ASSOCIATION OF QUATERNARY RESEARCHERS

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Annual Report

Association of Quaternary Researchers (AOQR)

Birbal Sahni Institute of Palaeosciences,
53 University Road, Lucknow – 226 007,
Uttar Pradesh, India.

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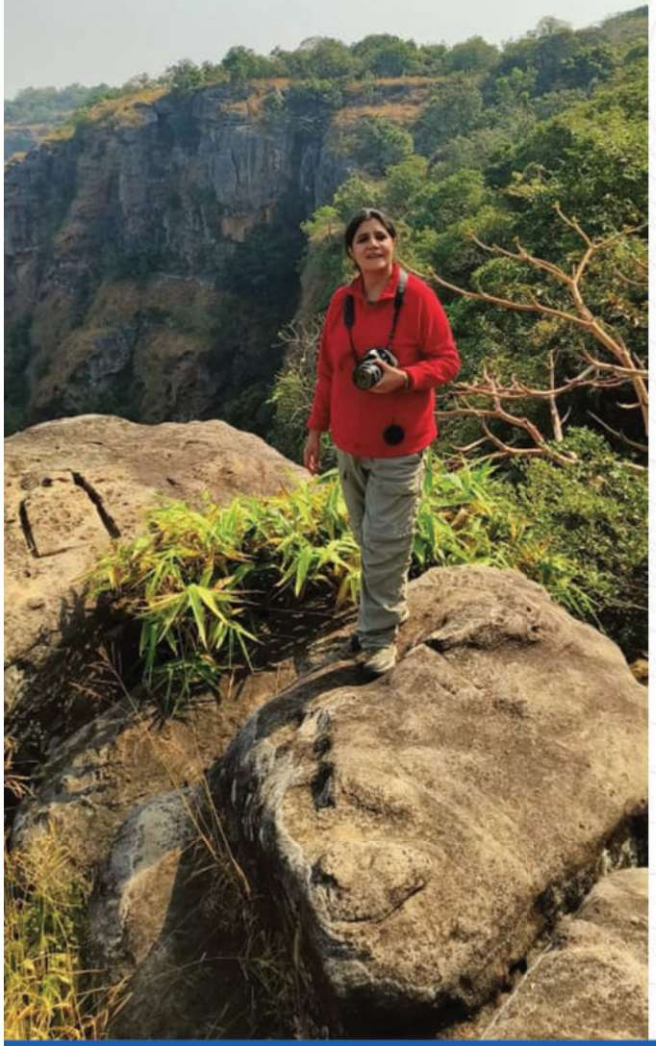
Vol.6 No.1 April 2024

FROM THE AOQR DESK



Dear Quaternary Family,

I am happy to present the Quaternary Chronicles newsletter volume 6(1) with new thoughts, ideas, publications, announcements, etc. Thank you to all who have contributed to this volume and the ECR team who have put it together. Apologies if something is missed. I thank all the contributors for this issue; it is your love and support that gives us the reason to bring out this newsletter.

Coming up is the 2nd Indian Quaternary Congress (IQC) in IISER Mohali from 3-5 June 2024. We have received 130 abstracts, and we look forward to an interesting scientific discussion on various themes of IQC. We are all geared to come to Mohali, and I assure you that you will have a fabulous time savouring the taste of all the various aspects of Quaternary Science.

We recently celebrated International Women's Day on March 08, 2024, and it is a moment to acknowledge the remarkable contribution of Indian women researchers in the field of Quaternary Science. Breaking the glass ceiling and overcoming the sticky floors of their bondages and the numerous chores that they are into at home, workplace, and fieldwork, as well as excelling and being a part of the journey of science, is indeed bravo. I am happy to announce that ~40% of the IQC abstracts are from our women researchers. AOQR is proud of its women researchers.

This quarter, we also witnessed the sad demise of our dear Professor B. S. Kotlia on 13th February 2024. Being trained with him in Quaternary geology, I owe him many things. Being a very hard taskmaster, he was very passionate about his research. He worked and trained students in a variety of archives as well as proxies and was well-versed in all of them. The notion remains that one can be an expert in only one proxy/discipline in one's lifetime, but Dr. Kotlia broke this notion back and forth by publishing in lacustrine sediments, speleothems, with multi-proxies. Starting from training in micropaleontology with Prof. Ashok Sahni, Prof. Kotlia guided me in my thesis on magnetostratigraphy and clay mineralogy. Similarly, his other students were trained in palaeontology, geochemistry, palynology, isotopes, etc. Name it, and Dr. Kotlia had ventured into that discipline. He was a man of a different energy level. Whosoever met him once remembered him for a lifetime. India lost a great Quaternary scientist. Our condolences to his entire family. He will be missed always.

At the request of many members, we have a life member option open now; please check our website, www.aoqr.org.

The next issue of the Quaternary Chronicles newsletter will come out in August 2024. Do share the happenings in the field of Quaternary sciences with us so they can be incorporated into the next issue. We circulate the request contributions occasionally on our website and WhatsApp page. Please contribute to the different sections of the newsletter.

Looking forward to seeing you in Mohali.

- Dr. Binita Phartiyal, Secretary- AOQR

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AOQR - Governing Body

Editorial ECR Team

The ECR team is thankful to all volunteers and members of AOQR to take this newsletter to a wider audience.

AOQR MEMBERSHIP CALL

Researchers of Quaternary Science of Indian sub-continent are welcome to submit your application. Be a part of a multidisciplinary team of researchers, and practitioners of Quaternary Science and represent Indian Quaternary Science at an international level. Members can get priorities at our annual e-conferences, publish in the edited books/ journal volumes by the members of the AOQR, access to webinars, e-conferences and specialized thematic workshops etc.

Write to us at **aoqr2019@gmail.com** *for membership application form.*

The membership of the AOQR is open to all individual of academia and industry subject to verification.

Welcome!

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Women in STEM:

Wellness begins with you!

Devesh Srivastava, **Founder 'Livstylrs', Health and Nutrition Coach**

LIVSTYLRS
BUILDING A BETTER TOMORROW

Diversity in the fields of science, technology, engineering, and mathematics (STEM) is critical for innovation and problem-solving. Women's value in STEM is immeasurable and essential. Women bring unique perspectives, creative thinking, and valuable skills to the table, leading to more comprehensive and inclusive solutions. By increasing the representation of women in STEM fields, we can tap into a larger talent pool, reduce gender bias, and inspire future generations of female scientists and engineers. Embracing and celebrating the contributions of women in STEM is not only the right thing to do but also the key to advancing society and driving progress in the 21st century.

Historically, women have been underrepresented in STEM fields, but they have demonstrated exceptional skills and talents that have enriched these disciplines. Women in STEM have made valuable advancements in diverse areas such as earth and atmospheric sciences, biomedical research, computer science, environmental engineering, and more. Their unique perspectives, diverse backgrounds, and dedication to their work have led to groundbreaking discoveries and advancements in technology, as well as other STEM-related fields. Despite facing challenges and barriers, women continue to excel in STEM and inspire future generations to pursue careers in these fields. Even after outstanding progress in recent years, women are still underrepresented in many STEM disciplines. This lack of representation can be attributed to various factors, including gender stereotypes, implicit bias, lack of female role models, and unequal opportunities for women in STEM education and careers. Efforts are constantly being made to increase gender diversity in STEM fields through initiatives that support and empower women in pursuing and advancing their careers in these areas.

Women in science and technology face specific health challenges due to various factors such as workplace stress, long working hours, discrimination, and lack of support. Research has shown that women in these fields are more likely to experience mental health issues like anxiety and depression, as well as physical health problems like musculoskeletal disorders from prolonged sitting or repetitive motions. Long hours of computer use, observing specimens under the microscope, and potential exposure to hazardous materials lead to physical and mental health issues such as eye strain, weakening of the lower body, bad posture and increased levels of stress and anxiety. Furthermore, research has shown that women in STEM fields may also experience gender-specific health concerns, such as higher rates of imposter syndrome, isolation, and discrimination, which can impact their overall well-being. In addition, women in male-dominated industries like science and technology may face barriers to advancement and opportunities for professional development, leading to feelings of frustration and burnout.

To address these challenges, organisations and policymakers need to prioritise the health and well-being of women in science and technology. Possible solutions include implementing programs and policies that promote work-life balance, provide access to mental health resources, and create supportive and inclusive work environments. By supporting the health and wellness of women in STEM, we can help ensure that they can thrive and make valuable contributions to their fields. In order to promote a healthy and successful career in STEM, women need to adopt habits such as a) Self-care: Prioritize self-care by managing stress, getting enough sleep, eating a balanced diet, and staying physically active; b) Networking: Building a solid support system by networking with other women in STEM, mentors, and colleagues to share experiences and advice; c) Continuous Learning: Stay updated with the latest advancements in your field through continuous learning and professional development; d) Work-life balance: Maintain a healthy work-life balance by setting boundaries, delegating tasks, and practising time management; e) Confidence: Build confidence by showcasing your expertise, seeking feedback, and celebrating your achievements. By adopting these healthy habits, women in STEM would thrive in their careers, overcome obstacles, and contribute to the success of the industry.

Fitness requirements for women in STEM can vary depending on the specific job role within the field. In general, physical fitness is not a formal requirement for most STEM positions, but maintaining a healthy lifestyle can be beneficial for overall well-being and performance in the workplace. Women in STEM who engage in regular physical activity may experience improved focus, energy levels, and stress management, which can contribute to their success in their careers. It is essential for women in STEM to find a balance that works for their individual needs and to prioritise their health and well-being alongside their professional goals. Physical fitness for women in forest ecology and geology field jobs is essential, especially in a demanding work environment that can involve fieldwork in remote locations, long hours, and heavy physical labour. Staying fit can help women in disciplines of fieldwork improve their endurance, strength, and overall health, enabling them to perform their job responsibilities more effectively and with reduced risk of injury.

Additionally, physical fitness also helps to alleviate stress and improve mental focus, which are crucial for success in challenging scientific work. Regular exercise and healthy lifestyle choices can also contribute to increased confidence, resilience, and overall job satisfaction for women working in wildlife, ecological and geological field areas. Moreover, fostering a supportive and inclusive work environment where women feel empowered to advocate for their own health needs is a crucial aspect of promoting overall well-being in STEM careers.

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Celebrating & Honouring Indian Women's Contribution to Limnology:

A tribute on International Women's Day

Yet again this year, as we commemorate International Women's Day on 8th March 2024, it is an opportune moment to acknowledge the remarkable contribution of Indian women researchers in the STEM (Science, Technology, Engineering, and Mathematics) fields. As a researcher, I thought extending a heartfelt acknowledgement to the remarkable women researchers from India was not only warranted but also imperative.

India, with its unique geological history, culture, biodiversity, landscapes and monsoonal climates, is endowed with equally diverse aquatic habitats. Over the years, women in India have achieved significant strides that have given them new social, political, and economic rights, including access to male-dominated research institutes. In particular, women researchers have made pioneering contributions and advanced their role in the STEM fields. They now play a crucial role in promoting research fields of freshwater biodiversity, ecosystem dynamics, and other environmental issues. In India, where limnological resources are indispensable for sustenance, encompassing drinking, agriculture, and livelihoods, female researchers have emerged as pivotal champions, spearheading vital conservation endeavours to safeguard these invaluable resources for present and future generations.

Limnology is the study of inland waters - lakes (both freshwater and saline), reservoirs, and wetlands ecological systems interacting with their drainage basins and the atmosphere. Female researchers from India working in limnological fields are all outstanding researchers who have contributed to advancing our knowledge of the structure and functioning of limnological systems. While I deeply admire the contribution of each female researcher in the field of limnology, I feel a sense of hesitation in naming specific individuals for fear of inadvertently overlooking any deserving names. The wealth of talent and dedication among these researchers is vast, and I wish to honour all their contributions equally.

In honouring the accomplishments of these remarkable female researchers, we must also acknowledge the obstacles they have surmounted in their quest for knowledge and greatness in STEM scientific research. Future generations of both men and women scientists can draw inspiration from their perseverance and enthusiasm in the STEM fields.

I believe the research stories of Indian women scientists will continue to inspire us all to strive for excellence in research endeavours. As we celebrate International Women's Day, I stand alongside the multitude of voices this year, united in celebration and profound reverence for the unparalleled contributions of women in the fields of science, technology, engineering, and mathematics.

Happy International Women's Day!

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BSIP-QLDP

Birbal Sahni Institute of Palaeosciences: Quaternary Lake Drilling Programme/ Project

Mahesh G Thakkar
Director
BSIP, Lucknow

The Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, Quaternary Lake Drilling Programme (BSIP-QLDP) started in 2021, aims to reconstruct the monsoon-driven climatic history of the terrestrial environment in the distinct topographical and geographical regions of the Indian subcontinent. It is the Institute's mega project and requires lake sediment cores from the middle of the lake from different sites in different states of the country for the study. For any mega-scale project, a strong partnership and support are needed, and the Indian Institute of Geomagnetism (IIG), Mumbai and the Geophysical group, National Geophysical Research Institute (NGRI), Hyderabad, teams are helping with drilling and core retrievals and geophysical survey for site selection for coring on each lake site respectively. Technical help related to the corer was received from the Imagineering Laboratory, Indian Institute of Technology Kanpur, and Central Institute of Petrochemicals Engineering and Technology, Lucknow.

Lakes are considerably the best recorders of climate variability on terrestrial ecosystems as sediments accumulated from the surrounding environment and microorganisms produced within provide high-resolution histories of local environmental conditions, lake water chemistry, temperature and lake productivity in the past. The BSIP-QLDP team of 23 scientists at BSIP, coordinated by Dr. Anupam Sharma and Dr Binita Phartiyal, study the sediment cores for various physical, chemical and biotic proxies, following the same protocol and procedures for high-resolution climate data. They are also producing integrated data analytics and modern analogues to improve the quantifications of the data.

The team is currently working on the manually collected cores from Kanwar Lake, Begusarai District of Bihar, and cores are being raised from Surha tal in Balia district of Uttar Pradesh presently. In the first phase of the BSIP-QLDP project, the Ganga Plains and Core Monsoon Zone, mainly comprising Uttar Pradesh, Bihar, Madhya Pradesh, Maharashtra, and Chhattisgarh states, will be studied. In the second phase, the BSIP QLDP will extend the operation and study to the Himalayas (NE and NW), Rajasthan, Gujarat, and the coastal part of the Indian subcontinent. This project is unique as it partners with leading organisations of the country with full support from Prof. A P Dimiri, Director, IIG, Mumbai, and Dr. Anand Pandey, Head, Geophysical group, NGRI, Hyderabad, and their respective teams.

India is a big country with different geographical regions that provide varying climatic zones together with diverse vegetation types governed by the southwest and the northeast monsoon, depending upon the season. These monsoonal winds exhibit a rich variety of natural variations on different timescales ranging across sub-seasonal/ intra-seasonal, interannual (year-to-year), multi-decadal and centennial timescales, which are evident from instrumental records and paleoclimate reconstructions, commonly known as monsoon variability. The frequency of extreme Indian summer monsoon (ISM) events has increased in recent decades, and there is significant spatial heterogeneity in the occurrence of extreme events. Moreover, the duration and intensity of ISM have altered during the past few years and are unpredictable, causing tremendous agricultural and economic loss. Climate modelling requires rigorous and accurate palaeoclimatic data for forecasting change in the future, which will be generated in this mega-project in the coming years. BSIP-QLDP samples need significant time to analyse these samples for various proxies. Still, this exercise will lead to filling gaps in information regarding the Indian Summer Monsoon; reconstructing the palaeo-climate and -hydroclimate variability during the late Quaternary using multi-proxy records; spatiotemporal mapping of abrupt and extreme climate events; accessing the

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chronological lag and disparity in long-term records; and ascertain the causal mechanisms of climate vs. vegetation. The data will be tagged with annual tree ring data, and the trend will be extended in the future. The scientific team will also be able to study climate-culture interaction to look at the social response variables and produce enormous data for palaeoclimate modelling of the Indian subcontinent, which will be of global importance. Finally, this multi-proxy paleoclimate data would be utilised for validation and hindcasting/forecasting of climate change scenarios using Species distribution modelling, Palaeoclimate modelling and social-ecological modelling. Combining the paleoclimate data with climate modelling experiments would provide a powerful tool for determining the processes and feedback that trigger gradual and abrupt climate change and is an essential component of testing and improving the climate models that are used to project possible future climate.

BSIP-QLDP is a long-term flagship program of BSIP with IIG and NGRI as collaborators and will go on for several years; however, it will establish a clear and robust picture and record of monsoon behaviour of past tens of thousands of years of history and credible data on palaeoclimate. Several PhD and research associates will be trained who will be good climate scientists/researchers in India in the future. The information generated will also help develop and strengthen the climate models. All work in BSIP-QLDP is for local to global audiences.

Anthropogenic Revulsion of Human Diet Throughout Quaternary Period:

Akash Kumar Srivastava
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IIT BHU, Varanasi

The Quaternary period is considered the age of humans and witnessed a multitude of developments in human life in terms of physiology, psychology, and technology. Humans evolved in this period from their archaic form to the modern one and reached the species threshold by enhancing their calibre to interact with their surroundings and mould it according to their needs. Food is a fundamental thing acquired from the environment and is an entity reflecting anthropogenic effects, as a diverse human strategy emerges alongside their dietary need. Most of the archaeological remains (stone tools, bone artefacts, pottery, etc.) that are available from the prehistoric period mainly belong

to the human effort to get their food in a more sophisticated manner. From the Early Pleistocene to the Late Pleistocene, the start of the Holocene, this long timeline marks the continuous journey of food metamorphosis. In the early phase, humans consumed their food without any modification and thus did not gain complete nutrition from their diet; the evidence suggests that they continuously worked toward this direction, which resulted in the development of many culinary activities. The transformation of the human diet from raw to cooked reflects not only their cognitive development but also informs the new dietary demand and their adaptation to the changing environmental situation. The cooking hypothesis developed by Richard Wrangham suggests that the advent of fire gave rise to the genus Homo and that Homo sapiens evolved with an obligation to consume cooked food. Indeed, fire became a game-changing invention and paved the way towards breaking human ties with other living beings. When they learn how to get their diet cooked, some activities and appliances also emerge to do the process more sophistically. Several culinary crafts and processes were developed in this direction, and anthropogenic affairs created a massive impact on human meals throughout the Quaternary period, showing the long journey of past human societies to humanise the naturally available foodstuffs.

As fire became easy to produce, multiple cooking methods like roasting, boiling, cooking with hot stone, and earth ovens were invented to make certain foods digestible and create new dishes. The invention of grinding tools marked a turning point in the history of societies that used stone tools. Their role in plant food exploitation and processing was crucial, making mixing many ingredients and producing a more comprehensive range of recipes possible.

