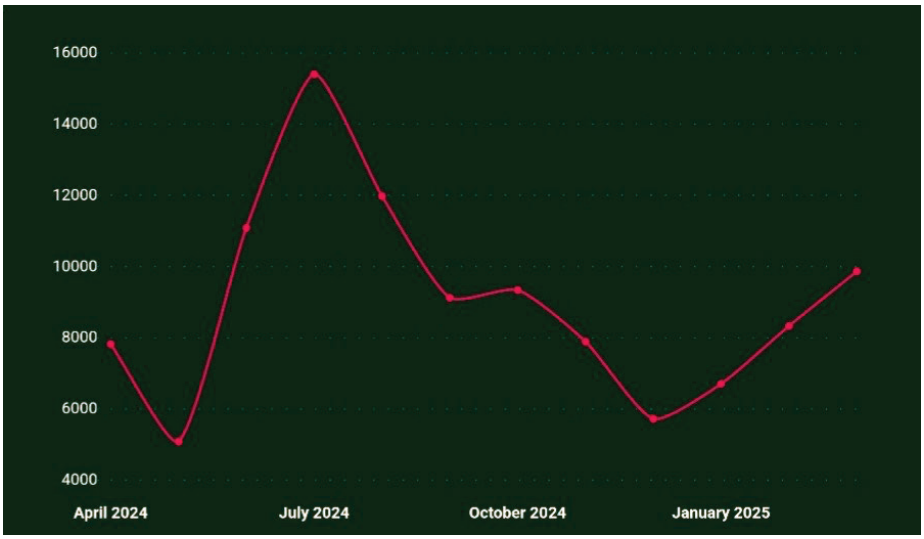


Fig. - Number of times research papers were downloaded from the website (April, 2024-March, 2025).

Annual Report & Miscellaneous

Beyond the journal's success, the Publication Unit delivered a comprehensive **Bilingual Annual Report (2023-2024)**, meticulously documenting the Institute's research journey in both Hindi and English. This vital record, covering April 1st, 2023, to March 31st, 2024, illuminated the diverse research projects undertaken, alongside showcasing the Institute's engagement through conference participation, prestigious awards, significant publications, enriching training initiatives, and the celebration of key institutional milestones like Foundation and Founder's Day. Unit-specific highlights and financial summaries were presented with clarity, enhanced by compelling visual representations and photographic documentation, offering a holistic view of the Institute's achievements.

The Publication Unit's contributions extended beyond academic dissemination. The team actively supported the Institute's organizational fabric by producing high-quality printed materials for key events, including invitation cards for Foundation Day, Founder's Day, and various conferences. Furthermore, they crafted insightful biographical profiles and concise abstracts of lectures delivered by distinguished speakers at these important gatherings, enriching the intellectual experience for all attendees.

This year reflects the Publication Unit's dedication to both advancing scholarly communication and supporting the Institute's broader mission, ensuring that knowledge creation and dissemination remain central to our endeavours, all thanks to the tireless efforts of the dedicated team.

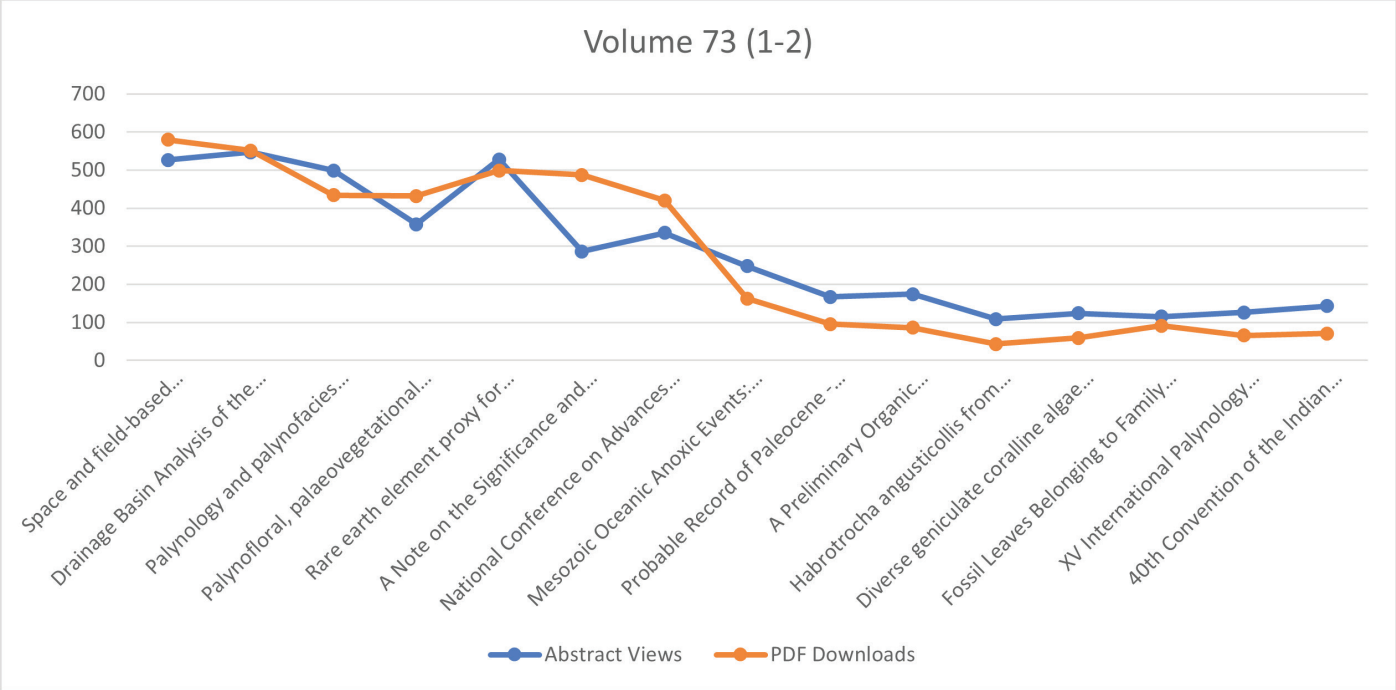


Fig. - Number of times articles of Volume 73 (2024) were downloaded and viewed (April, 2024-March, 2025).

Thinly bedded Ordovician metasediments of the Garbyang/Ralam Formation (Geldung area, Chamoli, Uttarakhand), comprising grey siliceous to calcareous phyllites and fine quartzites, exhibit tight folding and penetrative cleavage developed through ductile deformation during the Tertiary Himalayan orogeny.
Photo Courtesy: Dr. Hukam Singh, BSIP

STATUS OF IMPLEMENTATION OF RAJBHASHA HINDI

(L to R) Neelam, Swati Tripathi, Poonam Verma, Mahesh G Thakkar, Sandeep K Shivhare, Mishri Lal, Ashok Kumar, Manoj MC, Pavan S. Katiyar

The Institute continues to comply to the guidelines of the Department of Official Language, Ministry of Home Affairs, and regularly submits its progress reports to the Department of Science and Technology and the Rajbhasha Vibhag in New Delhi. In 2024, the Institute actively participated in both half-yearly meetings of the Town Official Language Implementation Committee (TOLIC-3) held at the Indian Institute of Sugarcane Research, Lucknow. The BSIP Rajbhasha Implementation Committee oversees the promotion of Hindi across the Institute. Through its quarterly meetings, it monitors progress and organises various initiatives, including Hindi Pakhwara, technical/scientific lectures, Hindi outreach activities, and interactions during fieldwork, workshops, and exhibitions. Scientists, technical officers, and staff members have shown enthusiastic involvement in using Hindi for scientific, administrative, and technical communication, reinforcing the Institute's commitment to the Official Language Policy.

Hindi Fortnight 2024

The Institute successfully organised Hindi Pakhwara 2024 from September 10 to 27, 2024, under the auspices of the Rajbhasha Implementation Committee. The fortnight-long program commenced with an official inauguration on September 10, 2024, the Foundation Day of BSIP, aimed at promoting the use of Hindi as the official language and fostering greater appreciation for its cultural and linguistic heritage. A series of programs was conducted during the period, covering both literary and creative domains. The competitions witnessed active participation from staff and students. The level of enthusiasm and interest shown by the participants reflected their deep engagement with the objectives of Hindi Pakhwara. Winners were felicitated with certificates and prizes at the Founder's Day function on 14th November 2024. The event celebrated talent and enthusiasm across various competitions.

As part of ongoing efforts to promote the use of Hindi in official and scientific communication, the Institute organised a series of Hindi workshops and popular lectures throughout the year. These sessions aimed to raise awareness of official language policies, enrich subject-specific Hindi terminology, and foster scholarly discourse in Hindi. Each workshop was followed by an interactive discussion, where participants actively engaged in conversations related to the subject matter and technical vocabulary introduced by the speakers. The details of the workshops and lectures are as follows:

Programs	No. of Parti-cipants	First Prize	Second Prize	Third Prize	Encouragement – I	Encouragement – II
Hindi Typing	7	Purneshwar Prakash Mishra	Ujjwal Tripathi	Abhay Shukla	Sudha Kuril	—
Hindi Noting	8	Abhishek Sachan	Sandhya Singh	Sandhya Mishra	Sudha Kuril, Purneshwar Prakash Mishra	—
Debate	8	Prashant Mohan Trivedi	Sneh Trivedi	Ujjwal Tripathi	Shivansh Saxena	Nivedita Mehrotra
Dictation (for MTS)	7	Prabhat Mishra	Lavkush Pandey	Sandhya Singh	—	Bhawna Awasthi
Essay Writing	8	Sandhya Mishra	Purneshwar Prakash Mishra	Brajesh Kumar Yadav	Barsha Shah	Abhishek Sachan
Poster Making	11	Sandhya Mishra	Nazim Deori	Archana Sonker	Arya Pandey, Kumail Ahmad	Mansi Swaroop, Shivansh Saxena, Mamta
Antyakshari	15	Arya Pandey, Vartika Singh, Vishwanath Gaikwad	Sandhya Mishra, Beena, Mayank Shekhar	Sanjay Singh, Alok Mishra, Arvind Tiwari	Sandhya Singh, Archana Sonker, Shivansh Saxena	—

1. Workshop on **"Official Language Implementation through IT Tools and Official Language Policy and Rules"**
   Speaker: Mr. Adarsh Gupta, Manager (Official Language), Indian Overseas Bank, Regional Office, Lucknow
   Date: June 24, 2024

The session highlighted the role of digital tools in the effective implementation of the Official Language Policy, with emphasis on practical applications in administrative contexts.

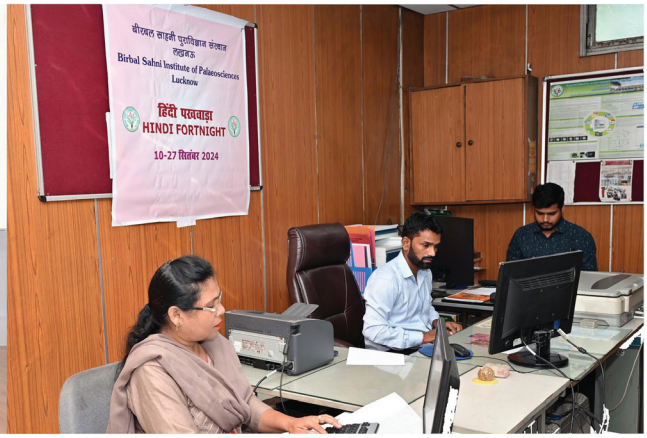
2. Workshop on **"Hindi Policy and Instructions"**
   Speaker: Mr. Abhishek Kumar Singh, Official Language Officer, Indian Institute of Sugarcane Research, Lucknow
   Date: September 12, 2024

The talk provided a comprehensive overview of the latest government guidelines and institutional responsibilities concerning the promotion and use of Hindi in official work.

3. Lecture on **"Alternative methods for palaeoecological and palaeoherbivory analysis"**
   Speaker: Dr. Sadhan K. Basumatary, Scientist 'E', BSIP, Lucknow
   Date: September 13, 2024

This scientific lecture, delivered by a scientist native to a non-Hindi region, highlighted the inclusiveness and accessibility of the Hindi language in scientific discourse. His talk offered insights into the fieldwork strategies and challenges in the far-flung northeastern regions of India.

4. Lecture on **"Spiti Valley: A High Himalayan Mountain Range that was Once a Sea – The**



Competitions held during Hindi Fortnight-2024

Hindi lectures and workshops at BSIP

Origin and Significance of the Natural Fossil Museum"

Speaker: Dr. Anju Saxena, Scientist 'E', BSIP, Lucknow

Date: December 30, 2024

This scientific lecture offered insights into the fieldwork strategies and challenges in the high-altitude Spiti Valley and the importance of fossils preserved in the deposits there. The discussion also introduced relevant Hindi terminology for geological and paleontological concepts.

5. Workshop on **"The Position and Potential of Hindi as a Global Language"**

Speaker: Prof. Himanshu Sen, University of Lucknow, Lucknow

Date: January 10, 2025

The workshop, especially organised on 'Viswa Hindi Diwas', explored the growing global relevance of Hindi, evaluating its cultural influence, academic reach, and opportunities for expansion in international forums.

Annual Hindi e-Magazine "Puravigyan Smarika"

In an ongoing effort to promote the use of Hindi in scientific communication and to encourage the creation of accessible

science literature, the Institute published the third issue of its Annual Hindi e-Magazine titled "Puravigyan Smarika" during the year. The magazine featured a collection of science and general articles contributed by authors from various organisations, as well as employees of the Institute. The content was diverse, informative, and well-received by readers, reflecting the contributors' commitment to promoting Hindi in academic and public discourse.

As a recognition of its quality and impact, **the Institute's in-house magazine "Puravigyan Smarika" was awarded the First Prize by the Town Official Language Implementation Committee (TOLIC-3), Lucknow**. This achievement underscores the Institute's leadership in fostering scientific literacy and official language usage through creative initiatives.

The Institute actively engaged in national and regional programs related to the promotion of Rajbhasha Hindi:

- Mr. Ashok Kumar, Hindi Translator, participated in the 4th All India Official Language Conference (14–15 Sep 2024, Bharat Mandapam, New Delhi).
- Dr. Poonam Verma, Dr. Gaurav Srivastava, both Scientist E, and Mr. Ashok Kumar participated in a two-day National Scientific Workshop in Hindi (20–21 Nov 2024, ARIES, Nainital). The scientific team delivered scientific lectures and chaired the sessions.
- Dr. Neelam Das, Scientist E, participated in the Joint Regional Official Language Conference 2025 . (Feburuary 17, 2025, Jaipur, Rajasthan).
- Dr. Anupam Sharma, Scientist G, and Mr. Ashok Kumar attended a Parliamentary Questionnaire Workshop (20 Dec 2024, DST, New Delhi).
- Dr. Poonam Verma and Mr. Ashok Kumar participated in a Town-Level Hindi Workshop (31 Dec 2024, ICAR-NBFGR, Lucknow).