Further, with a close connection to the fire, humans studied the burning process, the suitability of fuels and their appropriateness in different geographical locations. The hearth was a novel addition to the culinary behaviour of early humans, and subsequently, it started playing a prominent role in household activities. Thus, a completely new ecosystem developed alongside the human-food entanglement in prehistory, and all of its aspects were mainly human inventions. Further, with civilisational progress, a specific cooking place became an essential phenomenon, and all early civilisations of the world reflected the fact that cooking made us human. So, the Quaternary period witnessed not only the evolution of humans but also the transformation of their food entirely.

The Present is Key:

Unraveling the Anthropocene with the PALEOHER Foundation

- Prabhin Sukumaran
Dr. K.C. Patel Research and Development Centre
CHARUSAT, Gujarat

Geologists recently debated whether to recognise the Anthropocene as a new geological epoch formally. This epoch would mark the significant impact humans have had on Earth's landscape. After a fifteen-year-long discussion, geologists officially decided not to consider the Anthropocene as the latest epoch in the geological time scale. This decision has garnered both support and opposition from within the scientific community.

A critical question emerges: Do we have enough knowledge to understand how human activity shapes natural landscapes truly? This question forces us to reconsider a fundamental principle from our undergraduate education: the "Present is Key to the Past." This principle emphasises that understanding the present is essential for interpreting the past.

However, when considering human impact on landscapes, we must define what we mean by "present" in the geological context. Is it the vast Quaternary period, the Holocene epoch that began just 11,700 years ago, or should we focus on the much shorter timeframe of human history or even the rapid changes happening right now?

The present represents a snapshot of the current moment, a slice of time influenced by our past actions

and the catalyst for future reactions. However, when considering this in a geological context, the precision with which we can comprehend this slice of time becomes uncertain. Are we mature enough to depict our own "present accurately"? Doubtful as it may be, rejecting the idea of incorporating the Anthropocene into the geological time scale might be a cautious decision.

Nevertheless, the imperative is clear - we must expedite our understanding of the present.

Geologists should transcend traditional boundaries, engaging in inclusive efforts and collaborations across multiple disciplines. Venturing into society to spread awareness and impart the meaning of the "present" is essential. The PALEOHER Foundation emerges as a humble initiative in this endeavour, aiming to cultivate a profound understanding of paleoanthropology, unravel the complexities of human societies, and illuminate the intricate web of environmental interconnections. Through these pursuits, the foundation seeks to catalyse impactful global change, contributing to a world where the lessons of the past shape a sustainable and harmonious future.

Head over to our website, www.paleoher.org, to discover more about the Paleoher Foundation and how you can be a part of this exciting journey. We offer a variety of pro bono opportunities for passionate individuals who want to contribute to a noble cause:

Young Paleoscientists: Are you a curious school kid fascinated by the ancient world? Join us and be part of exciting paleoher activities designed just for you. Explore the wonders of paleoanthropology, participate in interactive sessions, and embark on adventures to uncover the mysteries of our past. Whether you dream of becoming a geologist, paleontologist, archaeologist, or biologist, we're here to nurture your curiosity and passion for science.

Paleoher Experts: Passionate about your research? Willing to guide the next generation? Possess skills or facilities helpful in understanding the "present"? Join as an Expert by filling out basic details, and we'll list you in the community.

Paleoher Research Associates: A PhD scholar or an early career researcher (PhD awarded within the last five years)? Passionate about understanding the natural world and human-animal interactions? Join as a research associate to attend certificate programs, training, expert involvement, and exploration of Paleoher funding opportunities. Visit the website for early registration benefits.

Paleoher Volunteers: Are you enthusiastic about our work and eager to immerse yourself in explorations, societal activities, and outreach initiatives? We welcome undergraduate and postgraduate students from any discipline, as well as enthusiastic individuals regardless of academic background, education, gender, or location to join the community. As a volunteer, you'll have the chance to actively participate in various activities, lead independent initiatives under the Paleoher banner, and explore potential funding opportunities. Joining as a volunteer only requires your commitment to the community. Join now and be a part of a dynamic initiative shaping the future of paleoanthropology!

Paleoher Donors: Are you passionate about supporting scientific research and outreach? Consider becoming a donor and contributing to the vital work of the Paleoher Foundation. Your generous donations will help fund research projects, educational programs, and outreach initiatives, ensuring that the efforts will be fruitful for a sustainable future. Additionally, donors may benefit from tax deductions under section 80G of the Income Tax Act 1961.

The South Asian Biodiversity Portal Initiative

Trina Bose, Birbal Sahani Institute of Palaeosciences, Lucknow

The United Nations Intergovernmental Panel on Climate Change (IPCC) notes that climate change is accelerating, with the average global temperature forecasted to rise by 0.35°C by the end of the 21st century relative to the climatic conditions of 1986-2005 and according to the data from last year this rise was already achieved in 2023. This drastic mismatch was probably due to the lack of integration of Biodiversity information from the Global South, especially in South Asia, with the critical climate phenomena of the Monsoons and the highest population density.

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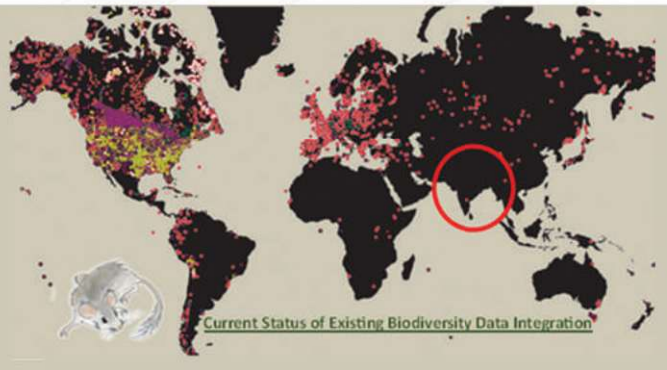

In today's world, data is everywhere. Examples of Earth System data include climate, precipitation, temperature, ecology, archaeology, chronology, pollen, fossil pollen, diatoms, ostracods, vertebrates, testate amoebae, stable isotopes, plant macrofossils, tree-rings, speleothems, etc. However, when starting research in a new region and collecting new data, it becomes challenging to collect all existing data from different sources. The South Asian Biodiversity Portal (SABDP) initiative was conceived to be the hub for information, conservation efforts, and education on our planet's incredible diversity of life. This initiative was conceived at Birbal Sahni Institute of Palaeosciences (BSIP), with its incubation partially funded by the International Union for Quaternary Research (INQUA) Humans & Biosphere Commission (HABCOM) via the LEM: 'Landuse-landcover mapping and modelling using pollen and isotopic data in different ecological regions of the monsoon' project granted to Trina Bose, Anjali Trivedi, BSIP, and Navya Reghu, French Institute of Pondicherry. The portal database is primarily based on the structure and platform of the Neotoma Paleoecology Database and will be part of their ecosystem. This is going to be a herculean task, for which the first step was taken on 2nd February 2024 when an environmentally conscious diverse group of researchers joined in the first meeting of the Council governing SABDP.

Hosting Institution: Birbal Sahni Institute of Palaeosciences (BSIP)

M.G. Thakkar, Director | Vandana Prasad, Ex-Director | Anupam Sharma | Binita Phartiyal | Anjali Trivedi | Trina Bose | Sandhya Mishra

Name	Affiliation	Name	Affiliation
Akash Srinivas	Ashoka University	Ningthoujam Premjit Singh	Wadia Institute of Himalayan Geology
Alok Kumar Kanungo	HSS, IIT Gandhinagar	Parth Chauhan	Humanities & Social Sciences, IISER Mohali
Anindya Sarkar	Geology and Geophysics, IIT Kharagpur	Prabhakar Bura	UP State Biodiversity Board
Anzar A Khuroo	Botany, University of Kashmir	Prabhin Sukumaran	CHARUSAT, Changa
Arnab Bhattacharya	CSE, IIT Kanpur	Pradeep Srivastava	Earth Sciences, IIT Roorkee
Arti Garg	Botanical Survey of India	Prashant A. Gawande	Sant Gadge Baba Amravati University
Bharat Pradhan	Sikkim Dept of Forest and Environment	Rajeev Patnaik	Geology, Panjab University
Bhavya PS	EESS, IISER Thiruvananthapuram	Ruman Banerjee	Pondicherry University
Biswajit Roy	National Centre for Polar and Ocean Research	Sanjeeva Nayaka	National Botanical Research Institute
D P Pathak	CDG, Tribhuvan University, Nepal	Shanti Pappu	Sharma Centre for Heritage Education
Debahuti Mukherjee	Geological Survey of India	Shyam S. Phartyal	EES, Nalanda University
Hitendra Padalia	Indian Institute of Remote Sensing	Soumya Dutta	CES, IIT Kanpur
K. Anupama	French Institute of Pondicherry	Srirang R. Yadav	Shivaji University, Kolhapur
K. Ilango	EFCC Department, Govt. of Uttar Pradesh	Subir Bera	Botany, University of Calcutta
Kalyan Sekhar Chakraborty	History, Ashoka University	T R Premathilake	Archaeology, University of Kelaniya, Sri Lanka
Naveen Gandhi	Indian Institute of Tropical Meteorology	V V Wagh	National Botanical Research Institute
Navya Reghu	French Institute of Pondicherry	Vasant I Kahalkar	Botany, MGAS & LNPC College, Armori, Gadchiroli
Nayanjot Lahiri	History, Ashoka University		

The work involved here is for our mother Earth and, hence, is open to people from all backgrounds and levels of education. All those interested are requested to contact southasianbiodiversityportal@gmail.com. The SABDP is open to volunteer participation of dedicated and environmentally conscious people, whether students or professionals keen for change. We need web developers, data engineers, scientists, machine learning/artificial intelligence experts, and student volunteers, in addition to all academic specialities.

Stoning the Past - Framing and Dealing with a New Brain

Manish Kumar Rai
Department of Neurology
Institute of Medical Science
Banaras Hindu University

The evolution of the brain has undergone significant structural changes since the emergence of life. This transformative process has been evident since the era of mammals, signifying a major shift leading to the evolution of hominins. Notably, the evolution of hominins since the Proconsuls has created a distinct division between Great apes and Hominins. Moreover, the evolution from Australopithecus onwards has directed hominins towards more extensive brain growth, and ultimately this progression has led to the emergence of modern Homo sapiens.

Over the past 300,000 years, the size of the human brain has remained relatively stable, while cognitive abilities have experienced a remarkable leap, exhibiting a spectrum of technological innovations ranging from stone tools to the launch of satellites. This progression accentuates the vast potential of the human brain, resonating through diverse cultural expressions.

The cognitive skills evident in stone tool making are a significant focus of study, offering insights into the volatile nature of the evidence of human decision-making. These decision-making skills, which have been utilised in stone tool making, are imprinted on the stone tools as part of their fabrication, broadly called the technology. These skills converge into the

dynamics of stone tools across different times and locations. The study for understanding this technology remains fragmentary, even with the latest cutting-edge technology employed. On top of that, keeping in line with understanding the history of humanly developed technology and its cognitive abilities leading to different cultural, social, and economic dynamics is another task. The use of extra somatic devices has evolved to an extent where the human brain can also have an extension.

The complexity of the human brain is reflected in activities that require hand-eye coordination and thoughtful planning, ultimately resulting in the creation of cultural artefacts. This transition from human "being" to human "having" with eloquent capabilities may signify a new evolutionary stage, particularly with the development of technologies like Neurolinking chips. Here, a chip would register the activities of the human brain, which may be convertible and directed to devices such as smartphones or a computer through mediums such as Bluetooth. The aspect of the brain may be enhanced and create a system like telepathy, which is a reality with predictable models. This aspect of the human brain, where thoughts are converted to impact devices and make an impact on cultural, economic, and social backgrounds, maybe the new evolutionary dialect in the study of human evolution. In this, the emerging human in the evolutionary line may be named Homo AI-Pithecus!!! This emerging human can mark a milestone comparable to earlier technological breakthroughs, such as the mastery of fire or the discovery of atomic energy. These milestones in human history equipped humans with energy sources manageable for both productive and destructive purposes. This also paved the way for the diverging and converging sectors of scientific thought, which eventually developed its ethics and morality. A similar grade of thought process may justify whatever impact this nexus of human and machine may create.

As human-machine interfaces continue to evolve, questions arise about the determination of superiority between humans and machines. Such developments may result in anticipated disputes, reminiscent of a time when Homo sapiens stood as the sole surviving species on the planet. This lonely fight between humans and their creations may lead to a situation where they unleash a real Frankenstein brought right out of science fiction into the world where humans continuously search for their purpose. The morality, ethics, and rightful deeds in which humanity thrives may stand in conjunction where the machines-induced creative sphere makes a twist in the cultural evolution.

Yet, the future of this race remains uncertain. While humans have long been considered the dominant species, the prospect of being supplanted by their creations is no longer confined to the realm of science fiction. Future archaeologists may witness a species that pushed its boundaries endlessly, possibly forcing an evolutionary rupture that challenges natural constraints.

Perhaps it is in embracing imperfection that humans find their essence, allowing them to not only name their species but also to explore the evolution of others as machines carve their place on the evolutionary timeline; the narrative of the suggested Homo AI-Pithecus emerges, raising profound questions about the nature of humanity and its future trajectory.

Beyond the Surface: Investigating Microblade Technology and its Role in Bundelkhand's Prehistoric Narrative

Pratik Pandey
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Archaeological research in Bundelkhand has recently opened up, leading to new opportunities for scholars to explore the region's rich archaeological and cultural legacy in depth. After a prolonged hiatus due to the high criminal activities, the region is open to revisiting to uncover the prehistoric population once inhabited here. Combining legacy data with our current field investigations and the nature of multicultural findings shows that this area holds significant potential for prehistoric research.

In the Indian subcontinent, there is a notable scarcity of quaternary human fossil remains, attributed to factors such as the tropical climate's adverse impact on preservation, cultural practices like cremation, limited archaeological excavations, etc. Therefore, the study of prehistoric

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human behaviour and adaptation often relies on the examination of the lithic material they left behind. These lithic tools are chrono-culturally classified into different types and technologies, each reflecting specific stages of technological advancement, cultural development and species changes. Among these classifications, microblade technology holds particular significance as it represents a distinct method of tool production characterised by the creation of small, sharp blades from carefully prepared cores (see definition: Seong, 1998; Clarkson et al., 2009). The study of microblade technology in the Indian subcontinent serves as a marker of early modern human activity from the late Pleistocene to the early Holocene (Mishra et al., 2013). Detailed spatial and temporal analysis of the microblade technology of the Bundelkhand region may offer valuable insights into technological advancement, behavioural changes and debatable migratory theory.

The Bundelkhand region, characterised by its semi-arid nature, is situated at one of the proposed prehistoric migratory routes (Lopez et al., 2016; Clarkson et al., 2020); thus, the study may reveal an answer regarding the nature of early human occupation of the Indian subcontinent as well as South Asian. From a geological standpoint, this area is positioned between the Central Uplands and the alluvial plain of the Ganga Valley (Bhatt et al., 2024). The northern lower reaches of the Bundelkhand region lie in close proximity to the Ganga basin, making the study of microblade technology crucial in understanding the nature of the populations that first occupied this significant area. Recently, as part of my doctoral research, a systematic prehistoric investigation has been conducted in the confluence area of the Kail and Ken rivers to understand the current research scope in this area. The area is situated geographically on the border of the Banda-Chhatarpur district to understand the less-known geoarchaeology of the lower reaches of the Ken basin. During our fieldwork, several prehistoric sites were identified, spanning from the Acheulian to the microlithic period. Alongside stone artefacts, we collected petrified bones, including some of more recent origin, in close proximity.

The Bundelkhand region offers intriguing exposed geological sections with artefacts and fossils, indicating substantial potential for archaeological investigation. However, a comparative and comprehensive examination of microblade technology and its role in deciphering past human behaviour and adaptation within the Bundelkhand region has yet to be undertaken. Despite the presence of numerous microblade sites, direct chrono-cultural dates are conspicuously lacking in this region. The region exhibits considerable potential for paleoclimatic study. However, current investigations in this area remain sparse. Comprehensive exploration of paleoclimatic dynamics within the region is crucial for elucidating the paleoecological conditions of past hominin habitats. Such understanding is paramount for discerning the intricate processes underlying technological and behavioural evolution over time. By examining the distribution and characteristics of microblade assemblages, researchers can gain a deeper understanding of the cultural dynamics, technological innovations, and migratory movements of prehistoric human societies in the region. This interdisciplinary approach will not only shed light on the prehistoric human occupation of Bundelkhand but also provide valuable clues about the colonisation of the Ganga basin and its implications for prehistoric dynamics and cultural interactions in the global context.

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Assessment of Response of Pichavaram Mangroves to Predicted Sea Level Rise: *A Multidisciplinary Approach Using RSET–MH and Palynological Analysis*

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PhD Awarded

In the face of escalating climate change events, the Pichavaram mangroves endure as resilient frontiers, navigating the intricate dynamics of shifting temperature regimes, precipitation anomalies, and encroaching sea levels. It becomes imperative to undertake a comprehensive exploration of the ecological responses exhibited by Pichavaram mangroves, to safeguard their enduring vitality and ensure the preservation of coastal ecosystems. The study employs a range of precise scientific techniques to comprehensively investigate the Pichavaram mangrove ecosystem. Rod Surface Elevation Table-Marker Horizon (RSET-MH) involves the installation of vertical rods and markers, enabling continuous monitoring of the mangrove surface's elevation change and vertical accretion. Additionally, to assess plant bioturbation dynamics, the study combines various methods, including measuring plant litter production using litter traps, analysing litter bag decomposition, and counting pneumatophores. Furthermore, palynological analysis examines pollen and spores within the ecosystem, shedding light on historical vegetation dynamics and broader environmental changes. Together, these methods offer a comprehensive understanding of the mangrove ecosystem's resilience and adaptation to environmental challenges.

This thesis marks a significant milestone in establishing the Rod Surface Elevation Table–Marker Horizon (RSET–MH) station, the first of its kind in the Indian mangrove context. The initiative catalyzes an in-depth investigation into the response mechanisms exhibited by the Pichavaram mangrove forest, situated in Tamil Nadu, India, near Chidambaram. By meticulously quantifying the intricate dynamics of surface elevation change and vertical accretion, profound insights were garnered concerning the sedimentary processes and the adaptability of mangroves in the face of escalating sea level rise. The study area underwent differential changes in elevation during the monitoring period. Certain regions demonstrated a predominance of vertical accretion, leading to an elevation gain. However, other areas exhibited a net loss of elevation. Despite comparatively higher average rates of accretion in specific locations, they were concurrently associated with more pronounced shallow subsidence, ultimately contributing to the observed overall decline in elevation. The bioturbation dynamics will unravel the underlying ecological processes that govern the intricate interplay within the mangrove ecosystem. By employing palynological analysis, a thorough investigation of the pollen record unveiled the historical dynamics of vegetation and the intricate long-term changes that have shaped the present state of the Pichavaram mangrove ecosystem. The study was conducted in Birbal Sahni Institute of Palaeosciences, Lucknow under the supervision of Dr. Jyoti Srivastava, Scientist, BSIP. Significantly, this comprehensive approach has resulted in identifying Sonneratia griffithii pollen, previously unreported in the Pichavaram region. These collective findings enhances our comprehensive understanding of the mangroves' resilience, facilitating the formulation of evidence-based conservation and management strategies. Moreover, the pollen analysis will provide crucial insights into the mangroves' response to sea level rise, aiding in the assessment of their adaptive capacity and guiding targeted measures to mitigate the ongoing environmental challenges effectively.

The findings highlight that sites with lower elevation and lower accretion rates are more vulnerable to inundation risks. Bioturbation by

crabs was identified as a significant factor influencing sediment accumulation, with variations in crab abundance and activity observed among the sites. The study highlights the significance of litter production as an important parameter influencing vertical accretion in the Pichavaram mangroves. The findings emphasize the need to consider litter production rates and its subsequent decomposition in formulating conservation and management strategies aimed at sustaining and enhancing vertical accretion processes in the mangrove ecosystem.

Diatoms as indicators of environmental & climatic change in the myristica swamps of the Western Ghats

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Nestled within the lush sub-tropical evergreen forests of the Western Ghats, India, lie the enigmatic Myristica swamps, a rare gem of wetland ecosystems. These swamps, characterized by waterlogged conditions and rich humic decomposition, are home to rare and endemic biotas, offering essential services to both nature and humanity. However, amidst human activities, these invaluable ecosystems face degradation, teetering on the brink of extinction. Land use changes, in particular, cast significant shadows on their delicate balance, altering water chemistry and threatening their diverse biodiversity. In light of their ecological importance, this thesis embarks on a profound journey to unravel the mysteries of the Myristica swamps. It seeks to conduct a meticulous analysis, delving into the physical, chemical, and biological realms, with a keen eye on the microalgal biodiversity, particularly the elusive diatoms. These microscopic wonders, encased in siliceous shells, hold the secrets of environmental change within their fossilized forms, making them invaluable allies in understanding the past and present of these swamps.

Through the lens of diatoms, this study journeys deep into the annals of Quaternary research within the Western Ghats, peering into the modern and ancient diatom communities that call the Myristica swamps home. In doing so, the research sheds light on the historical and current environmental conditions, particularly throughout the Holocene period. This thesis utilized diatoms as a proxy to investigate the dynamics and underlying causes of Asian monsoon variability and conducted qualitative assessments using diatom-based reconstructions to delineate wet and dry phases and warm-humid and cool-dry periods. During this study, the first comprehensive checklist of fossil diatoms was developed from tropical freshwater environments across Asia. This compilation includes 266 species spanning 64 genera, detailing their environmental preferences. This will be further used to improve their applicability in paleolimnological reconstructions.

Central to this endeavor is the exploration of diatom assemblages within the Myristica swamps and their response to shifting water quality—a realm yet uncharted. Through extensive sampling and meticulous identification efforts, an analysis of over 19,000 diatom individuals revealed documentation of more than 170 species spanning over 40 genera. Among these, 63 diatom species are potentially novel and presumed to be endemic solely to the distinctive Myristica swamp environment. Yet, amidst this beauty lies a tale of looming danger—the human footprint growing ever larger, casting shadows upon the pristine landscape of the Central Western Ghats, posing a threat to this unique ecosystem. Consequently, diatoms reflected the intensity of human activities inside these swamps, sounding a clarion call for deeper understanding and urgent action.

After analyzing the modern diatom flora, the study attempted to understand the Holocene environmental history of these swamps by examining the fossil diatom diversity in a sediment core from this ecosystem during the late Holocene (5 kyr) to recent times. The diatom analysis revealed 101 species from 35 genera, with the highest number of species known as indicators of acidic conditions. The main stages in the swamp's evolution indicated overall reduced rainfall during the mid to late Holocene and increased human influence in the recent past, during the last 500 yr. Reconstructing this history will further help in providing a roadmap for safeguarding these precious ecosystems for generations to come.

To better understand Holocene environmental changes in the Western Ghats, this thesis also attempted to reconstruct the Holocene climatic history outside the swamps using the lacustrine sediments with a multi-proxy approach to reconstruct the Holocene environmental changes of the Kaas Plateau in the northern Western Ghats.

In essence, this thesis stands as a testament to the wonders of Myristica swamps, offering a glimpse into their past, present, and future through the lens of diatoms. It is a call to arms, a beacon of hope, guiding us towards a future where the beauty and biodiversity of these swamps endure, a legacy worth preserving for generations yet unborn.

To join QuatChron_AOQR Google Group: open https:// groups.google.com, login (using Gmail account), search for "QuatChron_AOQR" and ask to join.]

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NEW FINDINGS IN SCIENCE

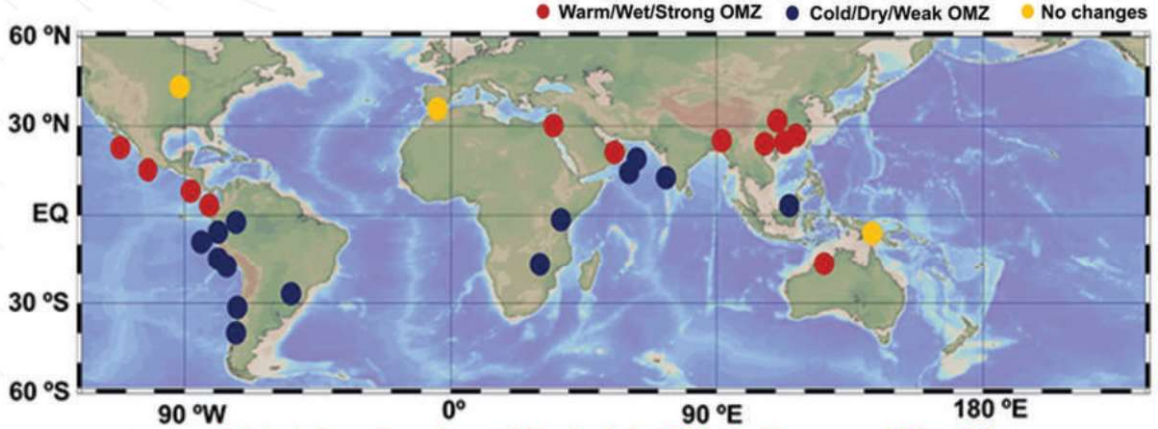
Millennial-Scale Changes in Atmospheric Nitrous Oxide During the Holocene

Azharuddin, S., Ahn, J., Ryu, Y., Brook, E., & Salehnia, N. **(2024).**
Millennial-scale changes in atmospheric nitrous oxide during the Holocene.
Earth and Space Science, 11, e2023EA002840.
https://doi.org/10.1029/2023EA002840

Nitrous oxide (N_2O) is an important greenhouse gas that responds to climate variation and is responsible for stratospheric ozone destruction. The growing level of N_2O in the atmosphere is of global concern. Anthropogenic emissions during industrialization have majorly contributed to the remarkable increase in atmospheric N_2O concentration from approx.270 ppb in 1750 AD to approx.332 ppb in early 2020 AD. Recent estimates suggest an anthropogenic contribution of approx.40% in the current total N_2O emission (IPCC AR6, 2021), whereas 60% of the emissions originate from natural sources. Among these, the terrestrial and oceanic sources account for 60% and approx.40% of N_2O emissions from the natural environment, respectively. Primary sources of atmospheric N_2O are nitrification and denitrification in terrestrial soils and the ocean, and the main sink is photolysis in the stratosphere. Variations in pre-industrial N_2O emissions from diverse sources are closely correlated with ecological processes regulating the cycling of nitrogen (N) and carbon (C) on land and in the ocean. N_2O production is contingent on metabolic processes (nitrification and denitrification) performed by specific groups of bacteria. Some hotspots of the globe, where major N_2O contributions from these processes occur, include the terrestrial soils in the tropical forests and marine suboxic waters around the major upwelling regions overlying the oxygen minimum zones (OMZs).

N_2O has a relatively long atmospheric lifetime (approximately 123 ± 10 years) and, therefore, mixes effectively in the troposphere, reflecting similar values globally for a particular time. Hence, the N_2O concentration retrieved from the ice cores can be a potential proxy for studying variations in the global nitrogen cycle. The records of past N_2O variations can provide an essential context for understanding the links between N_2O and climate change. Studies have mostly focused on the climate-related response of N_2O during glacial-interglacial periods. However, the detailed feedback mechanism responsible for the N_2O-climate relationship and its interdependence with terrestrial and marine processes during the entire Holocene remains elusive owing to the lack of high-resolution N_2O records covering the Holocene. This study presents a new high-resolution N_2O measurement analysed in the South Pole Ice (SPICE) core during the last 11 thousand years. Additionally, a composite N_2O record is constructed by combining the new measurements from SPICE with the existing records from other ice cores.

Our N_2O composite shows four significant periods of N_2O variation during 11.5–10.0 ka, 10.0–6.2 ka, 6.2–2.2 ka, and 2.2–1.4 ka. These include two local N_2O maxima in 11.0–10.0 ka and 3.0–2.2 ka and minima in 8.8–6.2 ka and approximately 1.4 ka. Apart from these, the new high-resolution record from SPICE shows a short-term N_2O decrease of around 2.8 ka, which is not observed in other records, possibly due to lower sample resolution and/or higher age smoothing. Comparison of Holocene N_2O composite with the paleo□proxy records suggests the plausible linkage of major monsoon (Asian, North African, South and North American, and Australian-Indonesian monsoon) and upwelling (Arabian Sea and Eastern TropicalSouth Pacific) regions in regulating the atmospheric N_2O during the Holocene.



Variation in the marine and terrestrial proxies during N_2O local minimum around 8.8 to 6.2 ka

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Newly Developed Modern Biotic Analogue from the Kaziranga National Park, Assam, India for biodiversity sustainability and palaeoecological analyses

Swati Tripathi & Sadhan Kumar Basumatary, BSIP, Lucknow

Publication details: Basumatary SK, van Asperen EN, McDonald HG, Tripathi Swati, Gogoi R. 2023. *Pollen and non-pollen palynomorph depositional patterns in Kaziranga National Park, India: implications for palaeoecology and palaeoherbivory analysis. The Holocene 34(2): 224-238 DOI: 10.1177/09596836231211851*

https://dst.gov.in/new-study-tracking-pollen-soil-kazirana-naional-park-can-interpret-climate-vegetation-change-help

https://pib.gov.in/PressReleasePage.aspx?PRID=2008607

Kaziranga National Park (KNP) situated in Assam state of India, was inscribed on the UNESCO world heritage Listin 1985 and known for Great Indian one horned Rhinoceros. Along with the iconic Greater one-horned rhinoceros, the park is the breeding ground of elephants, wild water buffalo, and swamp deer, undisturbed by a human presence. The park is within the Indo-Burma biodiversity hotspot region, a critical corridor for the immigration of members of the Indo-Malayan fauna into the Indian sub-region. It is also a critical reserve for tropical species, having served as a gene reservoir for these taxa during glacial periods. Over time, the tiger population has also increased in Kaziranga, and that's the reason why Kaziranga was declared a Tiger Reserve in 2006. Also, the park is recognized as an Important Bird Area by Birdlife International for the conservation of avifaunal species.

Climate Change is a dynamic process for the periodic vegetation shifts in a region. Nevertheless, the national park is highly protected areas for biodiversity conservation, the obvious changes observed in recent years is the extreme and unpredictable weather, and an increase in the frequency and intensity of natural disasters, which are one of the prime drivers for the biodiversity loss in National Parks. The weather pattern is changing almost every year and the farmers are suffering huge losses. Similarly, the extent of annual rainfall and the locations associated with heavy and scanty rainfall are no more predictable with certainty. In these circumstances, the precision in future climatic assessment is important and requires rigorous climate models which are built utilizing modern and past climatic data inputs which emerged from well-dated quantitative palaeo-reconstructions. Therefore, developing a modern pollen analogue is a prerequisite for the interpretation of the past vegetation and climate in a region. In this prospect, an attempt has been made to establish a modern analogue dataset based on pollen and non-pollen palynomorphs (NPPs) from different vegetation settings across the Kaziranga National Park of Assam. This study evaluates both the strengths and weaknesses of the biotic proxy and assesses how reliably modern pollen and NPP analogues can identify different ecological environments and could be used as a baseline in interpreting Late Quaternary palaeo-environmental and ecological changes more accurately in this region. Consequently, the palaeo-ecological data would assist in better understanding the sustainable future projections in and around the

Figure (a) Thick evergreen forest within Kaziranga National Park, (b) Bucerosbicornis (Hornbills) sitting on the tree within the evergreen forest, (c) Group of Elephasmaximus (Asian Elephant) in deciduous forest in Kaziranga National Park, and (d) Rhinoceros unicornis grazing in the periphery near swamp (Basumatary et al. 2024).

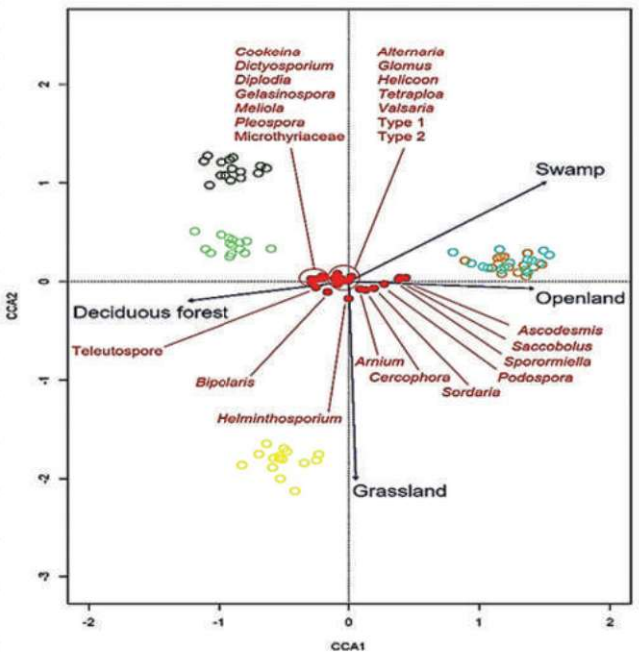

Figure. Canonical correspondence analysis (CCA) of non-pollen palynomorph (NPP) types and environmental variables (Basumatary et al. 2024).

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the national park. The study of the fossil pollen assemblage and past vegetation in tropical regions is more complex and critical due to high biodiversity and heterogeneity of the pollen preservation on the forest floor and nearby areas, compared to subtropical and temperate vegetation. Therefore, explicit formulation of modern pollen analogue is extremely prerequisite in this high precipitation tropical region for deciphering the past and future climatic scenario.

Since both fungal spores and the pollen grains in the sediments are commonly encountered in the same palynological slide, the documentation of coprophilous fungal spores, along with the pollen grains can be useful to interpret the impact of herbivores in relation to the different vegetation types in a region. As coprophilous fungal spores are dispersed only for a very short distance, they are local in origin and accumulate in sediments with pollen grains and are therefore indicators of the local presence of herbivores in relation to the existing vegetation. The previous palynological studies have often not recorded the presence of coprophilous fungal spores so cannot be used to determine the presence and abundance of herbivorous animals in the region. In the absence of skeletal remains of these herbivores, coprophilous fungal spores may serve as an important proxy that can be used to reconstruct the palaeoecology of a region with respect to the presence, types and abundance of herbivores and their impact on the local environment. Nowadays, there is an increasing global interest in palaeoherbivory and palaeodietary analysis in relation to palaeoecology during the Quaternary, particularly with respect to possible dietary changes that may have contributed to the Pleistocene-Holocene megaherbivores extinction (like woolly rhinoceros and mammoth), thus, this modern biotic analogue (reference) could also aid in finding the plausible causes for the megafaunal extinction through the palaeodietary analysis in coprolite and sedimentary sections deposited during the Quaternary. While some research has been conducted to understand past vegetation and climate history in relation to the paleoherbivory in national parks in tropical regions of the world, little research has been carried out on modern pollen deposition in relation to the different vegetation types in national parks and wildlife sanctuaries in Asia.

The relationship between, the vegetation types and wildlife in Kaziranga National Park based on the abundance of local arboreal and non-arboreal pollen taxa and coprophilous fungal spores in the palynoassemblages were well assessed for the palaeoherbivory and past ecological interpretation. This modern biotic analogue provides a means to distinguish the natural forest vegetation, from areas with heavy grazing or modified into cropland in both tropical and temperate regions. The resulting information can serve as a baseline to examine the influence of palaeoherbivory on vegetation in the National Park in the past. The study could help public and wildlife management agencies to understand the association of flora and fauna especially herbivores in National Parks to conserve it for the current and future prospect, thus informing the National Biodiversity Mission.

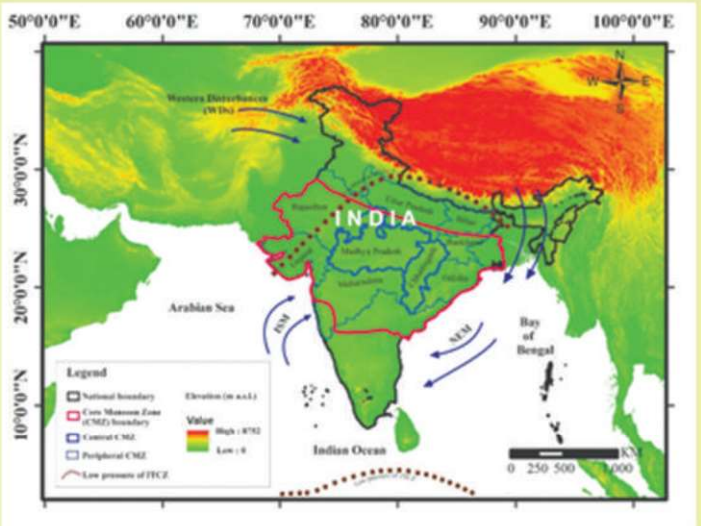
Core Monsoon Zone of India and its significance in palaeoclimatic studies

Mohammad Firoze Quamar, BSIP, Lucknow

Publication Details: Mohammad Firoze Quamar, Upasana Swaroop Banerji, Biswajeet Thakur, Ratan Kar. 2024. Hydroclimatic changes in the Core Monsoon Zone of India since the Last Glacial Maximum: an overview of the palynological data and correlation with the marine and continental records. Palaeogeography, Palaeoclimatology, Palaeoecology 633, 111844. https://doi.org/10.1016/j.palaeo. 2023. 111 844.