These initiatives reflect the Institute's proactive and sustained efforts to strengthen Hindi as an official and scientific language, aligning with national language policy goals.

Miscellaneous

The Institute maintained its steadfast commitment to the effective implementation of the Official Language Policy, in line with Section 3(3) of the Official Language Act, 1963. Several initiatives were undertaken during the year to promote the use of Hindi in administrative and scientific communication. The bilingual website remained operational, providing global access to information in Hindi and English. Multilingual software was installed

BSIP Staff in Rajbhasha Events and Workshops

on all internet-enabled systems to support Hindi usage in documentation. All essential forms were made available in bilingual format, ensuring inclusivity in administrative procedures. The BSIP Library continued to enrich its Hindi section with the addition of new books annually. The Annual Report 2024–25 was published in Hindi along with English. The Institute's international journal, '*Journal of Palaeosciences'*, featured Hindi abstracts for all research papers.

PERSONNEL

Director
Prof. Mahesh G. Thakkar

Scientist 'G'
1. Dr. Anupam Sharma

Scientist 'F'
1. Dr. Srinivas Bikkina
2. Dr. Ratan Kar
3. Dr.(Mrs) Binita Phartiyal
4. Dr. Anil Kumar Pokharia

Scientist 'E'
1. Dr. (Mrs) Neha Agarwal (w.e.f. 01.01.2025)
2. Dr. Shailesh Agarwal (w.e.f. 01.01.2025)
3. Dr. (Mrs) Deepa Agnihotri
4. Dr. Sheikh Nawaz Ali (w.e.f. 01.01.2025)
5. Dr. Sadhan Kumar Basumatary
6. Dr. Pawan Govil
7. Dr. Vivesh Vir Kapur (w.e.f. 01.01.2025)
8. Dr. Kamlesh Kumar
9. Dr. Abhijit Mazumder
10. Dr. Krishna Gopal Misra
11. Dr. Srikanta Murthy
12. Dr. (Mrs) Neelam (w.e.f. 01.01.2025)
13. Dr. (Mrs) Shilpa Pandey
14. Dr. S. Suresh Kumar Pillai
15. Dr. Mohd. Firoze Quamar (w.e.f. 01.01.2025)
16. Dr. Parminder Singh Ranhotra
17. Dr. (Mrs) K. Pauline Sabina
18. Dr. (Mrs) Anju Saxena
19. Dr. Santosh Kumar Shah
20. Dr. (Mrs) Anumeha Shukla
21. Dr. Hukam Singh
22. Dr. (Miss) Vartika Singh
23. Dr. Veeru Kant Singh
24. Dr. Gaurav Srivastava
25. Dr. (Mrs) Jyoti Srivastava (w.e.f. 01.01.2025)
26. Dr. Biswajeet Thakur
27. Dr. (Mrs) Swati Tripathi
28. Dr. (Mrs) Anjali Trivedi
29. Dr. (Mrs) Poonam Verma

Scientist 'D'
1. Dr. (Mrs) Abha
2. Dr. Arif Hussain Ansari
3. Dr. Manoj M.C.
4. Dr. Prasanna K (w.e.f. 01.07.2024)
5. Dr. Niteshkumar Narendra Khonde (w.e.f. 01.07.2024)
6. Dr. Runcie Paul Mathews
7. Dr. P. Morthekai
8. Dr. Santosh Kumar Pandey
9. Dr. Niraj Rai
10. Dr. Arvind Kumar Singh (w.e.f. 01.07.2024)
11. Dr. Sunil Kumar Shukla
12. Dr. (Mrs) Yogmaya Shukla (w.e.f. 01.07.2024)

Scientist 'C'
1. Dr. Mohammad Arif
2. Dr. Ansuya Bhandari
3. Dr. Trina Bose
4. Dr. (Ms) Adrita Choudhuri (w.e.f. 01.07.2024)
5. Dr. Gurumurthy G.P.
6. Dr. Anurag Kumar (w.e.f. 01.07.2024)
7. Sh. Sabyasachi Mandal (w.e.f. 01.07.2024)
8. Dr. (Mrs) Divya Kumari Mishra (w.e.f. 01.07.2024)
9. Dr. (Mrs) Shreya Mishra (w.e.f. 01.07.2024)
10. Dr. Ranveer Singh Negi (w.e.f. 01.01.2025)
11. Dr. Suman Sarkar (w.e.f. 01.01.2025)
12. Dr. Mayank Shekhar (w.e.f. 01.01.2025)
13. Dr. Premraj Uddandam (w.e.f. 01.07.2024)

Scientist 'B'
1. Sri Sanjay Kumar Singh Gahlaud
2. Dr. Nimish Kapoor, Redeployment Staff of Vigyan Prasar (w.e.f. 04.9.2024)

Technical Officer 'D'
1. Sri Madhukar Arvind
2. Sri Pavan Singh Katiyar
3. Dr. Subodh Kumar
4. Sri Rattan Lal Mehra
5. Sri Yogendra Pratap Singh

Technical Officer 'B'
1. Dr. Syed Rashid Ali
2. Sri Digamber Singh Bisht
3. Sri Dhirendra Kumar Pal
4. Sri Dhirendra Sharma
5. Dr. Sanjai Kumar Singh

Technical Officer 'A'
1. Sri Sumit Bisht
2. Dr. Nilay Govind
3. Sri Ishwar Chandra Rahi

(The names are in alphabetical order according to surnames)

4. Dr. Nandita Tiwari

Technical Assistant 'E'
1. Dr. Amrit Pal Singh Chaddha
2. Sri Prasanta Kumar Das
3. Sri Pawan Kumar (Superannuated on 31.01.2025)
4. Sri Madan Singh Rana
5. Miss Kirti Singh
6. Sri Ajay Kumar Srivastava (Superannuated on 30.06.2024)

Technical Assistant 'D'
1. Sri Sandeep Kumar Kohri
2. Sri Ishwar Chandra Shukla
3. Sri Jitendra Yadav

Technical Assistant 'B'
1. Sri J. Baskaran
2. Sri Ashok Kumar Sharma
3. Ms. Shivalee Srivastava
4. Sri Ram Ujagar
5. Sri Raja Ram Verma

Technical Assistant 'A'
1. Ms Archana Sonker
2. Mr. Shailendra Kumar Yadav

Registrar
Sri Sandeep Kumar Shivhare

Accounts Officer
Sri Ashutosh Shukla

Section Officer
1. Sri Mishri Lal
2. Mrs Swapna Mazumdar
3. Sri Shailendra Singh Panwar
4. Sri Rameshwar Prasad (w.e.f. 01.09.2024 & Superannuated on 28.02.2025)
5. Sri Gopal Singh (Superannuated on 31.08.2024)
6. Sri K.P. Singh (Superannuated on 30.06.2024)
7. Sri Avinash Kumar Srivastava (w.e.f 20.08.2024)

Assistants
1. Sri Rahul Gupta, Assistant (Officiating) (w.e.f. 01.01.2025)Miss
2. Anupam Jain (Officiating) (w.e.f. 01.01.2025)
3. Sri Dheeredra Kumar (Redeployment Staff of Vigyan Prasar w.e.f 01.06.2024)
4. Sri Rajesh Kumar Mishra (w.e.f. 27.12.2024)
5. Sri Manoj Singh (Officiating) (w.e.f. 01.01.2025)
6. Dr. Manisha Tharu

Hindi Translator
1. Sri Ashok Kumar

Upper Division Clerk
1. Mrs Sudha Kureel

Lower Division Clerk
1. Sri Shailesh Kumar
2. Sri Akshay Kumar
3. Sri Purneshwar Prakash Mishra
4. Mrs. Savita Nair
5. Sri Abhay Shukla
6. Ms. Barsha Shah
7. Sri Abhishek Sachan
8. Mrs Vijaya Venkateshwari
9. Sri Pushkar Verma
10. Sri Karan Yadav

Driver 'IV'
1. Sri Pushpendra Kumar Misra

Multi Tasking Staff
1. Mrs. Bhawana Awasthi
2. Mrs Beena
3. Sri Ram Chander
4. Sri Ram Dheeraj
5. Sri Vishwanath S. Gaikwad
6. Ms Prapti Gupta
7. Sri Palton Ho
8. Mrs. Ram Kali
9. Sri Sanjay Kashyap
10. Sri Wasiullah Khan (Redeployment staff of Vigyan Prasar, w.e.f 01.06.2024)
11. Sri Deepak Kumar
12. Sri Indra Kumar
13. Sri Jitendra Kumar
14. Sri Ramesh Kumar (Superannuated on 31.05.2024)
15. Sri Sunit Kumar
16. Sri Dhan Bahadur Kunwar
17. Sri Manish Mishra
18. Mr. Prabhat Mishra
19. Mrs. Nandani
20. Sri Lavkush Pandey
21. Sri Puneet Pandey
22. Sri Mathura Prasad
23. Sri Ashik Gyaniram Saryam
24. Sri Ravi Shankar
25. Sri Aquil Siddiqui
26. Sri Ankit Pratap Singh
27. Mrs. Sandhya Singh
28. Sri Indra Kumar Yadav
29. Sri Shivam Yadav

Birbal Sahni Research Associate
1. Dr. Priya Agnihotri (w.e.f 07.03.2025)
2. Dr. Harshita Bhatia (w.e.f 07.03.2025)
3. Dr. Kajal Chandra (w.e.f 07.03.2025)
4. Dr. Anil Asaram Chavan (w.e.f 07.03.2025)

5. Dr. Suyash Gupta (w.e.f 07.03.2025)
6. Dr. Amit Kumar Mishra (w.e.f 07.03.2025)
7. Dr. Stuti Saxena (w.e.f 07.03.2025)
8. Dr. Sarvendra Pratap Singh (w.e.f 10.03.2025)

Birbal Sahni Research Scholar

1. Ms. Aishwarya Gupta (w.e.f. 07.03.2025)
2. Sri Madhav Prasad Mishra (w.e.f. 10.03.2025)
3. Sri Shubham Pandey (w.e.f. 18.03.2025)
4. Ms. Priyanka Pathak (w.e.f. 07.03.2025)
5. Sri Ramanand Sagar (w.e.f. 20.03.2025)
6. Ms. Shakshi Singh (w.e.f. 10.03.2025)
7. Ms. Vimochani Tripathi (w.e.f. 20.03.2025)
8. Sri Siddhant Vaish (w.e.f. 08.03.2025)
9. Ms. Ruchita Yadav (w.e.f. 10.03.2025)

APPOINTMENTS

Birbal Sahni Research Associate

1. Dr. Priya Agnihotri (w.e.f 07.03.2025)
2. Dr. Harshita Bhatia (w.e.f 07.03.2025)
3. Dr. Kajal Chandra (w.e.f 07.03.2025)
4. Dr. Anil Asaram Chavan (w.e.f 07.03.2025)
5. Dr. Suyash Gupta (w.e.f 07.03.2025)
6. Dr. Amit Kumar Mishra (w.e.f 07.03.2025)
7. Dr. Stuti Saxena (w.e.f 07.03.2025)
8. Dr. Sarvendra Pratap Singh (w.e.f 10.03.2025)

Birbal Sahni Research Scholar

1. Ms. Aishwarya Gupta (w.e.f. 07.03.2025)
2. Sri Madhav Prasad Mishra (w.e.f. 10.03.2025)
3. Shri Shubham Pandey (w.e.f. 18.03.2025)
4. Ms. Priyanka Pathak (w.e.f. 07.03.2025)
5. Shri Ramanand Sagar (w.e.f. 20.03.2025)
6. Ms. Shakshi Singh (w.e.f. 10.03.2025)
7. Ms. Vimochani Tripathi (w.e.f. 20.03.2025)
8. Shri Siddhant Vaish (w.e.f. 08.03.2025)
9. Ms. Ruchita Yadav (w.e.f. 10.03.2025)

PROMOTIONS

Scientific Staff

1. Dr. Prasanna K, Scientist-D (w.e.f. 01.07.2024)
2. Dr. Niteshkumar Narendra Khonde, Scientist-D (w.e.f. 01.07.2024)
3. Dr. Arvind Kumar Singh, Scientist-D (w.e.f. 01.07.2024)
4. Dr. (Mrs) Yogmaya Shukla, Scientist-D (w.e.f. 01.07.2024)
5. Dr. Adrita Choudhuri, Scientist-C (w.e.f. 01.07.2024)
6. Dr. Anurag Kumar, Scientist-C (w.e.f. 01.07.2024)
7. Dr. (Mrs) Divya Kumari Mishra, Scientist-C (w.e.f. 01.07.2024)
8. Dr. (Mrs) Shreya Mishra, Scientist-C (w.e.f. 01.07.2024)
9. Sh. Sabyasachi Mandal, Scientist-C (w.e.f. 01.07.2024)
10. Dr. Premraj Uddandam, Scientist-C (w.e.f. 01.07.2024)
11. Dr. (Mrs) Neha Agarwal, Scientist-E (w.e.f. 01.01.2025)
12. Dr. Shailesh Agarwal, Scientist-E (w.e.f. 01.01.2025)
13. Dr. Sheikh Nawaz Ali, Scientist-E (w.e.f. 01.01.2025)
14. Dr. Vivesh Vir Kapur, Scientist-E (w.e.f. 01.01.2025)
15. Dr. (Mrs) Neelam, Scientist-E (w.e.f. 01.01.2025)
16. Dr. (Mrs) Jyoti Srivastava, Scientist-E (w.e.f. 01.01.2025)
17. Dr. Mohd. Firoze Quamar, Scientist-E (w.e.f. 01.01.2025)
18. Dr. Ranveer Singh Negi, Scientist-C (w.e.f. 01.01.2025)
19. Dr. Suman Sarkar, Scientist-C (w.e.f. 01.01.2025)
20. Dr. Mayank Shekhar, Scientist-C (w.e.f. 01.01.2025)

Administrative Staff

1. Sri Avinash Kumar Srivastava (w.e.f 20.08.2024)
2. Sri Rameshwar Prasad (w.e.f. 01.09.2024)
3. Sri Rajesh Kumar Mishra, Assistant (w.e.f. 27.12.2024)
4. Miss Anupam Jain, Assistant (Officiating) (w.e.f. 01.01.2025)
5. Sri Manoj Singh, Assistant (Officiating) (w.e.f. 01.01.2025)
6. Sri Rahul Gupta, Assistant (Officiating) (w.e.f. 01.01.2025)

Multi Tasking Staff

1. Sri Ankit Pratap Singh, MTS III (w.e.f. 27.12.2024)
2. Mrs. Bhawana Awasthi, MTS III (w.e.f. 27.12.2024)
3. Mrs. Sandhya Singh, MTS III (w.e.f. 27.12.2024)
4. Sri Suneet Kumar, MTS III (w.e.f. 27.12.2024)
5. Sri. V.S. Gaikwad, MTS II (w.e.f. 27.12.2024)
6. Sri Deepak Kumar, MTS II (w.e.f. 27.12.2024)
7. Sri Indra Kumar, MTS II (w.e.f. 27.12.2024)
8. Sri Ravi Shankar, MTS II (w.e.f. 27.12.2024)
9. Sri Inder Kumar Yadav, MTS II (w.e.f. 27.12.2024)

SUPERANNUATION

1. Sri Ramesh Kumar (Superannuated on 31.05.2024)
2. Sri Ajay Kumar Srivastava (Superannuated on 30.06.2024)

3. Sri K.P. Singh (Superannuated on 30.06.2024)
4. Sri Gopal Singh (Superannuated on 31.08.2024)
5. Sri Pawan Kumar (Superannuated on 31.01.2025)
6. Mrs. Ram Kali (Superannuated on 31.01.2025)
7. Sri Rameshwar Prasad (Superannuated on 28.02.2025)

OTHER RESEARCH SCHOLARS

CSIR-Senior Research Associate
1. Dr Shamim Ahmad

DST-ANRF Fellows
1. Ms. Aditi Bajpai, JRF
2. Sri Arunaditya Das, JRF
3. Ms. Aditi Nautiyal, JRF
4. Sri Amal MS, JRF
5. Ms. Jinamoni Saikia, JRF
6. Ms. Korobi Saikia, SRF
7. Sri Deveshwar Prakash Mishra, RA
8. Sri Ravi Shankar Maurya, RA
9. Sri Sachin Kumar, Project Assistant

DST-SERB-SUPRA Project
1. Sri Sourav Hazra, JRF

MoES Projects
1. Sri Piyal Halder, SRF
2. Ms. Ayushi Mishra, SRF
3. Sri Benjamin C Sam, Project Associate

MANDU Interdisciplinary Research Project
1. Sri Avanish Mishra, Project Assistant

MoES-UKERI Project
1. Ms. Arushi Kumar, Project Associate

Sponsored Project (Vadnagar)

NCAOR Project
1. Sri Masud Kawsar, SRF

CSIR Sponsored Project
1. Sri Anupam Nag, JRF

DST-WISE-KIRAN
1. Ms. Shristee Gupta, JRF

Self Supported Ph.D. Scholars
1. Ms. Archana Sonker, Technical Assistant 'A'
2. Ms. Nidhi Tomer, SRF

Self-Supported Ph.D. Scholars (DST-INSPIRE, CSIR-NET, UGC-NET)

DST-INSPIRE Fellows
1. Sri Mohammad Arif Ansari, SRF
2. Ms. Deeksha, SRF
3. Sri Hidayatullah, SRF
4. Sri Kishor Vasant Katange, SRF
5. Ms. Sneha Mary Mathew, SRF
6. Ms. Arya Pandey, SRF
7. Sri Anand Rajoriya, SRF
8. Sri Suraj Kumar Sahu, SRF
9. Ms. Pooja Nitin Saraf, SRF
10. Sri Shivansh Saxena, SRF
11. Sri Prashant Mohan Trivedi, SRF
12. Ms. Maneesha Muraleedharan ET, JRF
13. Ms. Rashmi, JRF
14. Ms. Adhra Renny, JRF
15. Sri Sangram Sahoo, JRF
16. Ms. Mansi Swaroop, JRF

CSIR-NET Fellows
1. Ms. Prachita Arora, SRF
2. Sri Mohd Ikram, SRF
3. Sri Nagendra Prasad, SRF
4. Sri Ramanand Sagar, SRF (Till 19.03.2025)
5. Sri Jereem Thampan, SRF
6. Sri Shirish Verma, SRF
7. Sri Nishant Minz, JRF
8. Sri Gursewak Singh, JRF

UGC-NET Fellows
1. Sri Kumail Ahmad SRF
2. Sri Nazakat Ali, SRF
3. Ms. Aparna Dwivedi, SRF
4. Sri Faizan Ahmad Khan, SRF
5. Sri Brijesh Kumar, SRF
6. Sri Pushpendra Pandey, SRF
7. Sri Tanveer Warid Rahman, SRF
8. Ms. Mitra Rajak, SRF
9. Sri Samiksha Shukla, SRF
10. Sri Arvind Tiwari, SRF
11. Ms. Divya Verma, SRF
12. Ms. Sadhana Vishwakarma, SRF
13. Sri Shubhajit Ghosh, JRF
14. Sri Satendra Kumar Gupta, JRF
15. Ms. Snigdha Konar, JRF
16. Sri Ajay Kumar, JRF
17. Sri Pronobesh Roy, JRF

Other Ph.D. Research Scholars
1. Sri Alok Kumar Mishra
2. Ms. Sabera Khatoon
3. Sri Sadanand Pathak
4. Sri Ahmad Shafi
5. Sri Sarvendra Pratap Singh

Committees/Sections/Units Group Photographs

Director's Unit

(L to R): Dhan Bahadur Kunwar, Puneet Pandey, M.J. Janani, Mahesh G. Thakkar, Pushpendra K. Mishra, Madhukar Arvind

Registrar's Office

1st Row (L to R): Karan Yadav, Sandeep Kumar Shivhare, Rahul Gupta

2nd Row (L to R): Jitendra Kumar, Prabhat Mishra, Prapti Gupta, Pushkar Verma, Vishwanath S. Gaikwad

Account Section

(L to R): Himanshu, Rajesh Kumar Awasthi, Abhishek Sachan, Rajesh Kumar Mishra, Ashutosh Shukla, Purneshwar Prakash Mishra, Lavkush Pandey, Barsha Shah & Preeti Kumari

Research Development & Coordination Cell

(L to R): K Pauline Sabina, Anupam Sharma, Hukam Singh & Vivesh Vir Kapur

Establishment Section

(L to R): Shiv Mani, Ashok Kumar, Rameshwar Prasad, Chitra Chatterji, Akshay Kumar, Mohd. Aquib

Stores and Purchase Section

(L to R): Shailendra Yadav, Anupam Jain, Swapna Mazumder, Manoj Singh, Dheerendra Kumar & Manish Mishra

Scientific Activity Section

(L to R): Savita Nair, Manisha Tharu, Wasiullah Khan

Knowledge Resource Center

(L to R): Bhawana Awasthi, Inder Kumar, Sumit Bisht, Dhirendra Sharma, Sudha Kureel

Sponsored Project Section

(L to R): Abhay Shukla, Avinash K. Srivastava, Inder Kumar

Earth and Planetary Exploration Group (EPEG)

1st Row (L to R): Binita Phartiyal, M.G. Thakkar, Anupam Sharma

2nd Row (L to R): Vivesh Vir Kapur, Amritpal Singh Chaddha, Sunil Kumar Shukla, Kamlesh Kumar, Yogmaya Shukla

SEM – CLSM Committee

(L to R): Shivalee Srivastava, Archana Sonkar, Vartika Singh, Hukam Singh, Subodh Kumar & Mohd. Firoze Quamar

Information, Documentation & Knowledge Resource Centre Committee

(L to R): Sumit Bisht, Niteshkumar Narendra Khonde, Veeru Kant Singh, Binita Phartiyal, Nandita Tiwari, Dhirendra Sharma & S. N. Ali

RTI Personnel and Appellate Authority

(L to R): Madhukar Arvind, Pavan S. Katiyar, Binita Phartiyal, Swapana Majumdar

Computer and Website Committee

1st Row (L to R): R. S. Negi, Anurag Kumar
2nd Row (L to R): P. S. Katiyar, S Suresh K Pillai, Divya Kumari Mishra, Vivesh Vir Kapoor, Nilay Govind

Garden / Decoration Committee

(L to R): Anil Verma, Mathura Prasad, Barsha Shah, Adrita Choudhuri, Abhijit Mazumder, Ansuya Bhandari, Jitendra Yadav, Inder Kumar Yadav, Sachin Kumar Yadav

Maceration Committee

(L to R): Amrit Pal Singh Chadda, Poonam Verma, Anil K. Pokharia,Abhijit Mazumdar, Deepa Agnigotri, Raja Ram Verma

Auditorium and Audio – Visual Committee

(L to R): Madan Singh Rana, Pavan Singh Katiyar, Santosh Kumar Shah, Neeraj Rai, Jyoti Srivastava & Nilay Govind

Staff Welfare Committee

(L to R): Manish Mishra, Rajesh Awasthi, Gaurav Srivastav, Swapna Mazumdar, Vartika Singh, Poonam Verma & Deepa Agnihotri

Swachhata Hi Sewa (Special Campaign 4.0) Committee

(L to R): Nimish Kapoor, Yogmaya Shukla, Sadhan K. Basumatary, Ashutosh Shukla, Anupam Sharma, Shilpa Pandey, Sanjay Kumar Singh, Biswajeet Thakur

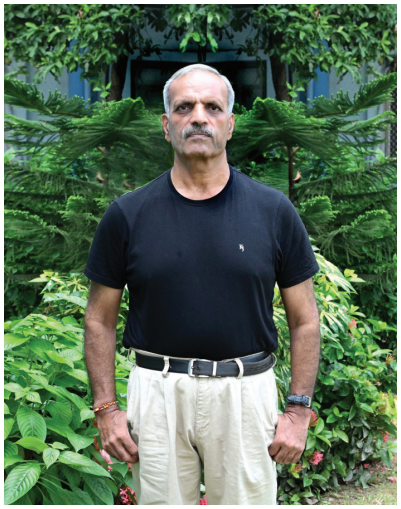
Museum & Herbarium Committee

(L to R): Ram Dheeraj, Ram Ujjagar, Gaurav Srivastava, Shilpa Pandey, Hukam Singh, Ranveer Singh Negi, Sanjai Kumar Singh

Centre for Promotion of Geoheritage and Geotourism Committee (CPGG)

(L to R): Akhilesh K Yadava, Vivesh Vir Kapur, M.G. Thakkar, Shilpa Pandey & Sanjai K Singh

Security Incharge



Ashok Kumar

Cultural / Compering Committee

(L to R): Sanjai K. Singh, Shilpa Pandey, Neelam, Anumeha Shukla & Nandita Tiwari

Outreach Activities Committee

(L to R): Amrit Pal Singh Chaddha, Mohd. Firoze Quamar, Kamlesh Kumar, Shilpa Pandey, Sanjai K Singh, Nimish Kapoor & Y.P Singh

Liaison Officer for SC/ST

Srikanta Murthy

Deputation for Scientific / Research Conferences & Workshops Committee

(L to R): Runcie Paul Mathews, Hukam Singh, Shilpa Pandey, Gurumurthy G.P.

Photography Committee

(L to R): Jitendra Yadav, D.S. Bisht, Barsha Shah, Adrita Choudhuri, Ansuya Bhandari, Abhijit Mazumder

Periodical Reports/MoU to DST & Parliamentary Queries, Etc. Related Committee

(L to R): Neha Aggrawal, Madhukar Arvind, Anupam Sharma, Vivesh Vir Kapur & Arvind Kumar Singh

Publication Committee

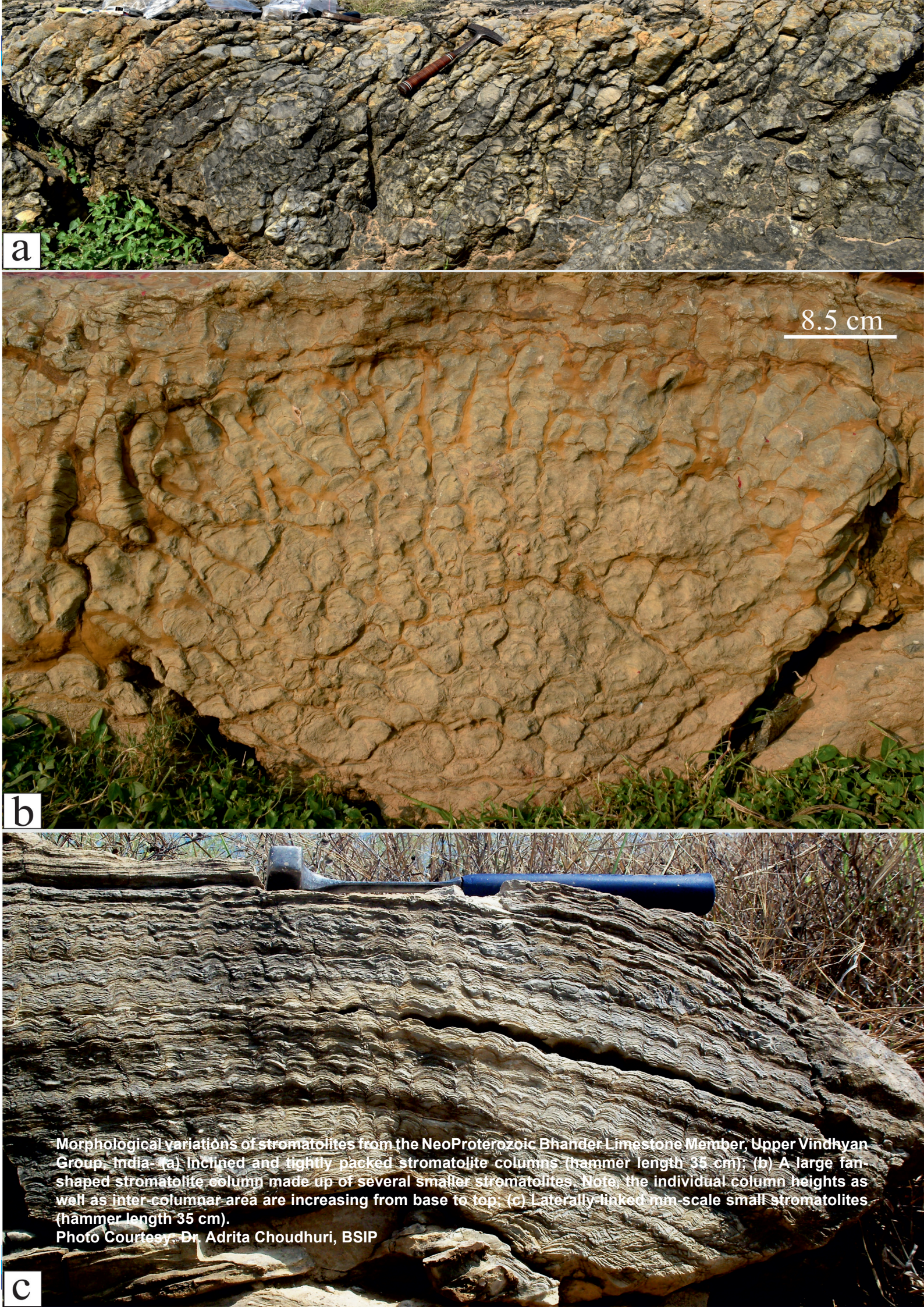
1st Row (L to R): Syed Rashid Ali, Prasanna K., Sumit Bisht, Rattan Lal Mehra
2nd Row (L to R): Shivali Srivastava, Deepa Agnihotri, Binita Phartiyal, Suman Sarkar, Swati Tripathi

Whole Section Cutting Laboratory Committee

(L to R): Arvind Kumar Singh, Vivesh Vir Kapur, Anumeha Shukla, Santosh Kumar Pandey and Palton Ho

Academy of Scientific and Innovative Research (AcSIR), Committee.