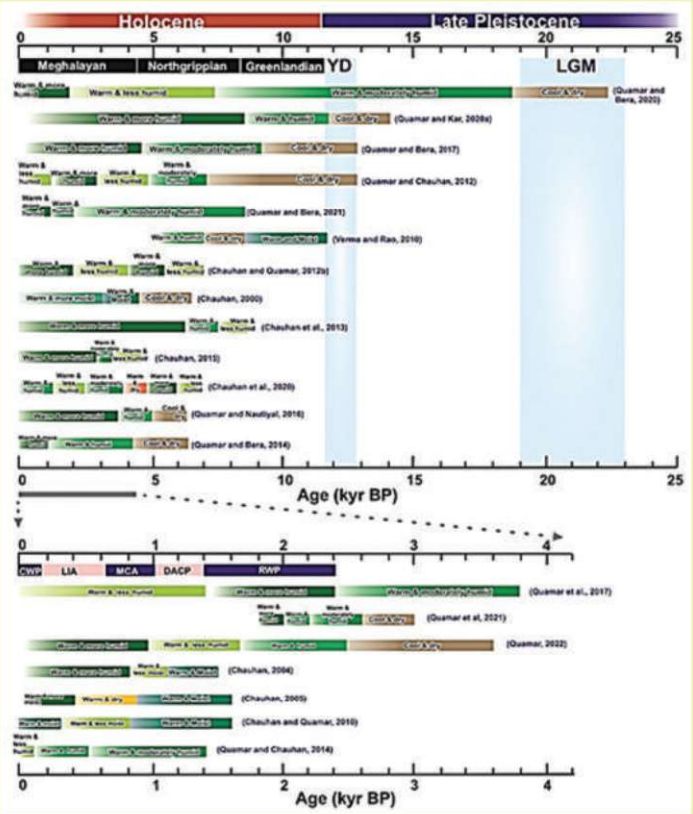
The Core Monsoon Zone (CMZ) is the area or zone in which the variation of rainfall during the months of July and August (peak rainfall months in India) well-represents the intensity of the annual Indian Summer Monsoon (ISM) rainfall (ISMR) i.e., the areas lying between latitudes 18 °N and 28 °N, and longitudes 65 °E and 88 °E fall. Being sensitive to the ISM fluctuations, it is regarded as the key region for the identification of weak or intense monsoon periods. We know that the ISM provides ~80% of the annual precipitation throughout the major part of the Indian sub-continent, from June to September. This ISM is significantly impacted by the ocean-atmospheric processes, such as the El Niño–Southern Oscillation, Indian Ocean Dipole, Atlantic Multidecadal Oscillation, Atlantic Zonal Mode, Pacific Decadal Oscillation, etc.

The ISM progression over the Indian landmass is a manifestation of the lateral Intertropical Convergence Zone (ITCZ) migration over the northern Indian Ocean and the Indian subcontinent. The ENSO is linked with the ISMR through an interaction between the equatorial Walker circulation and the regional Hadley circulation, which are considered as the world's two prominent atmospheric zonal and meridional circulations respectively. Thus, the ENSO has been demonstrated as the strongest driver of the ISM rainfall variability on an interannual basis. An El Niño year is dominated with the typical break phase, whereas the active phase of the ISMR is associated with the La Niña



GTOPO 30 digital elevation map (DEM) of India, showing the central (Madhya Pradesh and Chhattisgarh), as well as the peripheral CMZ.

year. However, the instrumental datasets for the last century revealed weakening of ENSO-ISM rainfall relationship in the recent period which has been attributed to the atmospheric changes as a result of global warming have shown a weakening of ENSO-ISMR relationship in the recent period. Hence, understanding the teleconnections of ENSO-ISMR is crucial in the central Indian CMZ, as being sensitive to the ISM fluctuations, the CMZ is regarded as the key region for the identification of 'break' or 'active' spells of the ISM. Please see the publication for the citations. The CMZ can be divided into the central CMZ and the peripheral CMZ, wherein the former includes the Indian states of Madhya Pradesh and Chhattisgarh, whereas the latter includes the adjoining states, such as Gujarat, Rajasthan, northern Maharashtra, Uttar Pradesh, Haryana, Bihar, Jharkhand and Odisha. Pollen-based palaeoclimatic studies in the central Indian CMZ suggested that the LGM (~20,000 yr BP) was cool and dry (reduced monsoon) in the central CMZ, whereas the peripheral CMZ showed strengthened Northeast Monsoon (Oct.-Dec.) during the LGM. The globally observed Younger Dryas (~12.9–11.7 ka) was cool and dry (weak ISM) in the central CMZ region, whereas peripheral CMZ records suggested monsoonal influence. The Holocene Climate Optimum (7000–4000 yr BP) was observed to be asynchronous in the central Indian CMZ. The extreme climatic events, such as at 8.2 ka and 4.2 ka, were poorly registered due to it being more sensitive towards intensified monsoon phases rather than the weaker monsoon spells. The last two millennia have been observed to be climatically dynamic with intensified ISM phases manifested during the Roman Warm Period (2500–1450 yr BP), the Medieval Climate Anomaly (1050–650 yr BP), and the Current Warm Period (100 yr BP–present); with intermittent weak ISM phases, such as the Dark Ages Cold Period (1450–1050 yr BP) and the Little Ice Age (LIA; 650–100 yr BP).



Climate reconstruction from the studies conducted in the central CMZ (Madhya Pradesh and Chhattisgarh)

Title: **Assessing Health of the High Altitude Lake (HAL) Tenbawa and Ecosystem Sustainability in Response to Changing Climate in the Lachung Valley, Sikkim Himalaya**

Dr. Manasi Debnath, Nagaland University, Nagaland (PI)

Prof. Milap Chand Sharma (Jawaharlal Nehru University, New Delhi) & Dr. Mriganka Shekhar Sarkar (NERC-NIHE, Arunachal Pradesh) (Co-PI):

Funding Agency: ***National Mission on Himalayan Studies (NMHS); Ministry of Environment, Forest and Climate Change (MoEFCC) Government of India***

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Overview:

Due to climate change induced extreme events, there is potential for loss to habitats, ecosystem and human society in the fragile mountainous regions like ours. Poor understanding of climate change impact on the glaciers, glacial lakes, glacial lake outburst floods (GLOF), and other impact on the higher altitudinal lakes (HAL) and adjacent ecosystems from the Lachung valley of Sikkim, Indian Himalayan Region (IHR) has incentivized usto initiate this research. GLOF is known to cause considerable loss to ecosystem, such as loss of vegetation and biodiversity, siltation in rivers affecting water quality, and soil and nutrient losses caused by water erosion on agricultural lands and subsequently affecting the living conditions of several tens of thousands of people residing downstream of the IHR. The recent GLOF from the South Lohnak lake in Sikkim has drawn local and international concerns on the looming disasters induced by the climate change. The dynamic nature of the cryosphere and its impact on the HAL has implications for future water security across India's international borders,as well as biodiversity sustenance in the proximity. Developmental activities in such sensitive and fragile IHR necessitates initiation for an integrated research of the issues.

Evidence of palaeo GLOFs down-valley fromTenbawa lake in Lachung valley, Sikkim is already existing. Therefore, the present research would integrate various physical and chemical parameters of selected HAL (Tenbawa lake), its dynamic nature, surrounding geomorphic stability, GLOF risk probability analysis, and surrounding ecosystem evaluation. The expected outcome from geomorphological records of landform and sediment assemblages will provideexplicitdata on glacier and lake area dynamics, and for the event reconstruction. The successive output from HAL area-water depth analysis through bathymetric survey, paraglacial and periglacial landform stability analysiswouldevaluate the health of lakes and project the future potential of GLOF if any, while assessing biodiversity in and around high-altitude lake ecosystems will assistin understanding and conserving these unique and fragile ecosystems under the present climatic and anthropogenic continuum.

39th Annual Convention of the Indian Association of Sedimentologists (IAS) & International Conference on "Voyage of Sedimentology from the Mountains to the Oceans: An Innovative Trajectory"

By **Sivaprakasam Vasudevan**, Associate Professor, Department of Earth Sciences, Annamalai University, Tamil Nadu

The 39th Annual Convention of the Indian Association of Sedimentologists (IAS) and the International Conference on "Voyage of Sedimentology from the Mountains to the Oceans: An Innovative Trajectory" took place from December 6th to 8th, 2023, at the Department of Earth Sciences, Annamalai University under the convenership of Dr. S. Vasudevan. The conference aimed to showcase the multifaceted aspects of sedimentary processes, environments, and resources, aligning with the impending centenaries. Experts, researchers, academicians, and professionals in sedimentology converged to share groundbreaking research and experiences. Ten scientific themes were identified, covering ancient Earth, tectonics, biological processes, continental and marine depositional systems, modern sedimentary processes, resource exploration, environmental studies, geochemistry, and technological advancements. Professor Ganapathy Shanmugam, University of Texas at Arlington, USA, gave the convention address. The event featured the International Association of Sedimentologist lecture series by Professor Daniel Ariztegui, former President of the International Association of Sedimentologists and affiliated with the University of Geneva, Switzerland; Professor Matthieu J.B. Cartigny from the University of Durham, United Kingdom; Professor Tracy D. Frank from the University

of Connecticut, USA. The conference was also attributed to keynote speeches, distinguished lectures, oral and poster presentations, workshops, and field excursions, fostering a comprehensive exploration of sedimentological concepts. The workshops included "Navigating the Publishing Process in Sedimentology" by Dr. Alexander Braiser, from the University of Aberdeen, King's College, Scotland, UK, and "Chemical Clues: Coastal Sediment Geochemistry," by Prof. T. Ramkumar, from the Annamalai University, Tamil Nadu, India, providing valuable insights into publishing and geochemical analysis. Participants gained practical insights through post-conference visits to Pichavaram Wetlands and Neyveli Lignite Open Cast Mine, enhancing their understanding of coastal geomorphology and resource extraction. The event comprised convention addresses, lectures, keynote speeches, distinguished presentations, awards, and 172 abstracts. The 39th Annual Convention and International Conference offered a platform for scholarly exchange, fostering collaboration and innovation in sedimentological research. Through its diverse program and practical experiences, the event significantly advanced sedimentology and its applications across various disciplines.

5th Workshop on Luminescence dating and its applications (Feb 20–23, 2024)

by ***Dr. Madhav K. Murari,***
Inter University Accelerator Centre (IUAC),
New Delhi.

Association for Luminescence Dating (ALD) organized the 5 th Workshop on Luminescence dating and its applications on Feb 21–23, 2024 (in Physical Research Laboratory (PRL), Ahmedabad) with an extra day preworkshop training on 20 Feb 2024 (in Institute of Seismological Research (ISR), Gandhinagar). Workshop was attended by 100 participants (Scientists and students) from various institutions/universities from different parts of the country. Prof. A. Bharadwaj (Director, PRL) inaugurated the main workshop event at PRL, Ahmedabad and the preworkshop event was welcomed by Dr. S. Chopra (Director, ISR) at ISR, Gandhinagar. Recent advancements in methodology to applications were discussed by the experts of the fields and scholars working in the field while preworkshop day included a small field trip at the nearby site to ISR, Gandhinagar to teach the sampling procedure. A hands-on training that included data analysis and luminescence measurement protocols through various lectures from the experts. The whole program was managed by Prof. A.D. Shukla (Chair), Dr. N. Chauhan (Convener) and Dr. S. Sharma (Co-Convener) from PRL (Ahmedabad) and Dr. S. Prizomwala and Dr. F. Bhattacharya, Dr. N.M. Makwana, and Dr. K. Goswami from ISR (Gandhinagar). The Ministry of Earth Science (MoES) Government of India, Gujarat Council on Science and Technology, Government of Gujarat, AMETEK, and Gemmological Institute of India (GII) are acknowledged for their generous support.

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Quaternary Chronicles
Happenings in the Sub-continent
ASSOCIATION OF QUATERNARY RESEARCHERS

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TROPQUA 2024 — 3rd INQUA-PAGES ECR Workshop

*Tro*pical hydroclimate variability in the *Qua*ternary: Insights from proxies and models, and the way forward

3 - 7 November 2024

CSIR-National Institute of Oceanography, Goa, India

This workshop aims to bring together early career researchers (ECRs) investigating tropical climate hydrodynamics in the Quaternary based on proxy data and climate models, with the *'common goal'* of bridging the gap between these two components of research and fostering collaboration.

Important dates:

Abstract submission & travel grant application
Opens: 20 March
Closes: 20 April
Registration: *Opens:* 07 May, *Closes:* 01 July
Travel funds available for ECR's - visit the website for more details

Visit the TROPQUA 2024 website for more details OR email us at tropqua2024@gmail.com

PAGES EARLY-CAREER NETWORK

Early Career Researchers INQUA ECR

3rd INQUA-PAGES ECR workshop on Tropical hydroclimate variability in the Quaternary (TROPQUA) Please visit the official workshop website for more details - https://lnkd.in/djDpkjMG

UPCOMING EVENTS

PUBLICATIONS

Key publications (January-March 2024)

Jha et al. (2024) *combine palaeoenvironmental records and spatial modeling of archaeological sites in the Ganga Plain for the last ~100 ka. They find evidence of high rainfall during specific periods, fluctuating rainfall during others, and arid conditions at certain intervals. Archaeological findings indicate the presence of the Acheulian culture, diverse Mesolithic cultures, and an advanced Neolithic phase characterized by agriculture and pottery production. Their study suggests that integrating archaeological sites, geological mapping, vegetation analysis, and palaeoclimate records offers valuable insights into ancient human-environment interactions.*

Narzary et al. (2024) study the late Quaternary evolution of the Belan River Basin in central India. They analyze geomorphic indices of active tectonics, drainage patterns, and lineaments to assess slope adjustment resulting from uplift and subsidence. The study reveals that extensive valley fills began around 51 ± 7 ka and continued until approximately 22 ± 2 ka. These findings suggest that tectonically controlled valleys have shaped the drainage networks of the Belan River Basin, with denudational processes shaping the basin over a significant period.

Singh et al. (2024) analyze Late Quaternary deformation in the Eastern Himalayan Syntaxis, focusing on fault slip rates using luminescence and radiocarbon dating on landforms in the Siang and Mishmi ranges. They find that Late Pleistocene rates are lower than Holocene rates, suggesting strain partitioning. The Manabhum Thrust may be a proto-thrust or footwall imbrication of the Mishmi Thrust. A lower Holocene fault slip rate in the Siang range indicates significant strain partitioning. The study highlights the need to consider complete seismic and inter-seismic cycles in assessing uplift rates in active regions.

Irfan et al. (2204) investigate active tectonics in the Zanskar Basin, located south of the Indus Tsangpo Suture Zone in the NW Himalaya hinterland. They employ tectono-geomorphic analysis, drainage network dynamics, field observations, and GIS techniques. The study reveals modified geomorphic features indicating significant tectonic activity and differential rates of tectonics over time. Geomorphic indices, correlated with tectonics, climate, and erosion, suggest that basin geometry is primarily influenced by the Zanskar Shear Zone/South Tibetan Detachment System, the Zanskar Counter Thrust, and other local tectonic elements. Both past and ongoing tectonic processes have substantially shaped and modified the geomorphology of the Zanskar Basin.

Kotlia et al. (2024) analyse 7.65 m long core sediments from Khajjiar Lake, Himachal Pradesh, using a multi-proxy approach to reconstruct paleoclimate variability. Results indicate less humid conditions around 4600–4185 cal yr BP, with an extreme peak of dry and arid climate at approximately 4370 cal yr BP. Intensified monsoon and wetter conditions are observed during 4185–3790 cal yr BP, with fluctuations noted during other intervals. The study identifies two major climatic phases corresponding to the 4.2 ka and Roman Warm Period. Regional comparisons of mid-late Holocene climate records show broad synchronicity but with significant spatial variation in the timing and duration of climate events across regions.

Singh et al. (2024) assess paleoclimatic proxy records to understand the Western Himalayas' response to the Little Ice Age (LIA) cooling. Using Principal Component Analysis, they find consistent high moisture levels during the LIA, with increased winter precipitation and reduced summer precipitation across all records. Spectral analysis shows similar dominant frequencies between proxy records and LIA climate forcing, indicating the LIA's influence on hydroclimate changes. Decreased solar activity and increased volcanic activity contributed to cooling, affecting rainfall patterns. Synchronous changes in North Atlantic Oscillations and El Niño–Southern Oscillation records suggest a link between "monsoon breaks," intensified Westerly winds, and increased winter precipitation in the region.

Mohanty et al. (2024) conduct palynological analysis of surface soil and sub-surface sediments from the outwash plain of Hamtah Glacier, Lahaul-Spiti, India to indicate that the region experienced cold-arid conditions between 1580 and 1330 yr BP which can be related to the Dark Ages Cold Period. Thereafter, between 1330 and 950 yr BP, a comparatively warm and moist phase was observed, marking the Medieval Climatic Anomal in the region. The warm-moist phase was, however, short-lived, and from 950 yr BP to the Present, the region saw a return to cold-arid conditions which was, nevertheless, punctuated by a warm-moist period during 790 to 680 yr BP. The culmination of the long cold-arid regime is characterized by warmer conditions over the last 160 years, which is the manifestation of the Current Warm Period.

Pokharia et al. (2024) explore the periods of dynastic transitions and crop production at the urban site of Vadnagar, in semi-arid northwest India through several climate events, during the Late Holocene. Archaeobotanical data indicate the sufficient water availability during the Historic and Medieval periods, allowing crop production dominated large-grained cereals. However, during the Post-Medieval period a resilient crop economy based on small-grained cereals dominated, representing a human adaptation to prolonged weakening of monsoonal precipitation. Despite long-term reduction in summer humidity, the authors argue that an adaptable agricultural package coupled with suitable water management systems allowed for the resilience of the urban settlement at Vadnagar.

Jahan et al. (2024) analyse the active tectonic conditions in the Himalayan Frontal Thrust (HFT) region from Kathgodam to the Chorgallia sector using remote sensing, geomorphic indices, field evidence, and luminescence dating. They find moderate to high tectonic activity, concentrated more in the eastern half and declining westward. Petrographic investigations reveal sustained frontal deformation, with notable thrust-induced deformation fingerprints throughout specific sections. Thin section investigations unveil micro thrust duplexes and asymmetrical drag folds due to HFT-related brittle-ductile deformation. Quartz OSL dates from Quaternary sediments indicate hanging wall rock migration and HFT reactivation in the study area, providing valuable insights into the tectonic history of the Outer Himalaya.

Jha et al. (2024) present their study on plant-wax biomarker preservation in deserts and its implications for Quaternary environmental and human evolutionary studies. They assess n-alkanes and fatty acids from depositional sequences in the Nefud Desert, Saudi Arabia, and the Thar Desert, India, associated with archaeological contexts. Molecular patterns, including the carbon preference index and average chain length, indicate biomarker preservation in both Holocene and Pleistocene sequences. δ13C values and organic content offer insights into the vegetation contributing to the plant-wax pool. The study serves as a foundation for understanding human-environment interactions and reconstructing changes in arid habitats relevant to hominins during the Quaternary.

Dar et al. (2024) analyse lake sedimentation records from the Shey area of Leh, Ladakh Himalaya, examining sedimentological, petrological, and magnetic characteristics. They discover evidence of a lake-damming event, resulting in 16 m thick sediments, caused by topography, granite bedrock, and moraine material. These lakes formed from the coalescing of southern fan deposits with granite spurs, with sediments reflecting three fluctuating climate phases: high-energy fluvial-lacustrine, calm lacustrine-reducing, and intermittent climates, evidenced by alternating sandy and clayey layers. Petrography and magnetic data reveal diverse climates and mineral compositions, with sandy layers indicating warmth and vegetation, and clayey layers representing cooler periods. Around 100 ka BP, warm and moist conditions coincide with intensified Indian Summer Monsoon during MIS 5c, attributed to increased glacial melting and precipitation in the region.