(L to R): Neha Aggarwal, K.G. Misra, Ratan Kar, Akhilesh K Yadava, S. Bikkina, P Morthekai.



Morphological variations of stromatolites from the NeoProterozoic Bhander Limestone Member, Upper Vindhyan Group, India. (a) Inclined and tightly packed stromatolite columns (hammer length 35 cm); (b) A large fan-shaped stromatolite column made up of several smaller stromatolites. Note, the individual column heights as well as inter-columnar area are increasing from base to top; (c) Laterally-linked mm-scale small stromatolites (hammer length 35 cm).

Photo Courtesy: Dr. Adrita Choudhuri, BSIP

EVENTS

75th Death Anniversary of Founder, Prof. Birbal Sahni: April 10, 2024

The Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, solemnly observed the 75th Death Anniversary of its revered founder, Professor Birbal Sahni, on April 10, 2024. The commemorative event was led by Professor Mahesh G. Thakkar, Director, BSIP, along with all faculty, scientific, technical and administrative staff members. Floral tributes were offered at the *Samadhi* of Prof. Sahni, located within the serene premises of the Institute's lawn, in a heartfelt gesture of respect and remembrance.

A special *Hawan* and *Pooja* were also organised on the occasion, invoking peace and expressing collective gratitude for the life and legacy of the legendary scientist. The atmosphere was filled with reverence as the BSIP fraternity reflected on Prof. Sahni's monumental contributions to the field of Palaeobotany and Earth Sciences in India.

M. N. Bose Memorial Lecture: April 10, 2024

Prof. Sourendra Kumar Bhattacharyya (Retired Senior Professor and Dean, PRL) delivered 9th M. N. Bose Memorial Lecture on the topic "Triple Oxygen Isotopes in Silicified Woods from Deccan Intertrappeans provide evidence of high tropical rainfall in Late Cretaceous India" on 10th April 2024. The Speaker was felicitated with a shawl, bouquet and a memento as mark of respect for delivering this prestigious memorial lecture. The lecture was well received and attended by BSIP scientists, technical, administrative, research scholars and project staff members.

Brainstorming Workshop on "Patenting Your Innovations" at BSIP: April 12, 2024

In a concerted effort to promote awareness and appreciation of Intellectual Property Rights (IPR) in Earth Sciences, especially in Palaeobotany, Palynology, and Geosciences, the Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, organised a brainstorming workshop on the theme "Patenting Your Innovations" at the Institute campus on April 12, 2024. The event aimed to sensitize scientists and young researchers to the importance of protecting scientific innovations through patents.

Prof. M.G. Thakkar, Director, BSIP, delivered the Inaugural Address and highlighted the historic signing of a Memorandum of Understanding (MoU) between BSIP and Krantiguru Shyamji Krishna Verma Kachchh University (KSKVKU), Bhuj, Gujarat. He reflected on the scientific legacy of Prof. Birbal Sahni and drew connections to Krantiguru Shyamji Krishna Verma in London during the freedom struggle, laying the foundation for mutual academic collaboration.

The Chief Guest, Prof. Mohan Patel, Vice Chancellor, KSKVKU, spoke on the critical role of patenting rights in protecting scientific inventions. He explained the scope of patenting in basic sciences and shared national and global patent data to emphasise its role in economic growth and nation building.

Prof. Harkesh Bahadur Singh, Chairman, Uttar Pradesh State Environment Assessment Committee, delivered the keynote lecture on "Intellectual Property Rights (IPR)." He highlighted how IPR can safeguard innovations, encouraged researchers to pursue novel, patentable ideas, and shared successful examples of technology transfer.

Prof. Mrugesh H. Trivedi from KSKVKU delivered an insightful talk on "NABL – A Small Step Towards Quality Assurance for Vikshit Bharat @ 2047," emphasising quality research, plagiarism checks in the AI era, and the need for NABL accreditation for laboratory data validation.

The workshop saw enthusiastic participation, reinforcing BSIP's commitment to innovation and national development.

Celebrating Earth Day at BSIP: April 22, 2024

The institute celebrated the Earth Day on 22nd April, 2024 at BSIP, Lucknow which is an annual event to demonstrate support for environmental protection and to live a more sustainable life. It was organised by Garden Committee members (Abhijit Mazumder, Ansuya Bhandari, Adrita Choudhuri, Barsha Shah) at BSIP Campus and the scientific, technical and administrative staff of the institute participated enthusiastically in the Plantation Programme.

10th International Day of Yoga Celebration: June 21, 2024

The Institute's Campus was a vibrant hub of activity on International Yoga Day 2024, as students, scientists, technical and staff gathered to celebrate the ancient practice of yoga and its transformative impact on physical, mental, and spiritual well-being. The day's event began with a series of gentle yoga sessions led by experienced instructors, guiding participants through a range of postures and breathe work. The serene setting of the Institute's lush gardens provided the perfect backdrop for these mindful practices, allowing attendees to deeply connect with their bodies and find a sense of inner peace.

Director BSIP, Prof. Mahesh G. Thakkar addressed the staff members at the Inaugural Ceremony, highlighting the significance of yoga in promoting holistic healthcare and its growing recognition in curing health ailments. International Yoga Committee members of BSIP Dr. Kamlesh Kumar, Dr. Jyoti Srivastava, Dr. Ansuya Bhandari and Sh. Ashok Kumar organised the International Yoga Day 2024 event keeping in mind the theme of IDY 2024 "**Yoga for Self and Society**". Dr. Jyoti Srivastava and Sh. Ashok Kumar conducted a 1-hour Gentle Yoga Flow session in the morning, guiding participants through a

series of asanas (postures), pranayama (breath work), and meditation techniques designed to cultivate a sense of calmness and inner harmony. The session was well-attended, with majority of individuals participating, and the feedback from the attendees was overwhelmingly positive, with many expressing a renewed sense of vitality and improved focus. The yoga practice was followed by a Q/A session, where the participants had the opportunity to engage with the instructors and gain deeper insights into the integrated approach of yoga therapy.

15th Indian Summer Arctic Expedition: July 29 – September 1, 2024

Dr. Srinivas Bikkina participated in the 15th Indian Summer Arctic Expedition from 29 July to 1 September 2024, conducted at Ny-Ålesund, Svalbard, under the project "*Tracing Aeolian Dust and Footprints of Forest Fires over the Arctic: Observations from Svalbard"* aimed at studying atmospheric dust and fire-derived pollutants in the Arctic environment.

Recent studies have shown that high-latitude dust sources significantly contribute to the global dust cycle and are important for surface ocean biogeochemistry. Existing studies over the Svalbard region are rather sparse, in particular, focussing on the relative importance of localised versus regional dust transport to the Ny-Alesund region of Svalbard using radiogenic isotopes (87Sr/86Sr and 143Nd/144Nd). Furthermore, the Arctic region is especially sensitive to regional wildfires from Canada and nearby European countries. Therefore, the impact of regional wildfires on the surface soils of Ny-Alesund and the sediments of the surrounding fjords were investigated for forest fire-derived organic tracer compounds (e.g., levoglucosan and other related sugars) along with fatty acids and n-alkanes, soot carbon and stable C, N and S isotope composition of bulk particulate organic matter. Furthermore, the radiocarbon measurements were performed on different components of bulk organic matter to better constrain the impact of regional wildfires.

Surface soil samples were collected from 16 locations in the Ny-Alesund region alongside those from seven trenches. In addition, grab sediment samples were collected from Kong Fjorden (N=5) and Kross Fjorden (N=3). Furthermore, samples were also collected (changed) aerosol filters for the chemical composition of aeolian dust and organics from Gruvbadet (the Indian observatory).

Independence Day Celebrations: August 15, 2024

BSIP celebrated 78th Independence Day by hoisting the national flag by Professor Mahesh G. Thakkar, the Director of the Institute and singing the National Anthem on 15th August 2024 within its campus followed by Independence Day address by the Director and various performances by the Institute staff members. All the BSIP staff including research scholars and associates participated in flag hoisting ceremony.

First National Space Day Celebrations at BSIP: August 23, 2024

The Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, celebrated the First National Space Day on August 23, 2024, in alignment with the national theme "Touching Lives while Touching the Moon: India's Space Saga." The event commemorated the historic achievement of Chandrayaan-3 landing near the Moon's south pole and highlighted BSIP's expanding role in planetary and space research.

The celebration began with the traditional lighting of the lamp and invocation, setting a solemn and inspiring tone. Prof. M.G. Thakkar, Director, BSIP, delivered the Inaugural Address and unveiled the logo of the newly constituted Earth and Planetary Exploration Group (E.P.E.G.), signifying a milestone in the Institute's space science journey. Dr. Anupam Sharma, Scientist-G, introduced the objectives of E.P.E.G. and its role in positioning BSIP on the global map of planetary research, especially in astrobiology.

The Chief Guest, Prof. A.K. Singh, Dean, Faculty of Engineering & Technology, University of Lucknow, delivered a thought-provoking lecture on "The Sun-Earth Interaction and Climatic Variability." He highlighted the effects of space weather on climate systems, satellite operations, communications, and human health, emphasising the balance maintained by natural forces and the disruption caused by anthropogenic activities.

The event also featured a vibrant exhibition and a quiz competition, engaging students from various schools. Poster presentations showcased young minds' creativity and knowledge about space. The celebration concluded with a prize distribution ceremony, encouraging youth participation in space science. The event reinforced BSIP's commitment to advancing space research and nurturing scientific curiosity among students.

78th Foundation Day of BSIP: September 10, 2024

The Birbal Sahni Institute of Palaeosciences (BSIP) celebrated its 78th Foundation Day on September 10, 2024, at its campus in Lucknow. The event marked the Institute's ongoing legacy in understanding the Earth's geological and biological history. The program commenced with a brief introduction to BSIP's illustrious history by Dr. Shilpa Pandey. A floral tribute was paid to the visionary founder, Prof. Birbal Sahni.

Prof. Mahesh G. Thakkar, Director, BSIP, delivered the Welcome Address, recalling Prof. Sahni's pioneering spirit and highlighting the Institute's national scientific achievements and its future vision. Chief Guest Dr. S. Sundar Manoharan, Director General, Pandit Deen Dayal Energy University, Gandhi Nagar, inaugurated the event, appreciating BSIP's continued excellence in palaeosciences.

Dr. Bhaskar Narayan, Director, Indian Institute of Toxicology Research, graced the occasion as Guest of Honour. He introduced the "ICE" principle — *Innovation, Institution First, and Integrity (I); Collaboration, Competency, and Commitment (C); Engagement, Empowerment, and Ethics (E)* — encouraging BSIP scientists to embrace these values.

The Foundation Day lecture was delivered by Prof. D.K. Pandey (Retd.), Rajasthan University, on *"Corals, Civilization and Geological Significance."* He elaborated on the ecological and economic importance of coral reefs and emphasised the need for their conservation.

The event also marked the launch of *Puravigyan Smarika*, edited by Dr. Poonam Verma with Dr. Swati Tripathi and Dr. Neelam Das as co-editors. The magazine includes scientific, research, and outreach articles, reflecting BSIP's commitment to public engagement and promotion of palaeosciences in Hindi.

Awareness Program under Special Cleanliness Campaign 4.0 for the students of Shia PG College, Lucknow: October 15, 2024

As part of the Special Cleanliness Campaign 4.0, BSIP organised an awareness programme on cleanliness for undergraduate students of Shia PG College, Lucknow, on October 15, 2024. The event aimed to sensitise students about the importance of cleanliness in daily life and public spaces. The session included interactive discussions followed by the screening of documentary films focusing on Swachh Bharat Abhiyan and environmental hygiene. The initiative successfully engaged young minds in promoting civic responsibility and reinforced the message of a clean and sustainable India. The program was coordinated by the Special Cleanliness Campaign 4.0 committee members - Dr S. K. Basumatary, Dr Biswajeet Thakur, Dr Shilpa Pandey, Dr Nimish Kapoor, Dr S. K. Singh and Dr Nilay Govind.

Awareness Workshop at Kalicharan Degree College, Lucknow as a part of Special Cleanliness Campaign 4.0: October 16, 2024

As part of the Special Cleanliness Campaign 4.0, BSIP organised an awareness workshop and film screening session on October 16, 2024 at Kalicharan Degree College, Lucknow. The event focused on key environmental issues, including cleanliness, pollution, microplastics, and sustainable practices. Through informative discussions and impactful visual content, participants were sensitised to the critical challenges posed by environmental degradation and the importance of individual responsibility in mitigating these issues. The workshop was coordinated by the Special Cleanliness Campaign 4.0 committee members - Dr Shilpa Pandey, Dr Nimish Kapoor, Dr S. K. Singh and Dr Nilay Govind.

Governing Body Meeting: October 22, 2024

164th Governing Body Meeting of the newly constituted Governing Body was held on October 22, 2024 at BSIP, Lucknow.

Mission Karmayogi Workshop on Science Communication: October 23, 2024

As part of the National Learning Week under Mission Karmayogi 19–25 October 2024, a workshop titled "Art of Science Communication" was organised on October 23, 2024 at BSIP. The workshop was conducted by Dr Nimish Kapoor, Scientist, BSIP, focused on enhancing the science communication skills of research scholars and scientists. Through this interactive workshop, participants were introduced to techniques for translating complex scientific ideas into accessible narratives for non-expert audiences. Key elements included the use of storytelling, analogies, visual tools, and simplified language to improve public understanding of science.