Basumatary et al. (2024) produce a modern analog for pollen and non-pollen palynomorphs (NPPs) preserved in soil in relation to the different vegetation types and herbivore impact in the Kaziranga National Park. Their study demonstrates that the depositional pattern of pollen and NPP and their relative abundance in different vegetation types in the Park parallels the vegetation present in each type of habit and the impact of herbivores that utilize them. The pollen data from the different vegetation types in KNP reveals a strong relationship with the extant vegetation. This data can be utilized as a baseline for the interpretation of paleoecological and paleoherbivory studies in other parts of the Indian subcontinent as well as its potential application at a global level.

Kadam et al. (2024) report the discovery of giant magnetofossils within late Quaternary sediments retrieved from the Bay of Bengal (BoB), the youngest giant magnetofossils yet reported. Their magnetic and geochemical data suggest that an influx of fluvially derived reactive iron and organic carbon, combined with persistent suboxic conditions, supported the proliferation of giant magnetofossil-producing organisms. The discovery of a modern analogue to ancient giant magnetofossils expands our understanding of their temporal distribution within the geological record and is a promising step toward elucidating the nature of the organisms responsible for their formation.

Khan et al. (2024) analyze a sediment core from the Western Arabian Sea (WAS) to decipher long-term productivity and organic matter preservation trends using Globigerina bulloides abundance, total organic carbon (TOC), and calcium carbonate (CaCO3) content. They observe CaCO3 dissolution and heightened productivity during interglacial periods (MIS5e) linked to intense summer monsoon-induced upwelling. Notably, mid-MIS4 exhibits increased organic matter preservation and productivity, indicating stronger upwelling, winter convective mixing, and elevated aeolian transport from nearby landmasses. The Atlantic Meridional Overturning Circulation (AMOC) weakening corresponds to decreased productivity during Heinrich Events (HEs), except for H6 and H4 in the tropical Indian Ocean, with H6 notably displaying abnormal preservation during mid-MIS4. The study highlights the significant influence of AMOC and the summer monsoon on WAS primary productivity, suggesting ballistic effects may impede deep-water oxygenation, preserving organic matter during mid-MIS4.

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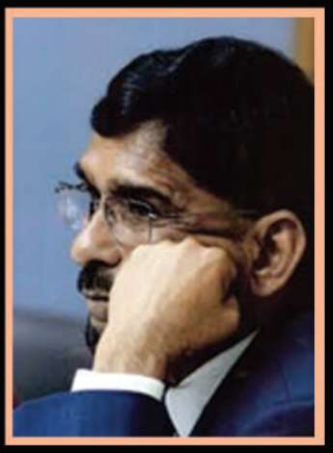
Quaternary Chronicles
Happenings in the Sub-continent
ASSOCIATION OF QUATERNARY RESEARCHERS

Tribute to a good friend indeed...



Dr. Bahadur Kotlia

Our good friend Dr. Bahadur Kotlia, a renowned Quaternary geologist, left for his heavenly abode on 13 February, 2024. Profoundly mourned by his family, friends, admirers, colleagues and students from all over the country, he will always be fondly remembered by fellow Quaternary geologists. Bahadur's demise is a great loss to the Indian Quaternary geological fraternity. We had been friends since 1975 and we had reached every major milestone almost together. Though we served in different Institutes/Universities and different states, we were on each other's caller list for over 40 years. I watched him as a gifted student initially and as an excellent researcher later.

We were eight students during Masters in the first batch of Geology from Kumaun University. It was a blessed batch under the guidance and mentorship of the Padma Bhushan awardee, Professor Valdiya. We all have some great fond memories of the Department of Geology, Kumaun University and mainly of the geological and educational tours during our Bachelor's and Master's. I would like to share a few extracts of our times together.

In the very first year of our Bachelor's, we were taken to the Dehradun–Mussoorie traverses by then the lone teacher, Shri Dinesh Garg ji. Spending a night in a dharamsala in Dehradun, we got ready in the morning for the first geological traverse of our life, Dehradun to Mussoorie, on foot. It was hard to make sense of what the teacher was trying to explain as we had no idea of Indian stratigraphy, and suddenly midway through, the teacher observed that two of our classmates were not wearing hunter shoes which he had made mandatory. Immediately, he asked them to return to Dehradun, buy hunter shoes and join the team at Mussoorie. The two students were Bahadur and Tara Chandra, who had no option but to walk down to Dehradun again, buy the shoes and trek up to Mussoorie to catch up with the group. When they arrived, there were absolutely no regrets on their faces or fatigue. As usual, Bahadur must have kept the tempo of Tara Chandra high with his interesting talks, folk songs and stories.

In moments of despair and anxiety during our educational tours, Bahadur, with his jolly nature and shayaris, used to make us feel good. I am reminded of these initial field trips only because when our respected teacher used to punish us in the field and was making our life difficult, Bahadur, with his comments used to make it interesting and memorable. Out of some 25 students in Bachelors, only 8 were admitted to the Masters in 1977. All of us have now retired from active services, occupying high positions in different organisations. I have a lot of good, fond memories during the Masters, mainly with Bahadur. I must mention that his handwriting and overlay sketches of the geological features were excellent. We used to make it a point to tally our illustrations with his before finalising the field reports. I recall at Bheeda Ghat, near Jabalpur, where Dr V. N. Agrawal, our structural geology teacher, asked us to draw the sketches of folds and classify them following Ramsay, it was Bahadur who helped us.

I had enough opportunities to meet Bahadur after our Master's as both of us moved to Gujarat. He joined PRL, Ahmedabad and I joined the Department of Geology, The M. S. University of Baroda, for higher studies. Both of us had common friends at PRL, and we had many common research issues too. In 1996, we travelled together to Germany to attend the INQUA Congress in Berlin. It was really fun travelling and sharing a room in a hotel in Berlin with him. He was a frequent visitor to Germany and was well acquainted with the transport system there. In the evening, we used to go to the city by subway trains to buy food from department stores. He was also fluent in German. I always requested that he arrange Indian food. During those days, Indian restaurants were very few and very expensive too. But, once he managed to take me to an Indian restaurant, and I cherish it even today. I can never find a better company than Bahadur, especially when you go to Germany.

Another event that I remember was when he organised an International Conference at Nainital. Many foreign delegates were asked to assemble at INSA, New Delhi, and I was assigned the duty of accompanying them to Nainital It was a really memorable trip to Nainital during that

conference, and we had an excellent conference dinner in a Balrampur house where he along with his students sang some local Kumauni songs. I also cherish yet another event, HIMPAC, organised by him at INSA, New Delhi, with the support of Dr. Sushma Prasad of Postdom, Germany. He had the skill and energy to organise such academic events, and all the foreign and Indian scientists very much appreciated his efforts. Bahadur was a good friend to hundreds of people, both from India and abroad. He was an excellent host at Nainital to all and, to me, he was special at Nainital as I used to take my students to Nainital for several years and he always welcomed us with his great usual smile.

Bahadur was an Alexander von Humboldt Fellow who has extensively worked on paleoclimatic changes and climate-tectonic interaction in the Karewas of Kashmir, Ladakh, and Uttarakhand Himalayas using a number of climate proxies. He worked on numerous projects funded by national funding agencies and also collaborated on several international projects. He also worked on crustal strain studies, Asian monsoon variability, neotectonics, geomorphology, past shaking events, and the evolution of lakes using a number of archives and proxies. He produced several PhDs and published nearly a hundred papers in reputed journals. He will be remembered for his work on the cave speleothems of the Indian Himalayas, which helped in unravelling the climate of the Indian Himalayas for the last 5,000 years.

Unique personalities call for tributes in different ways. He will be deeply missed by everybody, particularly his family, friends and students. No more texting /chatting, emails, phone calls/ discussions pertaining to speleothems. Wish him farewell in his journey to perpetuity. He will never be forgotten. May God rest his soul in peace and provide enough strength to his family to bear the loss.

Tribute to a good friend indeed...

with heavy hearts,
Prof. L. S. Chamyal

A TRIBUTE TO PROF. BAHADUR S. KOTLIA

***O, dear Bahadur**, your legacy shines bright*
In the corridors of memory, day and night
We met at the isotope lab, PRL, Ahmedabad
When you were a postdoc, and I was a grad
We worked on climate science together
Through the speleothems that record the weather
You were a mentor and a friend
A pioneer in your field
You explored the secrets of the past
Through the sediments you revealed
You shared your wisdom and your passion
With numerous students; you were a visionary
You taught them how to read nature's secret
Through the science of Quaternary
We parted ways but kept in touch

Through workshops and conferences and such
You guided my students and colleagues too
With your passion and your insights true
You inspired us all to learn and grow
With your wisdom and your kindness so
A researcher by heart, field geology was your passion
Unravelling Himalayan dynamics, your lifetime mission
Like a fish swimming in a pond or a bird flying in the sky
You roamed through nature's trail, spirit soaring high
Reading rock layers, measuring their chemical properties
Recreating environmental shifts and monsoon vagaries
You visited us in Pune in two thousand nineteen
We had lunch and laughter and reminisced the scene
Of our days at PRL, full of joy and fun
But little did we know, it was our last one
I will never forget your morning message
Etched in my mind with each day's passage
The serenity and divinity they illustrate
Forever resonate in my heart, heartstrings vibrate
You left us too soon, Prof. Kotlia
But your memory will live on
In the caves and the labs and the hearts of us all
You will always remain our Sun!

- **Dr. Supriyo Chakraborty**, *Savitribai Phule Pune University*

Quaternary Chronicles
Happenings in the Sub-continent
ASSOCIATION OF QUATERNARY RESEARCHERS

Quaternary Chronicle (QC) publishes three issues a year seeks to publish perspectives, recently published peer-reviewed papers in Quaternary science, new developments in Quaternary science methods/ techniques, past events, awards, abstracts of recently awarded Ph.D./MS thesis; Quaternary publications, obituaries and details on forthcoming conferences/opportunities/fellowships the world over. Each issue of the newsletter will therefore, comprise news on on/from the Indian sub-continent;. It will also have a platform for discussion on emerging questions and ideas in Quaternary science and details on new books/ monographs/ reviews. QC seeks to share original results, new ideas and innovative development for the common good and a possibility to serve as a catalyst for the initiations of major and coordinated initiatives in the country.

We now accept submissions for our upcoming issues. Submit all the contributions to **aoqr2019@gmail.com**. *Themes for contributions are given below:*

1.Perspective: *Perspective write-ups on emerging trends and new possibilities in Quaternary Science (500 words).*

2.Sneak-peek and Discussion: *Share any exciting findings/questions from your ongoing (unpublished) work already to facilitate discussion. Any other intriguing facts/ unanswered questions are also welcomed for discussion (150 words).*

3.Significant new manuscripts/ books/ monographs/ reviews: *Corresponding authors of recently published peer-reviewed papers are invited to submit a brief summary of their work (not published abstract) with complete reference, web-link, and corresponding email address (200-300 words). Also, include a PDF copy of the paper in the email (for reference only).*

4.Facilities and Instruments: *A list of available facilities at various Indian institutes will be given and updated as contributions are received. In-charge of the available facilities, mentioning whether it is open access or available on payment basis, may submit the details with contact details.*

5. Achievements: *Share national or international awards/ fellowships/ recognitions with the larger Quaternary community. Also, approved SERB/ DST/CSIR/ national/ international Quaternary projects with the title, affiliation details of the awardee and a brief abstract (200 words) may be submitted with a copy of the award letter (for reference only).*

6.Projects/Collaborations: *New projects and collaborations related to Quaternary Science may also be sought for enhancing the quality of ongoing/proposed research. Submit a brief summary of the project, collaborations required and the contact details for correspondence (200 words).*

7. New Thesis: *Abstracts of awarded PhD/MS degree are invited for contribution (250 words).*

8.Opportunities: *Submit details with web-link of any new openings and opportunities for wider circulation.*

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See the details in https://www.aoqr.org/#

ISSUES	Deadlines (Last date for submission)
Issue -1 (April)	**March 10**
Issue -2 (August)	**July 10**
Issue -3 (December)	**November 10**

ASSOCIATION OF QUATERNARY RESEARCHERS

Quaternary Chronicles

Happenings in the Sub-continent

Vol.6 No.2 August 2024

Dear Quaternary Enthusiasts,

We all understand the complex interplay of the lithosphere, atmosphere, biosphere, hydrosphere, and cryosphere in the last 2.6 Ma, which led to the Quaternary time slice, in which we all find a linkage. Understanding present and future climate change can only be assessed with the knowledge of the driver, mechanisms, and processes that govern it on both temporal and spatial scales. Achieving precision in climate forecast by modelling requires a variety of studies based on a range of diverse and independent proxies with the participation of researchers from different disciplines. In addition, multi-proxy studies addressing flood and drought events, paleo-fires, volcanic activities, earthquakes, tsunamis, landslides, and other extreme events of the past are necessary to develop better risk assessments for the future. These studies can also help prevent the majority of such natural calamities or mitigate their effects. A recognition of the responses of both plants and animals to past climatic changes certainly helps in providing an understanding of their expected range shifts, turnover, or even the possible extinction of a species on account of a changing climate in the future. This understanding would be very welcome in developing better conservation criteria and effective restoration practices. Our species is an excellent example of the outcome of evolutionary processes that occurred during the Quaternary, extensively altering the earth's ecosystem during the latter part of the Holocene. Unravelling the effects of natural and anthropogenic climate and environmental changes is extremely important to assess the major drivers correctly. These studies will help to better optimise resource management for more sustainable practices at local, regional, and global levels. The 2nd Indian Quaternary Congress (IQC) at IISER Mohali in June this year was a big success. Congratulations to Dr. Anoop Ambili and his organising team for their excellent hospitality and organisation. Indian Institute of Tropical Meteorology (IITM), Pune, will host the 3rd IQC in 2026.

IQC is an excellent platform from AOQR, the only association in India linking quaternary researchers in the country for better interaction and promoting interdisciplinary research through its meetings, conferences, workshops, lectures, and training programmes. The AOQR is also a co-organiser of the INQUA Congress 2027, along with the Birbal Sahni Institute of Palaeosciences, Lucknow (DST), and the National Centre for Polar and Ocean Research, Goa (MoES). As a run-up to the final INQUA Congress 2027, the AOQR has planned several activities to commence shortly. These activities include an online lecture series to commence in September 2024, training programs, small workshops, and outreach activities in schools and colleges. The idea is to look at newer areas, approaches, and techniques pertaining to Quaternary research through these activities within the ambit of the theme for the INQUA 2027 Congress, which is Quaternary Science as Societal Services.

We look forward to the enthusiastic participation of members and motivating other non-member Quaternary researchers to become part of this essential association in the rapidly changing Earth.

The Governing Body members, the ECRs, Team AOQR, and all the contributors for this volume of Quaternary Chronicles are thanked. Your support means a lot to us.

- **Vandana Prasad,** President AOQR

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AOQR - Governing Body

Editorial ECR Team

The ECR team is thankful to all volunteers and members of AOQR to take this newsletter to a wider audience.

AOQR MEMBERSHIP CALL

Researchers of Quaternary Science of Indian sub-continent are welcome to submit your application. Be a part of a multidisciplinary team of researchers, and practitioners of Quaternary Science and represent Indian Quaternary Science at an international level. Members can get priorities at our annual e-conferences, publish in the edited books/ journal volumes by the members of the AOQR, access to webinars, e-conferences and specialized thematic workshops etc.

Write to us at **aoqr2019@gmail.com** *for membership application form.*

The membership of the AOQR is open to all individual of academia and industry subject to verification.

Welcome!

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Perspectives

The western and northern routes of the Tibetan Plateau: A transnational perspective

- Lhamo Kyab
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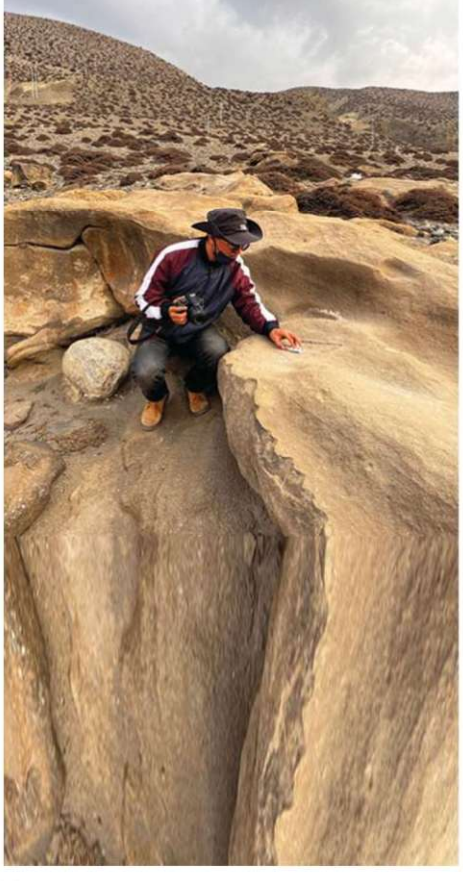

The Tibetan Plateau, covering 2.5 million square kilometres, stands as the world's largest plateau, averaging an elevation of 4,000 metres above sea level (d'Alpoim & Aldenderfer, 2019). The Himalayas, a formidable natural-glacial barrier, extend from the southeast to the southwest of the plateau. It features numerous cultural routes, linking the Himalayan regions with various countries across South Asia. These routes hold historical significance and played a crucial role during prehistoric hunting-gathering. To thoroughly comprehend the prehistoric cultural networks of the Tibetan Plateau, researchers must adopt a transnational perspective that transcends national boundaries. This approach involves analysing archaeological evidence of regions and acknowledging that cultural interaction often spans vast geographical areas that do not align with contemporary national divisions. By considering cross-boundary connections, scholars can gain a more holistic understanding of the diffusion of technologies, cultural practices, and ideologies that characterised these prehistoric networks.

Among the prehistoric cultural networks of the Tibetan Plateau, one of the most significant routes is the western route, which connects western Tibet/Ngari region to Central Asia through Himalayan mountain corridors. This route integrates with the Silk Road, forming sub-networks of ancient trade and culture across the Himalayan regions, including Ruthog, Garthog, Zada, Changthang, Saga and Dungpa in Tibet, Kashmir, Ladakh, Kinnaur, and Spiti in India, Gilgit and Balti in Pakistan, and Dolpo and Mustang in Nepal. Historical records indicate that this route has been an imperative cultural conduit since the Zhangzhung kingdom. Archaeological evidence witnesses that prehistoric cultural networks in these areas date back to the Neolithic period (Lu, 2016).