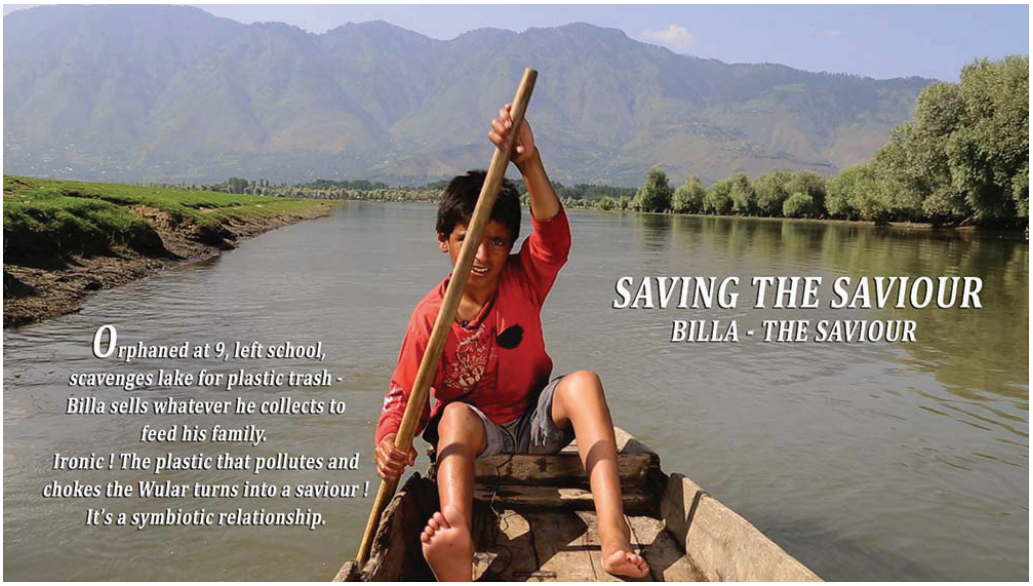
The workshop aligned with Mission Karmayogi's objective of building institutional capacities and fostering a culture of effective knowledge dissemination. It reinforced the importance of science communication as a critical skill for achieving broader societal impact through research and outreach. The workshop was coordinated by the Mission Karmayogi Committee. Three top karmayogis were felicitated for excelling in course completions and karma points.

Documentary Film Screening on Cleanliness and Environmental Awareness under Special Cleanliness Campaign 4.0: October 24, 2024

As part of the Special Cleanliness Campaign 4.0 initiative, a documentary film screening session was organised on October 24, 2024 at BSIP by Dr Nimish Kapoor, Scientist, BSIP to raise awareness about cleanliness, pollution, and environmental responsibility. The session featured a series of impactful short films addressing critical themes such as hygiene, sanitation, the hazards of microplastics, and environmental pollution.

A highlight of the event was the screening of the inspirational film "Saving the Saviour," which portrays the real-life story of Billa, a 12-year-old ragpicker from Bandipora, who took it upon himself to clean the Wular Lake, giving a new lease of life to the aquatic ecosystem.

This remarkable act of environmental stewardship was also recognised and praised by the Hon'ble Prime Minister in the *Mann Ki Baat* episodes aired by Akashvani. The event served as a meaningful platform to engage the community in collective reflection and action, reinforcing the Institute's commitment to national cleanliness campaigns and sustainable practices.



ASPIRE Workshop: Nurturing Science Communication and Public Engagement: October 25, 2024

To foster a culture of impactful science communication, the ASPIRE (Artful Science Communication to Popularize Impactful Research) programme was launched at BSIP. This unique initiative aims to train and inspire research scholars to effectively convey their scientific work to the general public. This initiative aligns with BSIP's commitment to making science accessible, relevant, and engaging for broader audiences.

As part of the initiative, the ASPIRE Workshop was organised on October 25, 2024 at the BSIP Auditorium. Conducted by Dr Nimish Kapoor, Scientist at BSIP, the workshop focused on equipping 35 participating research scholars with essential skills in science communication. The session emphasised transforming complex scientific concepts into simplified, engaging narratives using storytelling techniques, clarity of expression, and a focus on societal relevance.

The workshop also marked the official launch of the ASPIRE Popular Science Article Competition. This competition invited scholars to write popular science articles based on their research, encouraging them to emphasise real-world applications and societal impact. The ASPIRE Workshop and related activities represent a proactive step by BSIP in bridging the gap between research and public understanding. This effort reflects the Institute's broader mission to strengthen public engagement and foster a scientifically informed society.

Curtain Raiser Event for the India International Science Festival (IISF) 2024: November 8, 2024

On November 8, 2024, BSIP hosted a Curtain Raiser event for the 10th edition of the India International Science Festival (IISF) 2024. The event, held at the BSIP Auditorium, aimed to generate enthusiasm and public engagement in anticipation of the main festival. The IISF 2024 was successfully held from 30th November to 3rd December 2024 in Guwahati under the theme "Transforming India into an S&T-driven Global Manufacturing Hub."

The program commenced with opening remarks by Prof. M. G. Thakkar, Director, BSIP, followed by remarks from Shri Ashutosh Singh, Zonal Organising Secretary, Vigyan Bharati East UP. The Chief Guest, Dr. Bhaskar Narayan, Director, CSIR-IITR, delivered insightful comments on the significance of the IISF initiative. A promotional video for IISF 2024 was screened, adding to the excitement and awareness of the festival.

A popular science lecture titled "Himalayan Odyssey: Climate Change Perspective" was delivered by Dr P. S. Ranhotra, Scientist E, BSIP, highlighting the critical link between palaeosciences and contemporary environmental issues. The event was coordinated by BSIP Team - Dr S. K. Basumatary, Dr Nimish Kapoor and Dr S. K. Singh.

Founders' Day Celebration: November 14, 2024

The Birbal Sahni Institute of Palaeosciences (BSIP) celebrated its Founders' Day on November 14, 2024, commemorating the 133rd Birth Anniversary of its visionary founder, Late Professor Birbal Sahni. The event began with a tribute to Prof. Sahni's monumental contributions in establishing a globally renowned institute dedicated to fossil research and allied sciences.

Prof. Mahesh G. Thakkar, Director, BSIP, reflected on Prof. Sahni's legacy and elaborated on the Institute's major scientific achievements and ongoing research in diverse areas of palaeosciences. He emphasised BSIP's 20-year vision, which includes establishing Palaeoscience Centres in various universities across the country to expand academic and research engagement. He also appreciated the Institute's active participation in initiatives like the Special Cleanliness Drive-4, Hindi Pakhwada, and Vigilance Week.

Chief Guest, Prof. Talat Ahmad, Chairman, Governing Body, Wadia Institute of Himalayan Geology, highlighted Prof. Sahni's foresight in palaeobotany and lauded the Institute's transformation into a multidisciplinary centre of excellence. He appreciated the recent interdisciplinary advancements in palaeobotany, climate change, and environmental sciences, and endorsed the vision for national-level expansion.

The 54th Birbal Sahni Memorial Lecture was delivered by Prof. Anindya Sarkar (IIT Kharagpur) on *"Isotopes, Archaeology, and Climate: Decoding 3000 Years History of India."* He discussed the "Meghalayan Age" and presented new archaeological insights from Vadnagar, Gujarat, indicating a long-standing cultural continuity in India.

The 66th Sir A.C. Seward Memorial Lecture was delivered by Prof. Thijs van Kolfschoten, Ex President, INQUA, focusing on Lower Palaeolithic discoveries in Europe. He appreciated BSIP's key role in securing the bid to host INQUA-2027 in Lucknow.

The program concluded with a prize distribution ceremony for the winners of Hindi Pakhwada competitions including debates, essays, posters, and typing.

44th Indian Scientific Expedition to Antarctica (ISEA): November 6, 2024 - February 20, 2025

Dr. Srinivas Bikkina and Dr. Manoj M.C. of BSIP were deputed to participate in the 44th Indian Scientific Expedition to Antarctica (ISEA), held from 6 November 2024 to 20 February 2025. This field campaign was undertaken under the aegis of a research project "*Source apportionment of atmospheric/sedimentary black carbon and organic lipids from Schirmacher Oasis, Antarctica: A molecular-level tracer approach and 14C/13C-based isotope perspective*" focused on identifying and characterizing the sources of black carbon and organic lipids in the Antarctic environment using advanced molecular tracers and stable isotope (14C/13C) techniques.

The team commenced their pre-expedition activities at the National Centre for Polar and Ocean Research (NCPOR), Goa, on 7 November 2024. This phase included mandatory administrative procedures, training modules such as fire-fighting at SeaScan Marine Institute, and logistical briefings. The researchers arrived at Maitri Station, Antarctica, on 20 November 2024, where they coordinated with the station leadership and logistics personnel to initiate sampling operations. A high-volume dust sampler (APM-430) was successfully installed, and systematic sampling began on 24 November 2024.

During the expedition, the team conducted extensive fieldwork in and around the Schirmacher Oasis region. A diverse suite of environmental samples were collected to examine the transport pathways, origin, and seasonal variations of black carbon and organic molecular markers. These included:

- **Atmospheric Dust Samples:**
  - Nine dust samples were collected at intervals of 8–10 days to analyze BC and organic tracers.
- **Sediment, Permafrost, and Rock Samples:**
  - Surface sediments from various lakes from Schirmacher Oasis.
  - Permafrost samples collected near Elephant Hill.
  - Rock samples from multiple locations to study chemical compositions and environmental influences.
- **Snow and Ice Core sample filters:**
  - Snow samples from Mount Vataya, Mount Gruber, and Maitri surroundings to assess BC background levels.
  - An ice core (1m length) from Priyadarshini Lake for isotopic analysis.
- **Water Sample filters:**
  - Collected from six locations in Priyadarshini Lake to study particulate organic matter (POM) dynamics.
  - Water samples were collected daily at noon from Priyadarshini Lake to study the ecological dynamics of particulate organic matter (POM) during the lake's peak productivity period.
  - Additional water samples from lakes E12, L45, L46, L50, and L51 for comparative studies.
- **Algal Mats and Moss Samples:**
  - Retrieved from multiple lakes to examine biological contributions to organic matter cycles.

This comprehensive dataset will aid in distinguishing between locally generated and long-range transported pollutants affecting the Antarctic environment. The findings are expected to offer critical insights into anthropogenic and natural contributions to polar aerosol and sediment chemistry, supporting the development of robust source apportionment models and improving the accuracy of global climate projections.

The next phase of the project will involve detailed laboratory analyses, including molecular marker identification and radiocarbon dating. Results will be disseminated through peer-reviewed publications and international scientific forums, contributing to India's leadership in polar research and its commitment to understanding climate-relevant processes in high-latitude environments.

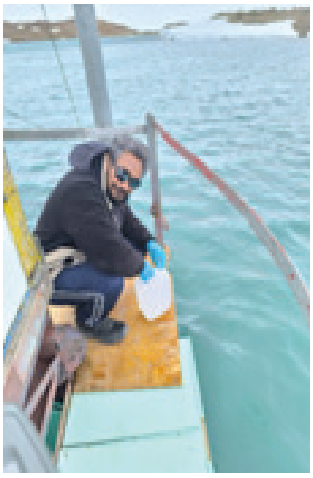
The team acknowledges the support extended by the Director, BSIP; the NCPOR administration; the 44th ISEA leadership; and the Maitri Station logistics team in ensuring the success of this scientific mission.









40th Convention of the Indian Association of Sedimentologists (IAS-2024) and National Conference held at BSIP: December 11-13, 2024

The 40th Convention of the Indian Association of Sedimentologists (IAS-2024), along with the National Conference on "An Odyssey of Sedimentology from Precambrian to Anthropocene: Significant Contributions in Environmental, Climatic and Energy Research", was held from December 11–13, 2024 at the Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow. The event served as a crucial platform for Geoscientists, researchers, academicians, and industry professionals to share knowledge on sedimentology and stratigraphy. The convention was organised under the leadership of Prof. Mahesh G. Thakkar, Director, BSIP along with Dr. Arvind Kumar Singh (Convener) and Dr. Santosh Kumar Pandey (Co-Convener).

Besides BSIP, the event was sponsored by major national scientific organizations, including: DST-Anusandhan National Research Foundation (ANRF); Ministry of Earth Sciences (MOES); Oil and Natural Gas Corporation Limited (ONGC); Council of Scientific and Industrial Research (CSIR); Wadia Institute of Himalayan Geology & Baker Hughes-Waygate Technologies.

Objectives: The primary goal of the conference was to advance sedimentological research and explore the role of sedimentology in addressing environmental, climatic and energy challenges. Key objectives included:

- Discussing sedimentary processes across different geological time periods.
- Understanding sedimentary basins, hydrocarbon exploration and climate interactions.
- Promoting multidisciplinary research in sedimentology.
- Encouraging young researchers through the Young Sedimentologist Award.

Inauguration and Keynote Addresses: The Conference commenced with a traditional lamp-lighting ceremony and a Welcome Address by the Director of BSIP, Prof. Mahesh G. Thakkar. The Abstract Volume of the Conference was also released during the ceremony. Ms. Sushma Rawat (Director-Exploration, ONGC) was Chief Guest of the Inauguration Ceremony. She highlighted ONGC's involvement in 19 out of India's 26 sedimentary basins and discussed the Kutch Basin's hydrocarbon potential. She also emphasized ONGC's goal of achieving net-zero carbon emissions by 2038. Prof. S.K. Tandon (IISER, Bhopal) was Guest of honour who spoke on the importance of selecting high-quality scientific journals for research publication. Prof. G.N. Nayak (President, IAS) stressed on the significance of BSIP's contribution to sedimentology and announced that the IAS journal would be published biannually.

Conference Themes and Scientific Sessions: The scientific program was structured around ten major themes, covering various aspects of sedimentology and stratigraphy. Each theme started with keynote talks delivered by the stalwart experts including Prof. Partha Pratim Chakraborty, Prof. Santanu Banerjee, Prof. Mukund Sharma, etc. followed by technical presentations by delegates from national laboratories and universities of the country. Apart from technical sessions, two workshops were also organised with the target audience of young and budding geoscientists of graduate and doctoral level. Dr. Ratan Kar, Scientist-F, led the discussion on Palynology and climate change studies and Prof. Subir Sarkar delivered an engaging workshop on sequence development pattern in siliciclastic and carbonate deposition. A record-breaking poster session was held, featuring 86 research poster presentations. A dedicated session on young sedimentologists was also organised and three best young sedimentologists presentations were also invited for selecting Young Sedimentologists Award among presenting PhD students. Besides, A post-conference field work to Chitrakoot region was also arranged for the participants of the 40th IAS -2024. In total, IAS-2024 hosted more than 230 participants from across the nation, thus, making this event a great success. The conference concluded with a General Body Meeting (GBM) of IAS, where it was announced that the 41st IAS Convention (IAS-2025) will be hosted by Pune University.