On the other hand, the northern route served as the primary cultural connection for the Tibetan Plateau. This route links to the Hexi corridor via the Tso-ngon regions, which have a long history of cultural and economic interactions in the Holocene. Many archaeological remains in the northern route and surrounding areas demonstrate the admixture of prehistoric culture and technologies. The Hixi Corridor has been a crossroads in the middle of China, Tibet, Mongolia, and Central Asia, facilitating the exchange of Eastern and Western cultures (Hung et al., 2014). The region connected by the northern route was subsequently the subject of conflicts between several historical powers, including the Tibetan Empire, Tang Dynasty, Tangut Dynasty, and Mongol Empire. Archaeological research has suggested that humans have adapted to the icy and hypoxic conditions of the Tibetan Plateau from the Pleistocene to historical periods (Dongju, 2016; Belleza, 2002). In addition, artefacts discovered across different sites provide solid evidence of the interactions and exchanges among ancient communities (Sharma, 1989; Banerjee & Sharma). Stone tools reflect lithic technologies that were shared and developed over time, while menhirs and megalithic monuments indicate ancient ritualistic and cultural practices that transcended regional boundaries (Tucci, 1935; Roerich, 1931). Rock art offers insights into ancient cultures' symbolic and morphological aspects, displaying similar themes and motifs that reveal ancient socio-cultural history. Thus, these remains can provide a comprehensive picture of the extensive and interconnected cultural networks that existed in prehistoric times (Bellezza, 2003).

The western and northern routes of the Tibetan Plateau likely served as pivotal networks for spreading prehistoric agriculture and pastoralism. The western route integrates the Ngari region to Central Asia with India, Nepal and Pakistan. Likewise, the northern route—connecting northeastern Tibet with Mongolia and China—provided essential mediums for the spread of domesticated plants and animals. Two cultural networks would have significantly impacted the subsistence strategies of ancient populations, allowing for the adaptation of farming and herding to the Tibetan Plateau. Additionally, the interaction along these routes may have fostered the development of hybrid agriculture and pastoralism. Understanding the role of the western and northern routes in prehistoric agriculture and pastoralism offers valuable knowledge of the socio-economic transformations that shaped early human societies in the Tibetan Plateau and surrounding areas.

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Perspectives

Ancient Horizons: Pre-Buddhist Archaeological Discoveries in Spiti Valley

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The Spiti Valley, located in Himachal Pradesh, shares borders with Tibet. It is a cold, barren desert landscape, and its name means "middle land," reflecting its position between India and Tibet. The valley is well-connected through various passes to Ladakh, Kinnaur, Kullu, Tibet, and further to Nepal, suggesting that the Himalayas were not a barrier but a mediator, forming a trade and cultural network across the high-altitude Trans-Himalayan region. Rock art, including petroglyphs and pictographs along with rock inscriptions, serves as a primary source for understanding the early history of Spiti Valley. Secondary sources include records from the British colonial period when Spiti was part of British India. Additionally, numerous Tibetan texts reference Spiti, providing historical context about Tibetan religious kings, Buddhism, and the history of Ngari, Guge, and Ladakh, all of which ruled Spiti at different times.

Buddhism arrived in Spiti in the 10th century CE with the establishment of Tabo Monastery in 996 CE, one of the oldest monasteries of the Guge Empire. Before the Tibetan Empire conquered it in the seventh century, Spiti was a part of the ancient Tibetan dynasty and later the kingdom of Zhangzhung. Tabo Monastery became a centre for Tibetan-Buddhist learning, preserving early Indo-Tibetan Buddhist art, architecture, and literature. Consequently, Spiti has a rich archaeological heritage, including monastic complexes, sculptures, chortens, mane walls, rock carvings, cave shrines, ritual objects, thankas, rock paintings, and manuscripts. Earlier studies primarily focused on the Buddhist era, with the history of Spiti Valley being traceable only to the 10th century, where the documentation ends.

Recent archaeological research has uncovered burials and funerary material in the Kinnaur district, extending into Spiti Valley. These findings include prehistoric artefacts and rock art from prehistoric to historical times, offering new insights into the region's cultural history and the pre-Buddhist era in the Trans-Himalayan region. Notably, the lithic assemblage site in Spiti is the first-ever discovery of stone tools in the Trans-Himalayan region of Himachal Pradesh, marking a significant addition to South Asian prehistory. The microlithic industry at Dzamathang in Spiti includes scrapers, points, blades, bladelets, flakes, and cores, suggesting the site was a factory for tool production. While research on Palaeolithic culture in Spiti Valley is in its early stages, similar high-altitude sites in Ladakh show typological similarities to tools discovered in Northern Tibet, indicating a connection between these regions. Spiti shares the same geographical zone as Tibet, suggesting it is the southernmost extension of Tibet's microlithic culture. Burial sites across the Trans-Himalayan region, including Uttarakhand, Mustang in Nepal, Western Tibet, and Chitral in North-Western Pakistan, show typological similarities in funerary remains, particularly in the position of skeletons and ceramic types. These similarities suggest cultural links and the evolution of burial practices from the beginning of the first millennium BCE or earlier. The findings reflect local traditions, trade activities, technological advancements, and beliefs in an afterlife.

In summary, the study highlights the archaeological evidence of lithic tools in Spiti Valley, dating back to 25,000 years ago, and human bone remains from 500 BCE to 700 CE. Rock art adds to our understanding of the region's past, from the Bronze Age to historical times. Further scientific study is needed to fully comprehend the cultural and technological developments in this arid Trans-Himalayan landscape. The findings indicate that the region was part of a larger cultural zone, emphasising the need for interdisciplinary research to explore early societies' adaptive behaviour, settlement patterns, migration, burial practices, and trade networks. This study opens new avenues for comprehensive investigation in an underexplored area of India.

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PERSPECTIVES

Harnessing Microbial Insights for Geological Breakthroughs

As a microbiologist deeply immersed in the field of microbial ecology, I am continually amazed by the profound connections between microbial processes and geological phenomena. In India, both geological research and molecular biology have reached impressive milestones. However, there remains a significant opportunity for synergy between these fields that has yet to be fully explored. It is time for geology to meet "omics"—the advanced study of biological molecules—to truly revolutionize earth science in India. I write this perspective to urge Indian geologists and microbiologists to collaborate for a greater cause.

Biogeochemical cycles, essential to Earth's systems, govern the flow of elements such as carbon, nitrogen, and sulfur through various Earth spheres. Microbial communities play a critical role in these cycles, mediating processes like decomposition, nutrient transformation, and mineralization. By integrating advanced molecular biology tools, such as metagenomics and metatranscriptomics, with geological research, we can gain unprecedented insights into these processes. For instance, metagenomic sequencing can identify microbial genes involved in essential functions such as carbon fixation and nitrogen cycling. This integration can enhance models of carbon sequestration and improve strategies for managing nitrogen and sulfur emissions.

Similarly, microbial activity is integral to processes like biomineralization and weathering, which are crucial for mineral formation and dissolution. Techniques like metaproteomics and metabolomics can reveal the metabolic pathways and enzymatic activities of microbes involved in these processes. Geologists and microbiologists collaborating on this front can develop new models for mineral formation and dissolution, leading to innovative applications in material science and resource exploration.

Also, bioremediation, the use of microorganisms to clean up environmental pollutants, is another critical area where microbial and geological research intersect. Advanced molecular biology tools can identify the microbial communities involved in pollutant degradation and their metabolic pathways. By integrating these insights with geological expertise, we can design more effective bioremediation strategies, optimize conditions for microbial activity, and improve the restoration of contaminated environments.

Further, certain microbes, microbial diversity patterns and microbial biomarkers serve as valuable proxies for past environmental conditions. Techniques such as lipidomics and proteomics allow us to identify and quantify these biomarkers with high precision. By combining geological and microbial expertise, we can achieve more accurate reconstructions of ancient climates, providing a clearer picture of past climate dynamics and enhancing our predictive models for future climate scenarios.

It does not stop here; extreme environments, such as deep-sea hydrothermal vents and polar ice caps, host unique microbial communities adapted to harsh conditions. Studying these extremophiles with advanced molecular techniques can reveal their adaptation mechanisms and metabolic capabilities. These insights are invaluable for astrobiology, as understanding how microbes thrive in extreme conditions can inform our search for life beyond Earth. Geologists and microbiologists working together can enhance models for extraterrestrial habitability and guide the search for signs of life on other planets.

The integration of geology and omics requires robust interdisciplinary collaboration. Platforms like the Association of Quaternary Researchers (AOQR) provide a valuable forum for geologists and molecular biologists to share knowledge, develop joint research initiatives, and explore innovative approaches to studying Earth's systems. Such collaboration can accelerate scientific discoveries and address complex environmental challenges more effectively.

To conclude, the convergence of geology and omics represents a transformative opportunity for advancing earth science in India. By embracing this interdisciplinary approach, we can achieve a holistic understanding of geological phenomena, enhance predictive models, and develop innovative solutions to environmental challenges. I urge my fellow scientists in geology and microbiology to come together, leverage our combined expertise, and embark on this exciting journey. It is time for geology to meet omics, and together, we can unlock new horizons and make significant contributions to our understanding of the dynamic Earth.

- *With optimism and anticipation,* **Senthil Kumar Sadasivam,**
National College (Autonomous), Tiruchirappalli (TN). *senthil@nct.ac.in*

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Heartiest congratulations to all the Awardees of the National Geoscience Award (NGA)

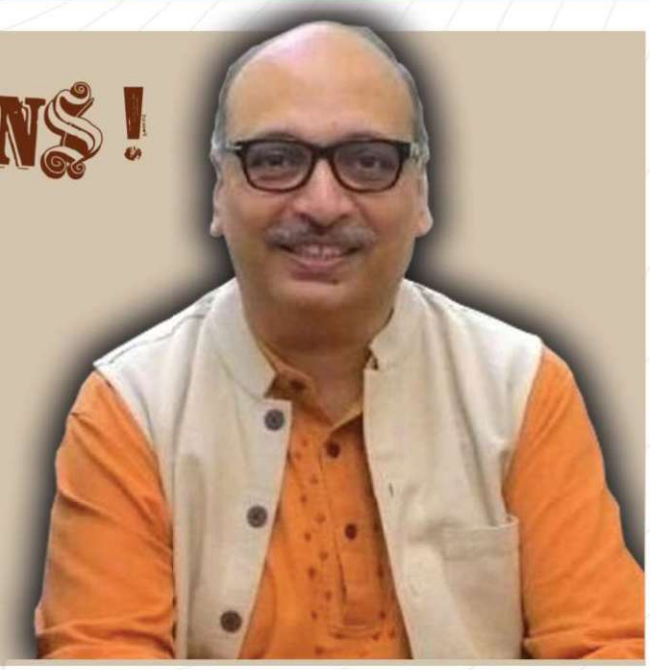
LIFETIME ACHIEVEMENT AWARD

The AOQR family extends its congratulations to **Professor D. M. Banerjee,** who received the prestigious National Geoscience Award for Lifetime Achievement in 2023. Dhiraj Mohan Banerjee completed his PhD in Geology from Lucknow University in 1967. He joined the Geological Survey in December 1967, where he initiated significant research activity on ancient phosphate deposits in Rajasthan.

Banerjee joined the University of Delhi as a Lecturer in 1967 and retired from the same institution as a Professor in 2008. Since then, he has held the position of INSA Emeritus Scientist. He has led the Indian contingent to Rome, Italy, for the 21st INQUA and ensured a successful bid to host INQUA 2027 in India—the first ever in the Indian subcontinent.

CONGRATULATIONS !

The AOQR family wishes **Dr. Rahul Mohan, Scientist F,** NCPOR Goa, for the prestigious National Geoscience Award. Dr. Rahul Mohan is the Governing Body member of AOQR. He specialises in marine micropaleontology, with particular mention to coccolithophores and diatoms, marine geology and paleoceanography. Dr. Rahul Mohan was also a member of the Indian contingent in Rome and was the Vice President of INQUA-2027.



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SIGNIFICANT FINDS

Non-pollen palynomorphs (NPPs): Discerning signals of herbivore grazing

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Reference: Quamar et al., Grana
DOI:10.1080/00173134.2024.2350537

Non-pollen palynomorphs (NPPs) are all 'extra' microfossils (now identifiable), excluding pollen grains, which survive chemical digestion during the pollen extraction process and appear on palynological microscope slides (van Geel, 2001). Moreover, NPPs are a large and taxonomically heterogeneous group of remains of organisms within the size range of pollen grains (ca. 10–250 µm), living in diverse environments. NPPs include fungal spores, algal spores, and testate amoebae, as well as plant and zoological (animal) micro-remains. Bas van Geel (1972, 1978), Hugo de Vries Laboratory at the Amsterdam University, The Netherlands, first started the systematic documentation of 'extra' microfossils in the Quaternary pollen slides. Because the Quaternary and, especially, the Holocene are relatively short geological periods, evolution and extinction did not play a significant role, implying that palynomorphs represent the remains of still-living taxa.

Among the fungal spores, spores of coprophilous fungi (SCF)/coprophilous fungal spores (CSF) (hereafter the SCF) (fungal spores that grew on the faeces/dungs of herbivores) are some of the most widely used NPPs, which serve as indicators of the local presence of herbivores in relation to the existing vegetation (Graf & Chmura, 2006; Johnson et al., 2015) and also to study palaeoherbivory. Studying SCF not only helps us understand what past herbivorous species ate, but it also tells us about ecology, diversity, niche partitioning, and changes in how common different species were in a particular area (Ebersohn & Eicker, 1992; Ekblom & Gillson, 2010; Velázquez & Burry, 2012; Tripathi et al., 2019; Basumatary et al., 2021; Pokharia et al., 2022, and references therein). The study of SCF also addresses the questions of pastoral and other human activities (Davis, 1987; van Geel et al., 2003; Burney et al., 2003; Gill et al., 2009; Miehe et al., 2009; Cugny et al., 2010; Feeser & O'Connell, 2010; Felauer et al., 2012; Johnson et al., 2015; Kamerling et al., 2017).

For many years, the SCF has been used to find out where large vertebrate herbivores live and how much they graze (Davis, 1987; Carrión, 2002; Carrión et al., 2000, 2005; van Geel & Aptroot, 2006; Davis & Shafer, 2006; Cugny et al., 2010; Ejarique et al., 2011; Baker et al., 2013; Ghosh et al., 2017; Quamar & Stivrins, 2021; Quamar et al.,

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2021; Kar et al., 2022; references therein). Sporormiella and Sordaria species are usually found on cow dung (van Geel & Aptroot, 2006; Ejarque et al., 2011) and are often used to show how much grazing there is (Almeida-Lenero et al., 2005; Ejarque et al., 2011). Besides these two, Podospora spp. and Delitschia spp. can only grow on other bacteria. In contrast, Cercophora sp., Coniochaeta ligniaria, and Sordariaceous ascospores can also grow on dead plant parts and other things that are breaking down (van Geel & Aptroot, 2006). Nigrospora spp., Cercophora spp., Delitschia spp., Podospora spp., Sordaria spp., and Sporormiella spp. can also be used to show when there is open vegetation (Ghosh et al., 2017), which may be linked to human pressure. According to Cañellas-Boltà et al. (2009), a lot of coprophilous NPPs (Sordaria-type and Sporormiella spp.) can be found where animals graze in the central Pyrenees in south-western Europe. The records of SCF, such as Sporormiella-type (HdV-113), Sporormiella-type, Sporormiella spp., Sordaria spp., Sordaria-type (HdV-55), Cercophora, Podospora-type (HdV-352), and Delitschia spp. (Plate 1), from the surface samples of Raipur-Bilaspur (Chhattisgarh State), central India (Fig. 1), suggest that bovines, goats, sheep, horses, donkeys, and other cattle, if any, are involved in the grazing activity and herbivory, thus indicating pastoralism in and around the study area.

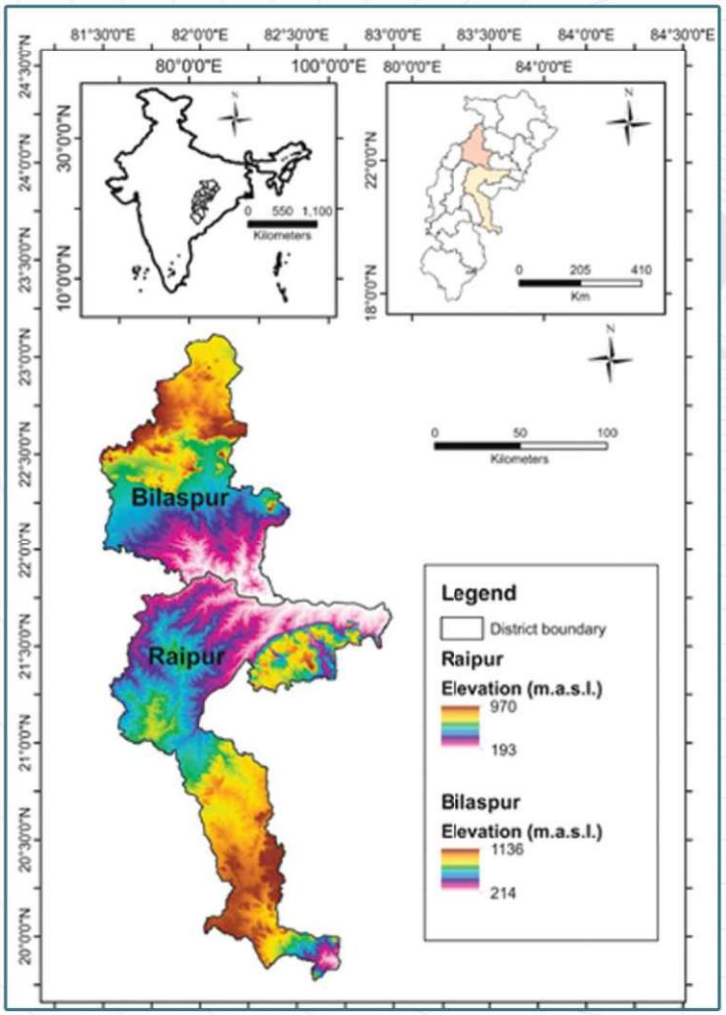
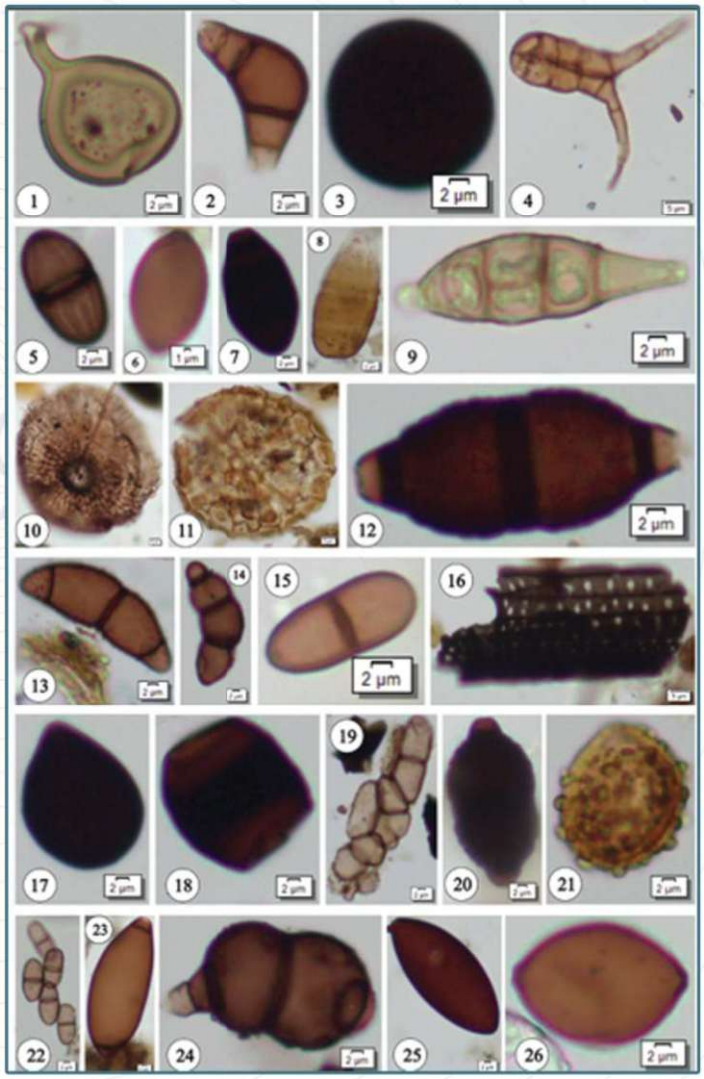


Fig. Shuttle radar topographic mission (SRTM) digital elevation map (DEM) of the Bilaspur and Raipur districts of Chhattisgarh State, central India. Geographic map of India showing Chhattisgarh State (inset left); Geographic map of Chhattisgarh State showing the Bialspur and Raipur districts (coloured) (inset right). Source of Figure 1: Fig. 1 was created using ArcGIS 10.3.



Plate

A. Glomus, B. Curvularia (conidium), C. Nigrospora, D. Tetraploa, E. Cookeina, F. Podospora, g. Podospora-type, I. Alternaria, K. Unknown remains (QPLBSIP-A), L. Caryospora calicarpa, M. & N. Fusarium-type, and H. Helminthosporium are some of the fungi that were tested. O. Diplodia-type, P. Phytoclast (plant-derived resins), A. Ellipsoidal spore with apical pore sticking out (Sordaria ascospore); B. Sporormiella-type (HdV-113); and C. A group of Sporormiella-type spores that are still attached. Some of the microfossils that were studied were: U. Globose microfossil with large gemmae (Bryophyte spore); V. Cercophora sp. (in bunch); W. Sordaria (HdV-55A); X. An ascospore that looks like Acrospira mirabilis; Y. Podospora-type (HdV-352, van Geel and Aptroot 2006); and Z. Sordaria-type.

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A multi-proxy lacustrine sedimentary record of sub-decadal to decadal scale variability of monsoon during the late Holocene in southern India

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The study looks at changes in rainfall over the last 2,000 years on a sub-decadal to decadal scale. It does this by using multiple proxy analyses of sediments found in southern India's Madagadakere Lake. Proxies like rock magnetic, C/N ratio, diffuse reflectance spectroscopic (DRS), particle size, and Fourier-transform infrared spectroscopy (FTIR) have been employed on lacustrine sediments for past rainfall reconstruction. The sediment profile was dated using AMS C-14, Pb-210 and Cs-137 methods. The rock magnetic parameters were calibrated with instrumental rainfall data for the past 115 years. The cyclic variation of rainfall was present during the Late Holocene in southern India, with increased monsoonal strength during 2100–1900, 1600–1250, 1050–925, 680–600, and 350–270 cal. years B.P. and relatively weak monsoons during the intervening periods. The study also indicates that persistent sub-decadal to decadal scale periodicities documented in the Madagadakere Lake sediment magnetic record revealed that rainfall variability during the past 2100 years in southern India was strongly modulated by external forcings (total solar irradiance) as well as internal factors (ENSO, IOD, and shifting of ITCZ). An investigation into a greater number of lacustrine sedimentary archives in southern India is necessary to understand regional and historical rainfall variability during the Holocene in the region

Reference: Aravind et al., 2024, Journal of Asian Earth Sciences, v. 270,106196. https://doi.org/10.1016/j.jseaes.2024.106196..

Predictive models for climate change impact on Tropical dry deciduous forests of India

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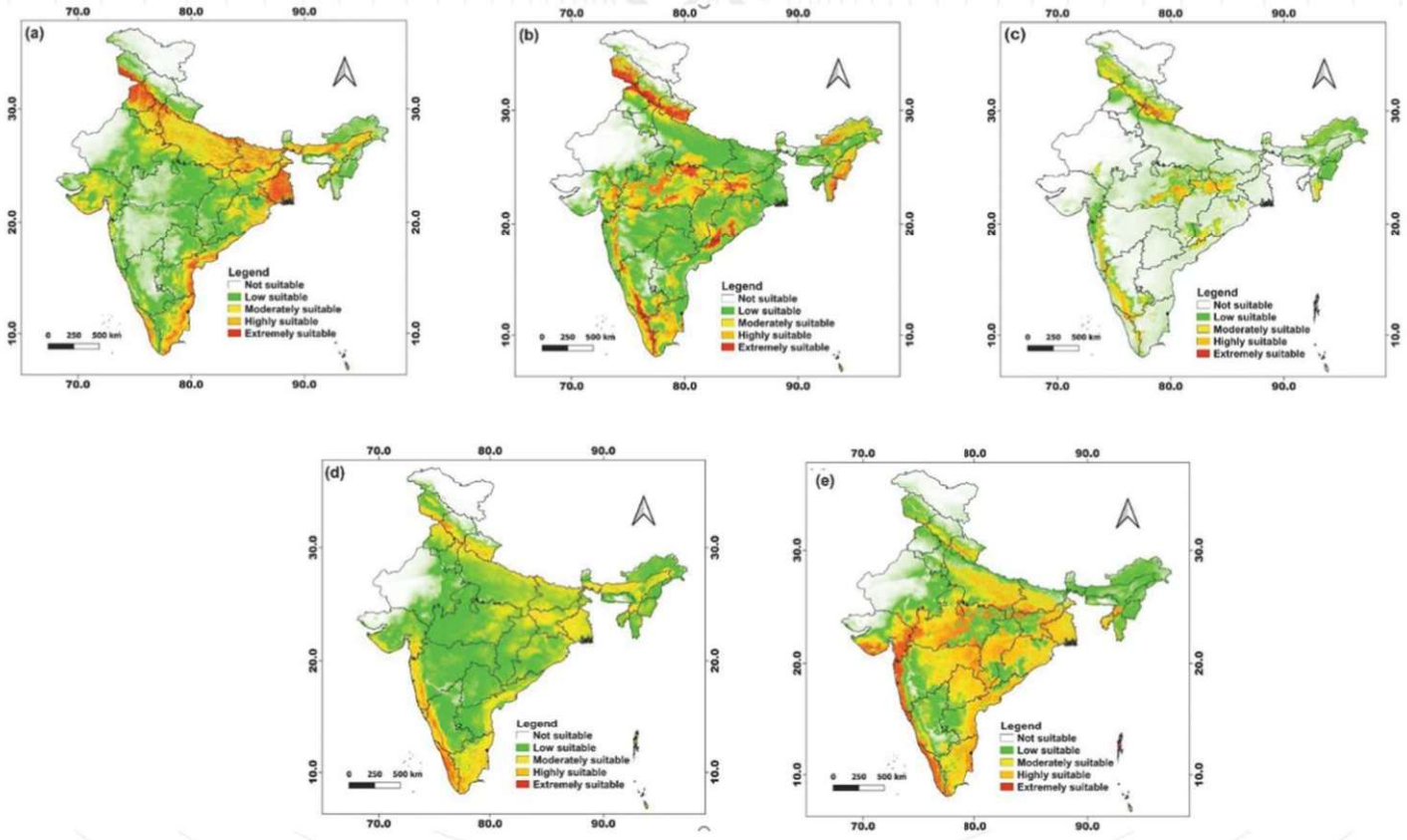
Climate change is a primary component of global changes and is expected to affect the distribution of species significantly. Understanding and predicting the influence of climate change on ecosystems and species is crucial for formulating sustainable strategies for conservation and management. Although tropical dry deciduous forests are adapted to physiological stress during extended drought periods, how they will respond to future changes in climatic regimes is still being determined. An assessment was conducted on the projected range shifts of key Non-Timber Forest Product (NTFP) species occupying this vegetation type in India, including Aegle marmelos, Buchanania lanzan, Madhuca longifolia, Phyllanthus embilica and Terminalia bellirica.

Their habitat suitability was analysed under current climate conditions, and their past (Middle Holocene, 6000 cal yr BP) and future (for the 2050s and 2070s) distributions were mapped under RCP 2.6 and 8.5 emission scenarios using MaxEnt species distribution modelling techniques. The results indicated that key bioclimatic factors, such as mean annual temperature (Bio_1), annual precipitation (Bio_12), isothermality (Bio_3) and precipitation of the coldest quarter (Bio_19), primarily drove the distribution of all species. These factors together accounted for about 70% of the species' distribution.

Additionally, topographical variables like altitude and slope played a significant role, contributing approximately 10-20% to the distribution patterns. The Western Ghats region emerged as a highly suitable habitat for most of the studied NTFP species, including B. lanzan, M. longifolia, P. emblica and T. bellirica. However, A. marmelos was primarily confined to the Kerala region of the Western Ghats. Also, Central India, encompassing states like Madhya Pradesh and Chhattisgarh, was identified as a highly suitable region for the distribution of species such as B. lanzan, M. longifolia and T. bellirica. Moreover, the habitat suitability for A. marmelos and.

P. embilica extended into the Brahmaputra valley and Northeast Hills in north-eastern India under the current climatic conditions. The existence of fossil pollen records of all target species in the habitats identified by past projections supported the model results, confirming the species' presence during the Mid-Holocene. These past projections indicated a widespread distribution of the target species during the Mid-Holocene, suggesting that they reached their broadest extent due to the warm and humid climate conditions in India



Predicted future distribution under RCP 8.5 (2070) of target species (a) Aegle marmelos (b) Buchanania lanzan (c) Madhuca longifolia (d) Phyllanthus embilica (e) Terminalia bellirica

at that time. This combined approach acts as an effective validation tool, showing a significant correlation between past predictions of the target species derived from Species Distribution Models and the fossil pollen data.

The study indicated that under the highest greenhouse gas emission scenario, RCP 8.5, projected for the year 2070, the suitable habitats for A. marmelos and T. bellirica are expected to expand. Conversely, the suitable habitats for B. lanzan, M. longifolia, and P. emblica are predicted to decline. B. lanzan is expected to experience a reduction in its extremely suitable habitat within the Western Ghats regions of Maharashtra, Karnataka, and Kerala, as well as in the Upper Gangetic Plains, Central Highlands, Eastern Plateau, and Chhota Nagpur Plateau. Similarly, for M. longifolia, the model predicts a significant decline in extremely suitable habitats in the Western Ghats regions, the Central Highlands, and the Siwalik Hills. For P. emblica, a decrease in extremely suitable habitats is anticipated in the Siwalik Hills, Western Ghats, Central Highlands, Assam Hills, and Brahmaputra Valley in north-eastern India. However, for A. marmelos, the model forecasts an increase in highly suitable habitats in the Siwalik Hills, Western Ghats of Kerala, Northeast Hills, and Brahmaputra Valley in north-eastern India. T. bellirica is projected to experience a significant expansion in highly suitable habitat, particularly in the Western Ghats, Central Highlands, North-East Hills, and Siwalik Hills. A. marmelos and T. bellirica are likely to show resilience to future climate changes, which can be attributed to their ability to endure a wide range of temperatures and precipitation variations, along with their notable resilience to drought and frost. In contrast, B. lanzan, M. longifolia, and P. emblica are highly sensitive to increased temperatures and changes in rainfall patterns predicted under future climate scenarios. Therefore, assessing the potential distribution of these critical NTFP species amidst rapid climate change is essential for formulating conservation and management strategies. This predictive method aids in pinpointing critical areas that require attention, facilitating more effective planning and resource allocation in response to climate change.

Reference: Saraf, P.N., Srivastava, J., Munoz, F. et al. How can dry tropical forests respond to climate change? Predictions for key Non-Timber Forest Product species show different trends in India. Environ Monit Assess 196, 727 (2024). https://doi.org/10.1007/s10661-024-12876-9

Kanwar wetland, Central Ganga Plain: A 15000-year climate record

Binita Phartiyal,
BSIP, Lucknow

Reference: Phartiyal et al., 2024. Quaternary Science Reviews (https://doi.org/10.1016/j.quascirev-.2024.108760)

In this study, under the Quaternary Lake Drilling Programme of BSIP, Lucknow, a vital study revealing the millennial-scale climate cycles, particularly the wetlands of the Ganga Plain, have been recorded. The mineral magnetic and textural analyses, along with chronology, distinctly record variation in the monsoon intensity since 15000 cal yrs BP in the sediment core collected from the Kanwar Lake in the Central Ganga Plain (CGP) of India. This unique high-resolution data allowed us to analyse monsoon fluctuation in the CGP with respect to changes in the North Atlantic process (internal) and external (solar cycles) forcing. During this period, several palaeoclimatic events, such as the Bølling-Allerød (B/A), Older and Younger Dryas, and the high-frequency fluctuations in the Holocene, viz., Greenlandian, Northgrippian, and Meghalayan stages, were observed. The B/A event is correlated with the Indian Summer Monsoon (ISM) intensification period of the CGP. Eleven dry events are recorded at 13600–13200, 13000–11700, 11000, 10600, 9800–9000, 8200, 6100–5300, 4300–4200,

381800–900,–900 and 300 cal yrs BP. During the Holocene, the sustained episodes of weaker monsoons centred around 10600, 9600, 8200, 6000, 4200, 2800, 1400 and 600 cal yrs BP, where the variability of the proxy data is mostly synchronous with the reduced upwelling intensity in the western Arabian Sea as well as realigned align with ~1500 years cyclic signals in the drifted ice proxy recorded Bond Events indicating weakened ISM circulation during colder North Atlantic. Two distinct short cycles, spanning 172–344 and 172–688 years, are evident around 12,000 and 14,000 cal yrs BP, with an additional occurrence from 86 to 344 years during 2000 and 6000 cal yrs BP, affirming the significance of external forcing, particularly solar activity. For the 1492-year cycle in ISM fluctuation, we postulate it may represent a combined forcing of external (solar) and internal (Atlantic Meridional Overturning Circulation) factors during the Holocene. This study provides the first high-resolution record available in the CGP, which brings out crucial monsoon reconstruction during the last 15000 years.

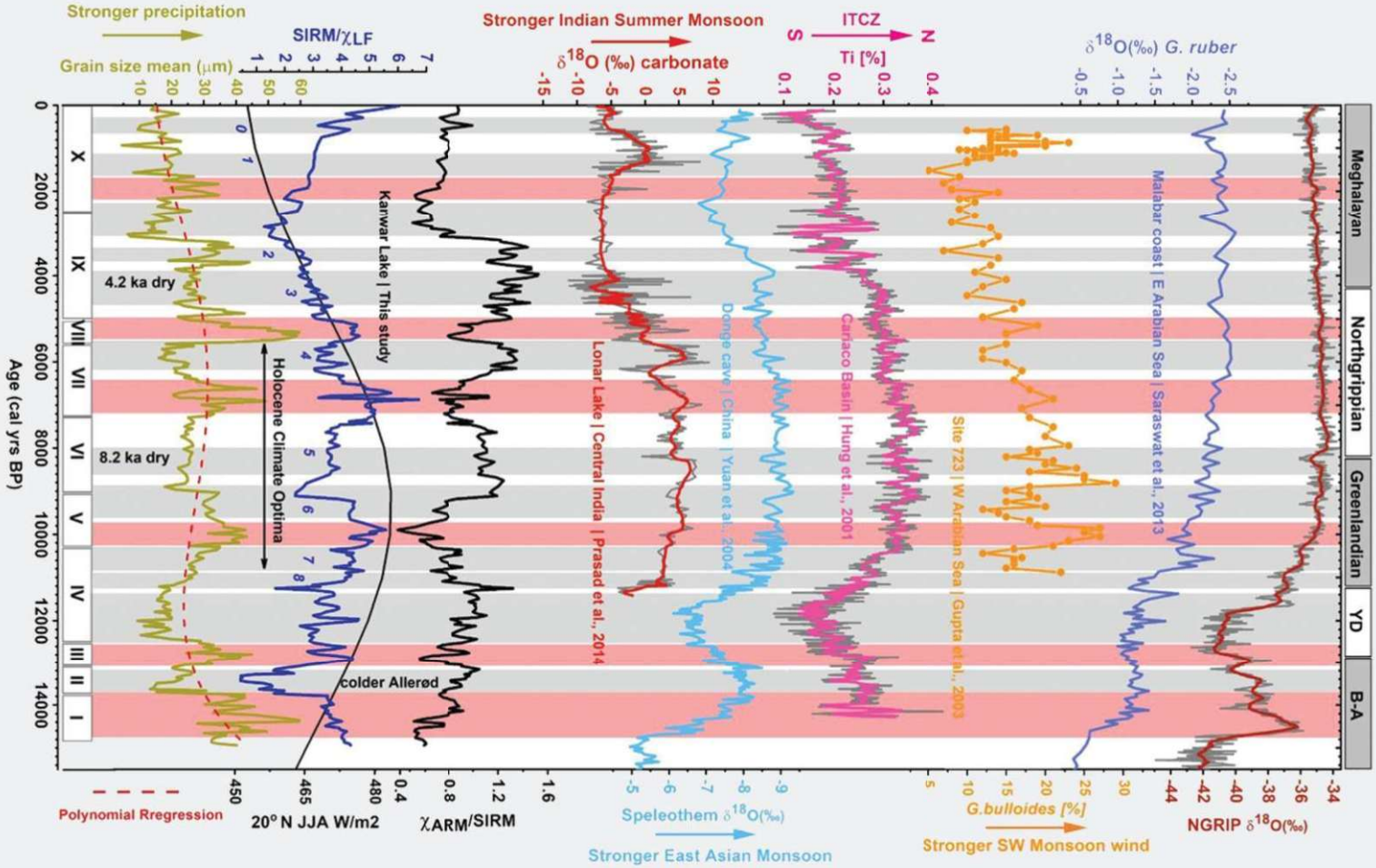


Figure: *Correlation between the record (mean grain size, SIRM/χlf and χARM/SIRM) and δ18O NGRIP (with 25-point detrended curve; brown) ice core records (NGRIP, 2004; Wolff et al., 2010), G. ruber δ18O records from the off the Malabar Coast in the eastern Arabian Sea (Saraswat et al., 2013), G. bulloides δ18O records from the western Arabian Sea (Gupta et al., 2003), Ti records (with 25 point detrended curve; pink) of the Cariaco Basin (Haug et al., 2001), Speleothem δ18O records of Dongge Cave, China (Yuan et al., 2004), δ18Ocarbonate records (with 10 points detrended curve; red) from Lona Lake, Central India (Prasad et al., 2014) and 20°N JJA insolation record (Laskar et al., 2004). The Bond events (0-8), B/A, Older Dryas, Younger Dryas, and other glacial/interglacial periods are also indicated. Major declines and increases in ISM are shaded in grey and pink, respectively.*

Figure References: *Gupta et al., 2003. Nature. 421, 354 –356; Hauget al., 2001. Science. 293, 1304–8; Laskar et al., 2004. Astron Astrophys. 428, 261–285; North Greenland Ice Core Project Members, (2004). Nature. 431, 147–151; Prasad et al., 2014. Earth Planet.Sci. Lett. 391, 171–182; Saraswat et al., 2013. Earth Planet. Sci. Lett. 375, 166–175; Wolff et al., 2010. Quat. Sci. Rev. 29, 2828–2838; Yuan et al., 2004. Science. 30, 575–578*

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Title: Holocene vegetation and climate dynamics in the cold-arid regions of Lahaul-Spiti, Northwest Himalaya

Dr. Deepika Tripathi, Wadia Institute of Himalayan Geology (PI)

Dr. Suman Lata Srivastava, Wadia Institute of Himalayan Geology (Co-PI)

Funding Agency-WISE-PDF, Department of Science and Technology (DST), Government of India.