Awards & Recognitions: The Valedictory Session was conducted on 13th December 2024 with Prof. M. P. Singh and Prof. S. K. Tandon as Chief Guest and Guest of Honour. The several Awards of Best Oral and Poster presentations were distributed. The Young Sedimentologist Award-2024 was conferred on Ms. Sambhabhna Lenka, NIO Goa. The best oral presentations were awarded to Dr. Alono Thorie, Ms. Shradha Menon, Mr. Mrityunjay Banerjee and Dr. Divya Singh. The Best Poster Awards were conferred to 10 participants, including Mr. Sumit Sagwal, Ms. Ayushi Bhatnagar, and Ms. Shivani Choudhari.

Post-Conference Field Excursion: A field trip to Chitrakoot, Uttar Pradesh, was conducted under the



40th Convention of Indian Association of
Sedimentologists &
National Conference on
IAS@BSIP - 2024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Birbal Sahni Institute of Palaeosciences, Lucknow

IAS@BSIP - 2024
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Birbal Sahni Institute of Palaeosciences


guidance of Prof. Mukund Sharma (Emeritus Scientist), Dr. Santosh Kumar Pandey (BSIP) and Dr. Arvind Kumar Singh (BSIP). The excursion focused on Precambrian sedimentology and Geobiology, allowing participants to study geological formations in the Vindhyan Basin.

Conclusion & Future Perspectives: The 40th IAS Convention and National Conference was a resounding success, fostering discussions on sedimentary geology, climate change, and hydrocarbon exploration. Key takeaways included:

- Integration of sedimentology with modern climate and energy research.
- Advancement of geoscientific research through cutting-edge modelling and technology.
- Encouragement of young sedimentologists through awards and recognition.

With the IAS-2025 Convention scheduled at Pune University, the event reinforced India's growing influence in global sedimentology research.

BSIP's Dynamic Participation at the 11th Bhopal Vigyan Mela: December 27–30, 2024

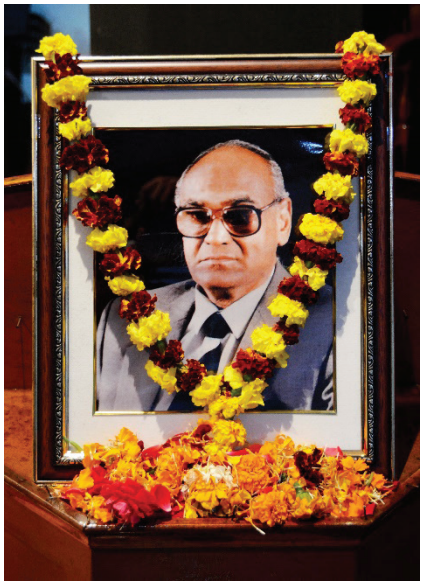
BSIP actively participated in the 11th Bhopal Vigyan Mela held from December 27–30, 2024, at Jamboree Maidan, Bhopal. Organised jointly by the Madhya Pradesh Council of Science & Technology and Vigyan Bharati, the event served as a vibrant platform for science communication and public engagement.

BSIP set up an engaging and educational exhibition attracting hundreds of visitors, including school students, educators, parents, and science enthusiasts. The BSIP exhibition highlighted key themes in palaeosciences, geology, and plant fossil studies. An impressive array of fossil plant specimens—including fossilised fruits, grains, and leaves—offered visitors a glimpse into Earth's evolutionary past. A standout feature was the Geological Time Clock, an innovative visual display that condensed Earth's 4.6-billion-year history into a 24-hour clock format, effectively illustrating the timeline of life on Earth.

In addition to fossil displays, BSIP showcased its advanced research and facilities through exhibits on Geoheritage and Geotourism; Palynology in Fossil Fuel Exploration; Organic Petrology; Ancient DNA Research; Archaeophytology; and Environmental Applications of Palaeosciences. These displays underscored BSIP's multidisciplinary approach and its contributions to contemporary scientific challenges. This event was coordinated by the BSIP team- Dr Suresh Pillai, Dr Nimish Kapoor, Dr S.K.Singh and Mr Ram Dheeraj.

Dr. B.S. Venkatachala Memorial Lecture: January 6, 2025

11th B.S. Venkatachala Memorial Lecture was delivered on January 6, 2025 by Dr C.M. Nautiyal, Former Scientist, BSIP on the topic "Isotopes, Planets and Life".



World Hindi Day Celebration: 10 January 2025

The World Hindi Day Program was enthusiastically organised at Birbal Sahni Institute of Palaeosciences, Lucknow on 10 January 2025 under the able guidance of Director Professor Mahesh G. Thakkar. This year's theme was "Hindi: The global voice of unity and cultural pride". The program began with the topic introduction by Dr. Swati Tripathi, who highlighted the global importance of Hindi language and emphasised the need for its promotion. In his Welcome Address, the Institute's Director Prof. Mahesh G. Thakkar spoke about the historical development of Hindi, its cultural significance, and the World Hindi Conferences held at the international level. He also informed the audience that the Institute's Official Language magazine, 'Pura Vigyan Smarika' has been awarded the First Prize by the Nagar Rajbhasha Karyanvayan Samiti, Lucknow, a matter of great pride for the institute.

The Chief Guest Professor Hemanshu Sen from Lucknow University delivered a lecture on the topic "Hindi as a global language: status and prospects". She stated that Hindi has enriched its form over time by assimilating words from various languages. Describing Hindi as a bridge of cultural unity, she elaborated on its global presence and future potential.

The program concluded with a vote of thanks by Dr. Neelam. In her address she encouraged everyone to use Hindi more frequently and emphasised the need to promote the language at both national and international level. The institute's scientists, employees and researchers actively participated in the event.

One Day Workshop on "Anti-Corruption and Vigilance Matters": January 13, 2025

The Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow organised a One Day Workshop on "Anti-Corruption and Vigilance Matters" on 13th January 2025 under the guidance of Prof. Mahesh G. Thakkar, Director, BSIP. The workshop aimed to promote transparency, accountability, and integrity among employees, and enhance awareness on key vigilance issues.

The Chief Guest and Keynote Speaker of the event was Shri Rajiv Verma, Consultant & Ex-Director, Central Vigilance Commission (CVC), New Delhi. His insightful address covered essential aspects of the vigilance framework, anti-corruption measures, types and functions of vigilance (preventive, punitive, participative), the role and responsibilities of Chief Vigilance Officers (CVOs), the complaint handling mechanism, and the process for filing PIDPI complaints.

In his Welcome Address, Prof. Thakkar emphasised the importance of integrity in science and governance, noting that corruption in the scientific domain could have devastating societal impacts. He stated that such workshops empower employees to work with greater honesty, discipline, and responsibility, which are critical for institutional development.

Shri Verma shared real-life case studies from various government departments, underscoring the severe consequences of corruption. He identified key causes such as administrative delays, regulatory overload, discretionary power misuse, and lack of transparency. He elaborated on the genesis of the CVC in 1962 and its role in curbing corruption through procedural reforms and standardised mechanisms.

The workshop witnessed active participation from BSIP's scientific, technical and administrative staff, as well as

research scholars. A prize distribution ceremony was also held to felicitate winners of the Vigilance Awareness Week speech competition. The event concluded with a vote of thanks by Dr. Swati Tripathi, Senior Scientist, who appreciated the enthusiasm and support of all participants and the keynote speaker in making the workshop a success.

Republic Day Celebration: January 26, 2025

Dr. K.R. Surange Memorial Lecture: February 06, 2025

8th Dr. K.R. Surange Memorial Lecture was delivered by Professor Ajit Kumar Shasany, Director, CSIR-NBRI on the topic "Internal immunity: Learnings from Plants" on February 6, 2025.

National Science Day Celebrations: February 28, 2025

BSIP, Lucknow, celebrated National Science Day on February 28, 2025 with great enthusiasm and a vibrant line-up of events. Aligned with the national theme "Empowering Indian Youth for Global Leadership in Science and Innovation for Viksit Bharat," the celebration aimed to inspire young minds, foster scientific temper, and promote public engagement with science.

The Chief Guest, Dr. Anil Rastogi, Former Deputy Director & Chief Scientist at CSIR-CDRI and a noted theatre & film personality, applauded BSIP's pioneering contributions in climate research and disaster forecasting. In his address, Dr. Rastogi highlighted recent advancements at the institute, including the Unmanned Surface Vehicle (USV), the establishment of a state-of-the-art Micro-Computed Tomography (Micro-CT) National Facility, and the development of the Coal Quality Assessment Laboratory. He emphasised the role of these facilities in improving environmental understanding and assessing risks such as Glacial Lake Outburst Floods (GLOF). Dr. Rastogi also inspired young researchers to blend their scientific pursuits with engagement in arts and culture, encouraging holistic personal development.

The event was chaired by Prof. Mahesh G. Thakkar, Director, BSIP, who emphasised the importance of youth-driven innovation in realising the vision of Viksit Bharat. He spoke about the significance of the Raman Effect, discovered by Sir C.V. Raman, which underpins Raman spectroscopy, a tool widely used in modern science and law enforcement.

A keynote scientific talk was delivered by Dr. Srinivas Bikkina, Scientist-F, on BSIP's collaborative polar research project with the NCPOR. Dr. Bikkina presented compelling findings on the impact of wildfire-derived soot on glacial melting in the Arctic and Antarctic, providing deeper insights into climate dynamics and global environmental challenges.

To promote science among students, BSIP organised speech and poster competitions, drawing participation from over 120 students from various regional colleges. A major highlight of the celebration was the outreach initiative "One Day as a Scientist", inspired by the Hon'ble Prime Minister's *Mann Ki Baat*. The program offered students interactive lab visits, hands-on experiences, and mentorship sessions with BSIP scientists, enabling them to gain a real-world perspective of scientific research and innovation. The event was coordinated by the outreach committee.

Research Advisory Council (RAC) Meeting: March 27-28, 2025

The Chairman, Governing Body of BSIP in consultation with Secretary, DST reconstituted the Research Advisory Council (RAC) of BSIP for a period of three years w.e.f. March 2025, following which the 61st RAC meeting was held on March 27 and 28, 2025 at BSIP. The Director, Professor M.G. Thakkar welcomed the Chairman, Prof. Subir Sarkar and members of the newly constituted RAC and provided an update on the progress of the institute. The RAC Chairman welcomed the RAC members and together they evaluated the ongoing (In house Project Nos. 1-8: 2021-2025) and the newly formulated In-house research projects (Thrust Areas 1-12) for FY 2025-2029 and provided invaluable inputs and constructive suggestions for further development of the BSIP in the interdisciplinary field of Palaeosciences.

A planispiral, ribbed ammonite fossil from the Middle to Upper Jurassic Spiti Shale Formation (Lapthal area, Chamoli, Uttarakhand) reflects open marine deposition and likely belongs to Perisphinctidae, Oppeliidae, or Stephanoceratidae, typical of Tethyan Jurassic faunas.
Photo Courtesy: Dr. Ranveer Singh Negi, BSIP

OUTREACH ACTIVITIES

BRAINSTORMING MEETINGS AND DISCUSSIONS ORGANISED TO FOSTER DEEPER ACADEMIA-INDUSTRY PARTNERSHIPS AT THE GEOLOGY AND RESERVOIR DEPARTMENT OF THE OIL INDIA LIMITED, DULIAJAN AND THE CENTRE OF EXCELLENCE FOR ENERGY STUDIES (COEES), GUWAHATI OIL INDIA LIMITED (OIL), GUWAHATI: 27TH MAY TO 1ST JUNE 2024

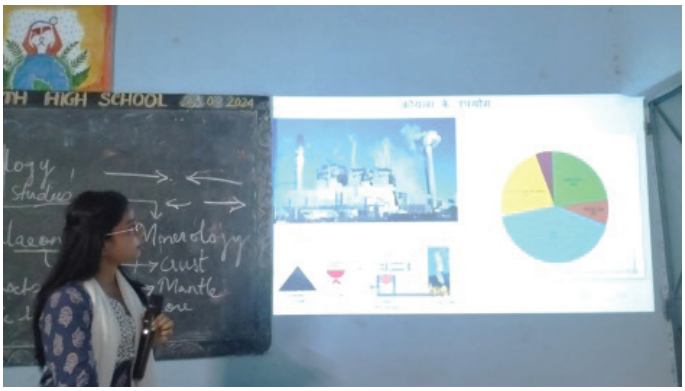
From 27th May to 1st June 2024, the Director of the Birbal Sahni Institute of Palaeosciences (BSIP), Prof. Mahesh G. Thakkar, alongwith Dr. (Mrs.) Poonam Verma, Dr. Suman Sarkar, and Dr. (Mrs.) Shreya Mishra from BSIP, Lucknow, organised and actively participated in a series of high-level brainstorming sessions and technical discussions. These meetings were held with the Director (Exploration & Development) and senior officials of Oil India Limited (OIL) at the Geology and Reservoir Office in Duliajan and at the Centre of Excellence for Energy Studies (COEES) in Guwahati.

The primary objective of these engagements was to review the progress of ongoing collaborative projects between BSIP and OIL, and to chart out the course for future joint research initiatives. The discussions focused on strengthening scientific cooperation in areas of micropalaeontological applications in hydrocarbon exploration.

In addition, a dedicated brainstorming session was conducted with representatives from various ancillary units of OIL India Limited. This meeting aimed to foster deeper academia-industry partnerships by encouraging knowledge sharing, identifying mutual research interests, and exploring innovative solutions to industry challenges. The visit emphasised the importance of collaborative research in advancing scientific understanding and supporting the strategic objectives of the energy sector.

OUTREACH ACTIVITY AT GOPALNATH HIGH SCHOOL, DURAGPUR, WEST BENGAL: SEPTEMBER 25, 2024

During field work at Durgapur, Asansol and Raniganj areas in September 2024, Dr. Pauline Sabina K and JRF, Ayushi Mishra alongwith GSI Staff Dr. Omnath Saha conducted an outreach program at Gopalnath High School in Durgapur and taught the basics of geology and the process of formation of coal and their uses as their towns are surrounded by coalfields of Eastern Collieries Limited. The students expressed keen interest to understand the origin and formation of coal and its uses.



INNO VISTAS: EXPLORING HORIZONS, GREENLAND PUBLIC SCHOOL, LUCKNOW: SEPTEMBER 27, 2024

BSIP Scientists Dr. Gaurav Srivastava and Dr. Ranveer Singh Negi, engaged with students at Greenland Public School, Lucknow, on 27th September 2024, as part of the thematic event '*Inno Vistas: Exploring Horizons*.' Students from classes VI to XII showcased their creativity and scientific curiosity through innovative competitions such as Inventia, EraArt, and GeoMorph. The event featured an impressive array of working models and artistic exhibits, reflecting the students' enthusiasm and talent, and fostering meaningful interaction with the visiting scientists.

Karmayogi Saptah: National Learning Week (NLW) October 19-27, 2024, BSIP: October 3, 2024

In line with DST directives (OM-A-33011/35/2022-Trg (E-41205), dated 14/10/2024), BSIP actively observed Karmayogi Saptah: National Learning Week (NLW) from October 19–27, 2024, completing the mandated four hours of learning on the iGOT Karmayogi platform. To enhance participation, the BSIP Capacity Building Committee, under the guidance of the Director, Committee Convener and Mission Karmayogi Nodal Officer, organised events on October 23, 2024. Director Prof. Mahesh G. Thakkar inaugurated the session, emphasising the "Amritkaal" vision of Developed India 2047 and the Gita's motto, "योग: कर्मसु कौशलम्» (efficiency in action). Mr. P.S. Katiyar outlined the Mission Karmayogi framework and NPCSCB's six pillars, while Mr. Y.P. Singh presented BSIP's Capacity Building Plan for Q3–Q4, FY 2024–25, featuring 100 curated courses. Dr. Nimish Kapoor delivered a lecture on "Art of Science Communication" and launched the "ASPIRE" article competition. Three top karmayogis were felicitated for excelling in course completions and karma points.

Swachhata Hi Sewa (Special Campaign 4.0) Swabhav Swachhata Sanskaar Swachhata, 2024

PLANTATION UNDER EK PED MAA KE NAAM, CLEANLINESS AND AWARENESS PROGRAM UNDER SWACHHATA SPECIAL CAMPAIGN 4.0, PRIMARY GOVERNMENT SCHOOL, SHAHPUR, ITAUNJA, LUCKNOW, UTTAR PRADESH, INDIA: OCTOBER 29, 2024

The *Swachh Bharat Mission Special Campaign 4.0* is a continuation of India's flagship cleanliness drive under the *Swachh Bharat Mission*. This initiative aims to address cleanliness, waste management, and sanitation across urban and rural areas. Building on previous campaigns, Special Campaign 4.0 has expanded its focus, incorporating digital solutions, enhanced public awareness, and engagement with local communities to ensure sustainable sanitation practices.

It aims with emphasis on making public places, such as railway stations, government offices, and schools, waste-free through organised waste collection and disposal systems. Furthermore, leveraging digital platforms for monitoring and ensuring transparency, including the use of apps for citizens to report waste issues. A strong focus on reducing single-use plastics, especially in public spaces and offices, to mitigate plastic pollution is a key concern. It campaigns and workshops to encourage citizens to practice daily cleanliness and adopt eco-friendly habits. It encourages local communities, NGOs, and stakeholders to ensure grassroots involvement and localised solutions for cleanliness and waste management. The campaign has led to increased cleanliness in government offices and has mobilized volunteers nationwide. Through collaborative efforts, there has been significant progress in waste collection, recycling initiatives, and plastic reduction. By integrating modern technology and community-driven efforts, Special Campaign 4.0 aims for long-term, sustainable results in India's sanitation and cleanliness standards.

Plantation program at Primary Government School, Shahganj under the Swachhata Special Campaign 4.0

OUTREACH ACTIVITY AT SUAGADA, BARABANKI, 27TH FEB, 2025

Scientists from BSIP (Dr. Abha Singh, Dr. Ansuya Bhandari, Dr. Mohammad Arif, Dr. Prem Raj Uddandam and Mr. Sanjay Kumar Singh Gahlod) visited the Primary School, Suagada, Barabanki, on 27.02.2025 under the advanced program/outreach activity). In this Outreach Program, the scientists provided information to the children on various topics of Palaeosciences, fossils, palaeomagnetism, and radiocarbon dating, etc.

Outreach Activities by the BSIP Museum Committee

BRIDGING CLASSROOMS AND RESEARCH: MAHAMAYA COLLEGE STUDENTS AT BSIP: FEB 18, 2025

Undergraduate science students and faculty from Mahamaya Government Degree College, Mahona, Lucknow, visited BSIP on 18 February 2025 for an enriching educational tour. The visit commenced at the BSIP Museum, where students explored a wide array of fossil specimens and gained insights into Earth's evolutionary history. They also toured key research facilities, including the Scanning Electron Microscopy (SEM) Lab, Radiocarbon (C-14) Lab, and the Amber Lab. At the Amber Lab, Dr. Hukam Singh, Convener of the Museum Committee and Senior Scientist at BSIP, introduced students to the study of fossil resins and explained the scientific relevance of insect inclusions in palaeo-ecological research. The visit provided students with hands-on exposure to palaeo-scientific tools and techniques, fostering curiosity and aligning with BSIP's ongoing commitment to outreach and science education.

FROM FOSSILS TO FUTURE - KIRTI PUBLIC SCHOOL, LUCKNOW VISIT TO BSIP MUSEUM & LABS: OCTOBER 16, 2024

Exploring the Past, Shaping the Future! Students and faculty of Kirti Public School, Lucknow, visited the Birbal Sahni Institute of Palaeosciences (BSIP) on 16 October 2024 for an engaging and interactive educational experience. The visit began at the BSIP Museum, where students explored fossil specimens and gained insights into Earth's deep history and the evolution of life. The group toured core research facilities, including the Amber, Radiocarbon (C-14) and Scanning Electron Microscopy (SEM) Labs. Students engaged actively with BSIP scientists, gaining first-hand insight into scientific research. The visit sparked curiosity and reflected BSIP's dedication to science education and outreach.

JOURNEY THROUGH TIME: BSIP HOSTS RAJKIYA BALIKA INTER COLLEGE, BILGRAM (HARDOI, U.P.), BSIP, JANUARY 8, 2025

Students from Rajkiya Balika Inter College, Bilgram (Hardoi, U.P.), visited the BSIP Museum and Laboratories on 8 January 2025. The educational tour offered a fun and engaging introduction to fossils, ancient life, and scientific research, sparking curiosity among the students.

DISCOVERING DEEP TIME: BARMA UNIVERSITY'S (WEST BENGAL) ACADEMIC TOUR TO BSIP: JANUARY 8 2025

Students from the Department of Botany, Cooch Behar Panchanan Barma University, West Bengal, undertook a long-distance educational visit to the Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, on 8 January 2025. The visit offered a unique opportunity to explore the BSIP Museum and cutting-edge research laboratories, providing insights into the ancient history of plant life and the methods used in palaeoscientific investigations. During the tour, students interacted with BSIP scientists, who shared their expertise on fossil preservation, plant evolution, and laboratory techniques such as radiocarbon dating and microscopy. The hands-on exposure and academic interactions enriched the students' learning experience and highlighted the importance of interdisciplinary approaches in botanical and palaeobotanical research.

STUDENTS MEET SCIENCE: MAHARISHI UNIVERSITY, LUCKNOW AT BSIP: JANUARY 29, 2025

Graduate and undergraduate students of Zoology and Botany from the Department of Science, Maharishi University, Lucknow, visited the Birbal Sahni Institute of Palaeosciences (BSIP) on 29 January 2025 for an insightful educational experience. The visit provided a multidisciplinary perspective on ancient life and scientific exploration through guided tours of the BSIP Museum and research laboratories. Students explored fossil exhibits that illustrated the evolution of plant and animal life, and interacted with BSIP scientists who explained various techniques used in palaeontological research. They visited the Scanning Electron Microscopy (SEM) Lab, the Amber Lab, and the Radiocarbon (C-14) Lab, gaining exposure to advanced analytical tools and methods. The visit encouraged scientific curiosity and offered valuable academic exposure, reinforcing BSIP's commitment to promoting science education and outreach.

Reservation and Concessions

The Institute is following General Reservation Orders of the Government of India as applicable to Autonomous Bodies and amended from time to time for the reservations and concessions of Scheduled Castes (SC), Scheduled Tribes (ST), Other Backward Classes (OBC) and Physically Handicapped Persons for the posts meant for direct recruitment in Group 'A', 'B', 'C' and 'D' as per Government of India orders.

Siachin Glacier snout in Ladakh
Photo Courtesy: Dr. Parminder Singh Ranhotra, BSIP

ACCOUNTS

MADHUR JAIN & CO.
CHARTERED ACCOUNTANTS
52, Eldeco Greens, Gomti Nagar, Lucknow - 226010;
Tel: 0522 - 4005810; E-mail: mjainco@gmail.com

INDEPENDENT AUDITORS REPORT

To,
The Governing Body,
Birbal Sahni Institute of Palaeosciences,
53, University Road,
Lucknow - 226007

Opinion

We have audited the financial statements of Birbal Sahni Institute of Palaeosciences (the Institute), which comprise the Balance Sheet at March 31st 2025, the Statement of Income and Expenditure and the Receipts & Payments Accounts, for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.

Subject to our comments in Annexure – A to our Independent Auditors Report attached, in our opinion, the accompanying financial statements give a true and fair view of the financial position of the Institute as at March 31, 2025, and of its financial performance for the year then ended in accordance with the Accounting Standards issued by the Institute of Chartered Accountants of India (ICAI).

Basis for Opinion

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the entity in accordance with the ethical requirements that are relevant to our audit of the financial statements, and we have fulfilled our other ethical responsibilities in accordance with these requirements. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Responsibilities of Management and Those Charged with Governance for the Financial Statements

Management is responsible for the preparation and fair presentation of the financial statements in accordance with the aforesaid Accounting Standards, and for such internal control as management determines is necessary to enable the preparation of financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the entity's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the entity or to cease operations, or has no realistic alternative but to do so.

Those charged with governance are responsible for overseeing the entity's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

A further description of the auditor's responsibilities for the audit of the financial statements is located at Institute's website at https://www.bsip.res.in/. This description forms part of our auditor's report.

For Madhur Jain & Co.
Chartered Accountants
Firm Reg. No.: 004865C

Sd/-
Madhur Jain, FCA
(Partner)
M. No.: 073699

Date:29/08/2025
Place: Lucknow
UDIN: 25073699BMJGYJ9966

ANNEXURE - 'A'

[Annexed to and forming part of the Independent Auditors Report for the year ended 31st March 2025]

COMMENTS / AUDIT OBSERVATIONS ON ACCOUNTS OF BIRBAL SAHNI INSTITUTE OF PALAEOSCIENCES, LUCKNOW'

1. As per para 8 of the Schedule 24 - 'Significant Accounting Policies' annexed to the financial statements it is stated that retirement benefits and leave encashment have been accounted for on cash basis. However, we have noticed that provision for pension payable to the tune of Rs. 98.90 lacs (as reported in Schedule – 7) has been created on 31.03.2025. Thus, the accounting treatment is contrary to the accounting policy mentioned above.

2. BSIP receives grants for various projects for research work undertaken by the scholars and scientists. The grant is utilized for expenses related to that project. However, as on 31.03.2025 we noticed debit balances in the following project grants i.e., excess expenditure over the quantum of grant pertaining to the following grants: -

S. No.	Project	Debit Balance as on 31.03.2025
1.	DST Project Dr. Manoj M.C.	21,277/-
2.	NHMS/CHEA Project Dr. P. S. Ranhotra	76,383/-
Total		**99,038/-**

The excess expenditure over quantum of grant is lying in ledger since many years. We are of the opinion that proper control deserves to be exercised in charging expenses to any grant account.

3. The Bank Reconciliation Statement pertaining to Account No.187301000001666 & Account No.187301000005118 maintained with Indian Overseas Bank, University Road Branch, Lucknow as on 31.03.2025 contains several very old and huge entries pending for reconciliation pertaining to many previous financial years. Figures reported in financial statements may differ if these entries reconciled. We are of the opinion that necessary steps to streamline the process and for proper reconciliation of these entries need to be taken by BSIP forthwith.

4. As per Schedule 11 - 'Loans, Advances and Other Assets' given to the below mentioned parties since many years are pending for recovery / adjustment as on 31.03.2025.

Particulars	Amount (in Rs.)	Remarks
Advance for Expenses		
Dr. Trina Bose	28,620.00	The amount is pending since many years and needs to be adjusted appropriately.
Mr. Shailesh Kumar	761.00	
Dr. Shilpa Pandey	5,16,444.00	
Mrs. Kirti Singh	3,450.00	
Aremco Products	55,309.56	
Mr. P K Mishra	15,000.00	
Dr. Syed Rashid Ali	2,570.00	
Swami Publishers Pvt. Ltd.	7,040.00	
Advance to Supplier		
AIC Specialties	360.00	The amount is pending since many years and needs to be adjusted appropriately.
Elemtex Limited	1,61,954.26	
Labindia Analytical Instruments Pvt. Ltd.	22,47,650.55	
Agico SRG	2,08,698.00	
Labco Limited UK	1,44,495.00	
UPS Express Pvt. Ltd.	14,007.00	
Advances for Fixed Assets		
Alliance Book Suppliers, Delhi	2,00,883.89	The amount is pending since many years and needs to be adjusted appropriately.
International Subscription Agency A/c	45,51,199.00	
M/s Spem A/c	55,324.00	
LC Charges	93,996.13	
Malvern Panalytical	3,23,139.00	
All-ways Logistics (CHA) Pvt. Ltd.	33,07,524.00	
DHL Express India Pvt. Ltd.	2,84,560.77	
Eleminatar India Pvt. Ltd.	1,17,31,775.00	
Kush Scientific	6,03,924.00	
Advance for Research Apparatus & Equipments		
Ge Oil & Gas India Pvt. Ltd.	4,27,30,151.00	The amount is pending since many years and needs to be adjusted appropriately.
Analytical Technologies	6,40,000.00	
Maksur Analytical System	60,66,700.00	
Thermo Fisher Scientific, Austria	24,28,717.92	
Thermo Fisher Scientific India Pvt. Ltd.	94,21,000.00	

We are of the opinion that necessary steps to streamline the process and for proper reconciliation of these entries need to be taken by BSIP forthwith.

5. On scrutiny of the Fixed Assets registers we observed that maintenance & updation of Fixed Assets register & Stores register needs to be strengthened. The value of fixed assets as per fixed assets register and stores register must match with the value in the fixed assets schedule. Proper reconciliation needs to be done and registers to be updated on regular basis. Also, RFID tagging is recommended in such situation to proper internal control. Yearly physical verification of Fixed Asset by third party valuer need to be done for strengthened the fixed asset register with the reported value in financial statements.

6. The internal control over loans and advances is not adequate. There should be a process of periodic reconciliation / settlement of the advances. During our verification, it was noticed that properly settlement of pending advances needs to be done periodically.

7. The internal control over issuance of consultancy invoices is not adequate. There should be a mechanism to issue the consultancy invoices centrally and proper reporting of the same should be made with GST/ GST-TDS/Income Tax TDS. Proper records should also be maintained and reconciled periodically. The lab wise consultancy invoices process of procurement and maintenance of lab records regarding consumption of chemicals and other consumables needs strengthening.

8. On scrutiny of the Projects Accounts ledgers we observed that various ledger account opened in tally data base, due to this there is difficulty in making accounting entries and there is no internal control over it. We are of the opinion that an unique code for each project should be assigned and accounting ledger according to such unique code should be created in tally data base. Further, closing balances in projects ledger should also be reconcile.

9. Interest of Rs.2,27,49,809/- earned on unutilized grant lying in Institute Account No.187301000001666 maintained with Indian Overseas Bank, University Road Branch, Lucknow for the period from FY 2017-18 to FY 2020-21 as per audit observation of FY 2020-21 has been refunded to Department of Science and Technology, Government of India. Therefore, expenses reported in Income & Expenditure Account is subject to the above prior period interest expenses.

For Madhur Jain & Co.
Chartered Accountants
Firm Reg. No.: 004865C

Sd/-
Madhur Jain, FCA (Partner)
M. No.: 073699
Date: 29/08/2025
Place: Lucknow
UDIN: 25073699BMJGYJ9966

Action Taken Report for the F.Y. 2024-25

<table>
<tr><th>Audit Observation</th><th>Action taken</th></tr>
<tr><td>1. As per para 8 of the Schedule 24 - 'Significant Accounting Policies' annexed to the financial statements it is stated that retirement benefits and leave encashment have been accounted for on cash basis. However, we have noticed that provision for pension payable to the tune of Rs. 98.90 lacs (as reported in Schedule – 7) has been created on 31.03.2025. Thus, the accounting treatment is contrary to the accounting policy mentioned above.</td><td>The amount of Rs. 98.90 lacs is advanced drawn for payment of Pension for the month of March 2025 and it is not a provision in true sense. This has been done as per the SOP of PFMS TSA for charging of Pension & retirement benefits up to March 2025 and to be paid in the next month.</td></tr>
<tr><td>2. BSIP receives grants for various projects for research work undertaken by the scholars and scientists. The grant is utilized for expenses related to that project. However, as on 31.03.2025 we noticed debit balances in the following project grants i.e., excess expenditure over the quantum of grant pertaining to the following grants: -
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<tr><td colspan="2">Total</td><td>99,038/-</td></tr>
</table>
The excess expenditure over quantum of grant is lying in ledger since many years. We are of the opinion that proper control deserves to be exercised in charging expenses to any grant account.</td><td>The excess amount shown have been correctly reflected in the UC's of the funding agency has been requested for recoupment of the same. All expenses are incurred in the interest of projects. However, the remedial actions will be taken in current financial year 2025-26.</td></tr>
<tr><td>3. The Bank Reconciliation Statement pertaining to Account No. 187301000001666 & Account No. 187301000005118 maintained with Indian Overseas Bank, University Road Branch, Lucknow as on 31.03.2025 contains several very old and huge entries pending for reconciliation pertaining to many previous financial years. Figures reported in financial statements may differ if these entries reconciled. We are of the opinion that necessary steps to streamline the process and for proper reconciliation of these entries need to be taken by BSIP forthwith.</td><td>Noted for compliance.</td></tr>
</table>

4. As per Schedule 11 - 'Loans, Advances and Other Assets' given to the below mentioned parties since many years are pending for recovery / adjustment as on 31.03.2025.

Particulars	Amount (in Rs.)
Advance for Expenses	
Dr. Trina Bose	28,620.00
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Thermo Fisher Scientific India Pvt. Ltd.	94,21,000.00

We are of the opinion that necessary steps to streamline the process and for proper reconciliation of these entries need to be taken by BSIP forthwith.

Noted for compliance.

5.	On scrutiny of the Fixed Assets registers we observed that maintenance & updation of Fixed Assets register & Stores register needs to be strengthened. The value of fixed assets as per fixed assets register and stores register must match with the value in the fixed assets schedule. Proper reconciliation needs to be done and registers to be updated on regular basis. Also, RFID tagging is recommended in such situation to proper internal control. Yearly physical verification of Fixed Asset by third party valuer need to be done for strengthened the fixed asset register with the reported value in financial statements.	Noted for compliance.
6.	The internal control over loans and advances is not adequate. There should be a process of periodic reconciliation / settlement of the advances. During our verification, it was noticed that properly settlement of pending advances needs to be done periodically.	Noted for compliance.
7.	The internal control over issuance of consultancy invoices is not adequate. There should be a mechanism to issue the consultancy invoices centrally and proper reporting of the same should be made with GST/GST-TDS/Income Tax TDS. Proper records should also be maintained and reconciled periodically. The lab wise consultancy invoices process of procurement and maintenance of lab records regarding consumption of chemicals and other consumables needs strengthening.	Noted for compliance.
8.	On scrutiny of the Projects Accounts ledgers we observed that various ledger account opened in tally data base, due to this there is difficulty in making accounting entries and there is no internal control over it. We are of the opinion that an unique code for each project should be assigned and accounting ledger according to such unique code should be created in tally data base. Further, closing balances in projects ledger should also be reconcile.	The unique numbering of projects has been allotted to all projects in CFY 2025-26 and tally entries are being done accordingly.
9.	Interest of Rs.2,27,49,809/- earned on unutilized grant lying in Institute Account No.187301000001666 maintained with Indian Overseas Bank, University Road Branch, Lucknow for the period from FY 2017-18 to FY 2020-21 as per audit observation of FY 2020-21 has been refunded to Department of Science and Technology, Government of India. Therefore, expenses reported in Income & Expenditure Account is subject to the above prior period interest expenses.	As per the audit observation, Interest earned has been refunded to consolidated fund of India in the FY 2024-25.

Sd/-	Sd/-	Sd/-
(Ashutosh Shukla)	(Sandeep Kumar Shivhare)	(Prof. Mahesh G. Thakkar)
Accounts Officer	Registrar	Director

Balance Sheet as on 31.03.2025

(Amount in Rs.)

Particulars	Schedule No.	Current Year	Previous Year
		31.03.2025	31.03.2024
CORPUS/CAPITAL FUND AND LIABILITIES			
Corpus / Capital Fund	1	1,38,57,33,353.43	1,44,08,28,972.07
Reserves and Surplus	2	8,23,95,146.00	7,85,93,927.00
Earmarked / Endowment Funds	3	1,15,55,81,475.25	1,02,78,71,251.51
Secured Loans and Borrowings	4	-	-
Unsecured Loans and Borrowings	5	-	-
Deferred Credit Liabilities	6	-	-
Current Liabilities and Provisions	7	4,98,99,600.59	8,07,22,072.38
Total		**2,67,36,09,575.27**	**2,62,80,16,222.96**
ASSETS			
Fixed Assets	8	28,26,73,148.88	30,01,07,728.46
Investments from Earmarked / Endowment Funds	9	1,15,55,81,475.25	1,02,78,71,251.51
Investments - Others	10	13,31,02,952.00	12,93,01,733.00
Current Assets, Loans & Advances	11	1,10,22,51,999.14	1,17,07,35,509.99
Miscellaneous Expenditure (to the extent not written off or adjusted)		-	-
Total		**2,67,36,09,575.27**	**2,62,80,16,222.96**
Significant Accounting Policies	24		
Contingent Liabilities And Notes On Accounts	25		

For Madhur Jain & Company
Chartered Accountants

Sd/-
Madhur Jain, FCA
(Partner)

Sd/-
(Ashutosh Shukla)
Accounts Officer

Sd/-
(Sandeep Kumar Shivhare)
Registrar

Sd/-
(Prof. Mahesh G. Thakkar)
Director

Income And Expenditure Account for the period/ year ended 31.03.2025

(Amount in Rs.)

Particulars	Schedule No.	Current Year	Previous Year
		2024-25	2023-24
INCOME			
Income from Sales / Services	12	30,38,850.00	22,17,971.00
Grants/subsidies (OB, Deposit A/C and Transfer from Cap. Fund)	13	55,76,90,785.00	1,03,00,61,005.77
Fees/Subscriptions	14	-	-
Income from Investments (Income on Invest. From Earmarked/Endow.Funds transferred to Funds)	15	6,65,34,448.00	5,72,43,137.00
Income from Royalty,Publication etc.	16	-	-
Interest Earned	17	2,19,378.00	2,81,430.00
Other Income/Adjustments	18	41,49,929.59	34,15,515.34
Increase/(decrease)in stock of Finished goods and works-in-progress	19	-	-
Total (A)		**63,16,33,390.59**	**1,09,32,19,059.11**
EXPENDITURE			
Establishment Expenses	20	39,42,07,472.00	36,44,83,001.00
Other Administrative Expenses etc.	21	12,90,47,797.00	10,15,07,567.62
Expenditure on Grants, Subsidies etc.	22	-	-
Interest	23	-	-
Depreciation (Net Total at the year-end-corresponding to Schedule 8)		4,86,49,323.23	5,21,39,238.58
Total (B)		**57,19,04,592.23**	**51,81,29,807.20**
Balance being excess of Income over Expenditure (A-B)		5,97,28,798.36	57,50,89,251.91
Interest Earned on Reserve Fund		38,01,219.00	33,15,947.00
Interest on GPF Fund transferred to GPF Fund		42,28,236.00	77,96,602.00
Interest on Institute Account refundable to DST		-	-
Interest on Pension Fund Transferred to Pension Fund		5,72,19,767.00	4,46,60,951.00
Interest on Building Fund FD transferred to Building Fund		-	-
Interest on Donated Fund FD transferred to Donated Fund		75,195.00	71,410.00
Transfer to Pension Fund		4,95,00,000.00	7,94,70,000.00
Balance being Surplus / Deficit carried to Corpus / Capital Fund		**(5,50,95,618.64)**	**43,97,74,341.91**
Significant Accounting Policies	24		
Contingent Liabilities and Notes on Accounts	25		

Receipt & Payment Account for the year ended 31.03.2025

(Amount in Rs.)

Receipts	Current Year 2024-25	Previous Year 2023-24	Payments	Current Year 2024-25	Previous Year 2023-24
I. Opening Balances			**I. Establishment Expenses**		
a) Cash in hand	-	-	a) Salaries and Wages	12,45,31,992.00	11,70,30,732.00
b) Bank Balances:-			b) Allowances and Bonus	10,37,07,518.00	9,08,79,720.00
- In Saving Accounts	8,66,36,091.49	10,39,03,414.79	c) Contribution to CPF (Employer's Contribution)	1,73,96,124.00	1,65,68,231.00
			d) Contribution to Other Funds	-	-
II. Income from Sale & Services			e) Staff Welfare Expenses	-	-
a) Income from Sales	-	-	f) Expenses on Employee's Retirement and Terminal Benefits	14,85,71,838.00	14,00,04,318.00
b) Income from Services	30,38,850.00	22,17,971.00	g) Others (specify)	-	-
III. Grant & Subsidy			**II. Other Administrative Expenses etc.**	12,90,47,797.00	10,15,07,567.62
a) Central Government	55,76,90,785.00	68,46,61,005.77			
b) State Government	-	-	**III. Addition in Fixed Assets**		
c) New Building Grant	-	34,54,00,000.00	(As per Schedule - 8)	3,12,14,743.65	9,24,79,601.04
IV. Fee & Subscriptions	-	-	**IV. Increase in Investments from Earmarked / Endowment Funds**	12,77,10,223.74	15,74,25,674.88
V. Income from Investment			**V. Increase in Investments Others**	38,01,219.00	-
a) Interest	6,65,34,448.00	5,72,43,137.00			
b) Dividends / Rent / Others	-	-	**VI. Increase in Current Assets**	-	41,26,45,925.75
			(As per Schedule - 11)		
VI. Income from Royalty, Publication etc.	-	-			
			VII. Decrease in Current Liabilities	3,08,22,471.79	1,77,43,874.00
VII. Interest Earned					
a) On Term Deposit	-	-	**VIII. Transfer to Designated Funds**		
b) On Saving Deposit	-	-	a) Interest on GPF Fund transferred to GPF Fund	42,28,236.00	77,96,602.00
c) On Loan	2,19,378.00	2,81,430.00	b) Interest on Institute Account refundable to DST	-	-
d) Interest on Debtors & Other Receivable	-	-	c) Interest on Pension Fund Transferred to Pension Fund	5,72,19,767.00	4,46,60,951.00
			d) Interest on Buding Fund FD transferred to Building Fund	-	-
VII. Other Income & Adjustments	41,49,929.59	34,15,515.34	e) Interest on Donated Fund FD transferred to Donated Fund	75,195.00	71,410.00
			f) Transfer to Pension Fund	4,95,00,000.00	7,94,70,000.00
IX. Increase in Funds	12,77,10,223.74	15,74,25,674.88			
(As per Schedule - 3)			**IX. Closing Balances**		
			a) Cash in hand	-	-
X. Decrease in Current Assets	3,61,49,494.80		b) Bank Balances:-	-	-
(As per Schedule - 11)			- In Saving Accounts	5,43,02,075.44	8,66,36,091.49
XI. Increase in Current Liabilities					
(As per Schedule - 7)	-	1,03,72,550.00			
XII. Decrease in Investments Others	-	-			
Total	**88,21,29,200.62**	**1,36,49,20,698.78**	**Total**	**88,21,29,200.62**	**1,36,49,20,698.78**

Description of the Back cover photo: Millennium-long Himalayan pencil cedar (*Juniperus polycarpos*) tree collected from highest treeline site (~4000 masl) of cold-arid Lahaul-Spiti, Himachal Pradesh, western Himalaya. Photo Courtesy: Dr. K.G. Misra, BSIP

ISBN 0972-2726

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