Identifying the key variables governing vegetation and monsoon dynamics is critical for reconstructing past vegetation and climate in any region. Lacustrine and peat deposits are regarded as the most reliable archives of past climate and current sedimentation. The current work offers a high-resolution multiproxy investigation of lacustrine sediments from the Lahaul-Spiti region of the Northwestern Himalaya. The study will be beneficial to comprehend the monsoonal and vegetational fluctuations in the western Himalaya.

Title: Integrating Palaeo-data and species distribution modelling for effective conservation of mangrove forests in the face of future climate Change

Dr. Pujarini Samal,
CSIR-National Botanical Research Institute, Lucknow (PI)

Dr. Dibyendu Adhikari,
Principal Scientist, CSIR-National Botanical Research Institute, Lucknow (Co-PI)

Funding Agency: Science and Engineering Research Board (SERB-NPDF)

Mangroves serve as a protective shield for coastal biodiversity. Despite their socio-economic significance, mangrove cover has substantially reduced due to natural and anthropogenic factors demanding proactive restoration planning. To understand mangrove resilience to climate change, we must consider ecological and biological factors beyond regional climate variations. Mangroves, though limited to tropical and subtropical ecosystems, vary significantly in biodiversity, physiology, geomorphology, and responses to precipitation, temperature, and salinity. These differences require a region-specific approach. Studies in the Pichavaram mangrove forest have examined vegetation cover changes due to salinity and seasonal variability, carbon flux, and current spatio-temporal variations. Effective conservation strategies need to predict climate change impacts and prioritise potential distribution areas, incorporating soil characteristics like salinity, type, clay content, and organic carbon stock to improve predictive accuracy. Mapping potential distribution aids in evaluating carbon stock and sequestration, highlighting mangroves' role in reducing greenhouse gases. Geoinformatics and machine learning support SDMs, optimising species' reactions to global warming and enhancing conservation. However, these models often need more field validation and rely on short-term records, missing long-term paleo-ecological processes. Ignoring paleoenvironmental records can mislead policymakers. We suggest a paleo-SDM model incorporating fossil pollen records to improve future distribution modelling for the Pichavaram wetlands. Combining SDMs with paleo records offers valuable insights for forecasting vegetation dynamics and targeting proactive conservation efforts. Within the framework of impending global climate change, as a part of the national objective, the conservation and restoration of mangrove communities will aid in mitigating atmospheric greenhouse gas emissions due to their capacity to store high amounts of organic carbon within the soil compared to other plant communities.

Title: Trans-Himalayan lake dynamics as sentinels to global climate change

Dr. Priyanka Joshi,
Agharkar Research Institute, Pune (PI)

Dr. Karthick Balasubramanian, Scientist, Agharkar Research Institute, Pune (Mentor)

Funding Agency: SERB-National Post Doctoral Fellowship (N-PDF)

Mountains are a unique and consistent landscape of the globe, and owing to the glacial history of the mountainous regions, glacial lakes form ever-present features of these landscapes. The Ladakh Range, NW Trans Himalaya, is one such example and has numerous glacial lakes and palaeolakes. This region is significant because it lies in the mid-latitude Westerlies-dominated region of India. Only during an intensified ISM (Indian summer monsoon) can the ISM variance be seen in the sediment archive deposited here. Therefore, it is an excellent place to study the two precipitation regimes, which are very much responsible for the prolonged ice cover in the higher reaches of the region, thus enhancing the climate and reshaping the landscape. The glacial lakes in the region have attracted much attention as they are often situated in protected natural areas, a feature that leads to their role as sentinels of global environmental change. These lakes are very sensitive to climatic changes, offering a critical record of catchment and environmental changes, and need attention as they are very ecologically rich. Hence, this study focuses on the glacial lake biota coupled with other physical and biotic proxies to shed light on the ecological thresholds and establish the new ecological status of these high-altitude lakes.

Masud Kawsar
Birbal Sahni Institute of Palaeosciences, Lucknow
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad, Uttar Pradesh, 201002, India

Thesis title: ***The Bengal Fan Evolution Through Neogene and Quaternary: Implications for Deep Ocean Circulation, Productivity and Monsoonal Shifts***

Name of the Supervisor(s): Dr. Manoj M. C. (Birbal Sahni Institute of Palaeosciences, Lucknow, Uttar Pradesh, 226007, India) & Dr. Michael E. Weber (Institute for Geosciences, University of Bonn, 53115 Bonn, Germany)

The following thesis studies the Bengal Fan sediments deposited at two sites, namely U1451 and U1452, of the International Ocean Discovery Program (IODP) Expedition 354 in the Bay of Bengal (BoB). The high-resolution paleoceanographic reconstruction at Site U1452 demonstrates the glacial-interglacial changes in the deep-water mass geometry within the deep Northern Indian Ocean during the last 200 ka and the variable mixing proportions of ancient North Atlantic Deep Water (NADW) and Antarctic Bottom Water (AABW). Bottom water circulation in the BoB is linked to the intensity of Atlantic overturning and contributed to global cooling during the last glacial period. The thesis work also presents the only long-term evolutionary records of the deep and bottom water circulation strengths in the BoB and Northern Indian Ocean since the Mid Miocene (last 12 Ma). It discusses major controlling factors of the global deep water circulation pattern and the dominant role of interoceanic gateway closures such as the Central American

Seaways, Panama Canal, as well as north Atlantic Basin tectonics in controlling the Atlantic overturning strengths through the Neogene and Quaternary. The thesis also includes a numerical model that tells the difference between two types of shear stress: turbid and background. These types of shear stress work in the Benthic Boundary Layer (BBL), which is deep in the BoB, and have been linked to active and passive fan growth since the Late Miocene. The geochemical investigations of the lower Bengal Fan deposits since the Early Miocene (18 Ma) bring out very crucial information regarding the Himalayan erosion, exhumation, and development of Bengal Fan at the eastern part of the BoB. The reconstruction of chemical weathering intensity effectively captured the high-resolution records of South Asian Monsoon variability during the Neogene through Quaternary. Geochemical signatures point out significant changes in the provenance of terrigenous material in the Bengal Fan during the Late Miocene and also demonstrate the reorganisation of the eastern Himalayan River system during the Mid-Late Miocene. The geochemical investigation also demonstrates the long-term variability of marine productivity in terms of contemporary monsoonal and paleoceanographic conditions in the region.

Srihari Seralathan
Department of Geology, Anna University, Chennai

Thesis Title: Characterization and quantification of microplastic in various environments in and around greater Chennai and evaluation of human health risks

Supervisor: Dr. T. Subramani, Professor & Head, Department of Geology, Anna University, Chennai-600025

Microplastics are ubiquitous in a variety of environments, ranging from high mountain ranges to inland lakes, rivers, reservoirs and oceans. Hence, a co mprehensive study has been carried out on the distribution and characterisation of microplastics (shapes, colours, and polymer types) in various environments, namely surface and subsurface waters and sediments in and around Greater Chennai.

Surface water samples were collected from different lakes (44) in and around Chennai, nearshore sea water from eight locations from Mahabalipuram to Thiruvottriyur, river mouth water samples from two prominent rivers, and two representative samples from RO (Reverse Osmosis) and tap water within the city limits. Seven samples were collected to study the microplastic contaminants in subsurface waters: two samples from boreholes, three open wells, and two hand pumps.

The estimation of microplastic abundance in sediments has been studied in three environments: lake-bottom, river mouth, and foreshore sediments. Overall, the research work reveals that lakes have the highest degree of contamination of microplastics amongst the four surface water environments compared to others, recording maximum microplastic concentrations of 2436 particles altogether from 44 lakes, followed by seawater accounting for 216 particles from 8 locations and canal water, Tap and Reverse Osmosis (R0) waters accounting for less than ten particles. In subsurface waters, all samples from the three environments record less than ten particles. In sediments, the highest content of microplastics is recorded in lakes, accounting for 830 particles. The relative abundance of polymer types in lake water has highlighted Chembarambakkam to have the highest count of PE (Polyethylene), PP (Polypropylene) and PET (Polyethylene Terephthalate) when compared to the counts obtained from other lake waters. In contrast, the largest count of PVC (Poly Vinyl Chloride) was obtained from Puzhal Lake. The highest content of Polystyrene (PS) has been detected in Nandivaram Lake.

Chengalpet, Kodangi, Anai Eri, and Chetpet lakes have recorded the lowest count of all polymer types of microplastics and the lowest concentration of microplastics. Analysis of the colour-wise distribution of microplastics in all the environments has revealed the black colour to be dominant in all the environments, with lakes having the highest proportion of black-coloured microplastics.

The health risk analysis of microplastics suggests that children have a higher carcinogenic risk over time than the adult population due to prolonged consumption of water from the lakes of Chembarambakkam, Shollinganallur, Guduvanchery and Puzhal, as the calculated values of microplastic carcinogenic risk over time are > 6. In contrast, the adult population is less susceptible to carcinogenic risk.

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Harikrishnan G
Awarding University -Goa University, Goa

Title of the Thesis: *Reconstruction of Holocene ocean surface condition in Svalbard, using Diatoms*

Supervisor: *Dr Rahul Mohan, National Centre for Polar and Ocean Research, Goa*

Anthropologically induced global warming is responsible for the increase in global mean temperature, rising sea levels, oceanic temperatures and acidification of the oceans. The effect of global warming is more amplified in the Arctic region, commonly known as Arctic amplification. This phenomenon is responsible for rapidly increasing air and ocean temperatures, sea ice decline, and melting of glaciers and ice sheets in the Arctic region. However, in order to understand the changes happening in the Arctic region and predict its future trajectory and impacts, one must study the past climate conditions in order to understand the analogues in earth's climatic history to that of modern warming as well as understand how the significant components of climate system interacted with each other.

The research focuses on quantitative, high-resolution SST and sea ice reconstructions from the two fjords, Kongsfjorden and Krossfjorden, in Svalbard through Holocene Thermal Maximum (HTM) as well as the last 60 years and whether the HTM can be considered as an analogue to modern warming. In order to achieve its aims, the study uses diatom microfossils from marine sediment cores from the fjords mentioned above. In order to achieve these goals, a multi-core from Korssfjorden and a gravity core from Kongsfjorden were collected to reconstruct SST and sea ice from both these fjords. Diatom microfossil reconstructions from the Krossfjorden multicore reveal significant warming in Krossfjorden August sea sura face temperatures (aSST) between 1953-2014 CE of about 0.6 °C, as well as a steady decline in sea ice extent (SIE). Arctic water diatoms were dominant over the entire record, along with multi-decadal variations in sea ice, indicated by the Marginal ice zone (MIZ) diatoms. When coupled with increasing aSST, the record indicates prolonged open water conditions in Krossfjorden over the last 60 years. The diatom microfossils from the Kongsfjorden core reveal that the HTM (10.5 to 7.5 ka BP) in Kongsfjorden moderately indicate relative assemblage percentages, and Factor Analysis from the core indicates that, during the HTM, Arctic water diatoms dominated the HTM period followed by MIZ diatoms. The diatom-based reconstruction indicates highly variable and moderate aSST along with periods of seasonal sea ice presence. The results highlight the importance of spatiotemporal variability of HTM as well as regional influences moderating the warming of the ocean surface.

The HTM diatom assemblages and the aSST reconstructions were also compared to the diatom assemblage and aSST reconstruction from the uppermost parts of the Krossfjorden sediment core. The diatom assemblages during the HTM period in Kongsfjorden are very similar to the diatom assemblages in the modern core top of Kongsfjorden and Krossfjorden. The recent warming in the area, based on long-term observational studies as well as reconstructions, may have already reached sea surface temperatures comparable to the HTM warming. The findings of the study suggest ocean surface conditions in Kongsfjorden-Krossfjorden to be analogous to their HTM conditions. The results and observations of the study underline the fact that while modern warming in the Arctic region is an important topic of discussion, palaeoclimate studies are important to create a baseline for understanding climate change in the region.

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Sachin Srivastava,
Birbal Sahni Institute of Palaeosciences, Lucknow
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad (U.P.)

Thesis Title: *Tracing early migration of the Ahom into Northeast India using palaeogenomics and stable isotope approaches*

Supervisor: *Dr. Niraj Rai, Scientist-D, Birbal Sahni Institute of Palaeosciences (BSIP), Lucknow, Uttar Pradesh, 226007, India*
Co-Supervisor: *Dr. Maanasa Raghavan, Assistant Professor, University of Chicago, USA*

Since the upper Pleistocene, the northeastern region of India has been considered a channel contributing to modern human dispersal throughout Asia. According to various historians and geneticists, the history of Northeast India is the movement of different communities of people. One of the most documented waves of migration includes the Ahom. In this study, we used stable isotope and genetic analyses to figure out what the ancient Ahom people who were buried in a royal tomb ate and how their genes are related to those of modern-day Ahom people. The average 13C (-21.6±1.0°) and ε15N (10.6±1.7°) values from collagen show that the ancient royal Ahom people probably ate a variety of foods and mostly got their protein from plants.

The average values of δ13C and δ18O were - 12.0±1.8‰ and -6.5±0.8‰ were reflected in broader isotopic values of the Ganga-Brahmaputra basin, Tibet, and Myanmar. Different types of ancient Ahom maternal ancestry, such as mitochondrial haplogroups A21, M30, B5a1, and F1b1*, suggest that they may have come from East or South East Asia. Still, it is also possible that they mixed with people who already lived in North East India after they moved there. However, one individual's paternal ancestry (Y Chromosome haplogroup O1a1**) suggests paternal origins in Southeast Asia and East Asia.*

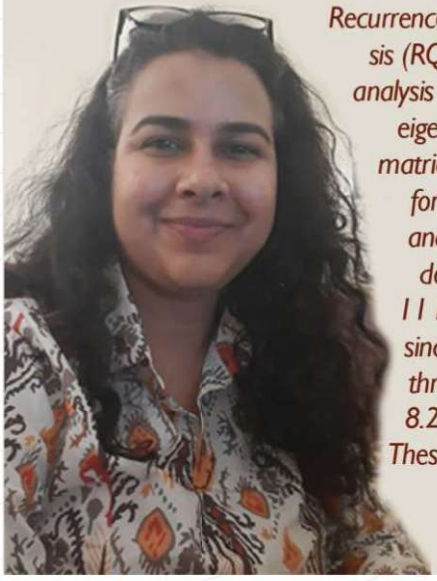
The autosomal genetic ancestry of ancient Ahom is from Southeast Asia and East Asia. On the other hand, modern-day Ahom has a mix ofgenetic ancestries from local communities of Indian Tibeto - Burman populations.

Priyanka Singh,
Birbal Sahni Institute of Palaeosciences, Lucknow
Academy of Scientific and Innovative Research (AcSIR), Ghaziabad (U.P.)

Thesis title: *High-resolution Late Quaternary Climate Reconstruction from Higher Himalaya: A Multi-proxy Approach*

Supervisors: *P. Morthekai (BSIP, Lucknow) and Prof. Kuldeep Prakash (BHU, Varanasi)*

A high-resolution (@ 1 cm) palaeoclimate was reconstructed using a 4 m proglacial palaeolake in Kunti Banar River valley (near Kalla Glacier) in the Higher Himalaya, influenced by both ISM and Western Disturbance (WD). Luminescence ages (fine grain polymineral) suggest the age of the lake was 16 kyr, whereas radiocarbon ages (bulk sediment organic carbon) showed a systematic offset. This overestimation was explained by the presence of petrogenic organic carbon (OCpetro = 0.06%) in the sediments in graphite form and the buried 2.5 Gg OCpetro at 160 kg OCpetro.yr-1. This study suggests not relying on bulk 14C ages in this region, where TOC is low. To figure out the paleoclimate over the last 16 kyr, stable carbon isotope composition (ε13C), environmental magnetism variables, end member modelled grain size, n-alkane data, and geochemical proxies were used. Constrained linear ordination analyses suggested that climate variability was primarily controlled by hydrological conditions (rainwater, snow, and/or glacial meltwater) in the catchment area and temperature to some extent. In addition, a patchy long-term palaeoclimate was reconstructed using moraines formed between 16 - 17 kyr, 21 - 26 kyr, and 41 - 81 kyr.



Recurrence quantification analysis (RQA), recurrent network analysis (RNA), and Laplacian eigenmaps for recurrence matrices (LERM) were performed to delineate WD and ISM. WD was found dominant during 12.5–11 kyr (YD), 9–7 kyr, and since~ 4 kyr. There were three climatic transitions: 8.2 kyr, 4.2 kyr, &2.3 kyr. These time-series analyses could delineate two climate systems.

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Hidayatullah,
Birbal Sahni Institute of Palaeosciences, Lucknow.

Academy of Scientific and Innovative Research (AcSIR), Ghaziabad (U.P.)

Thesis Title:
Reconstruction of palaeoceanography of the Western Tropical Indian Ocean during the Late Quaternary

Supervisor:
Dr. Pawan Govil, BSIP, Lucknow
Co-supervisor:
Dr. Rajani Panchang, Department of Environmental Science, Savitribai Phule Pune University

The present study aims to understand the variations in the past monsoon, palaeoproductivity patterns, upper ocean water column stratification, and thermal structure in the western tropical Indian Ocean (Western Arabian Sea and near the coast of Mozambique Channel) since the Late Quaternary. A multiproxy analysis was carried out on two marine sediment cores (VM3504-PC and 47-PC), studying relative abundance of planktonic foraminifera, total organic matter (TOC), δ13Corg, CaCO3 percentage (wt%), stable oxygen (δ18OG. ruber and δ18ON. dutertrei) and carbon (δ13CG. ruber) isotopes of foraminifera. The chronology of both the cores was established using radiocarbon 14C dates (five from each core) and tie points (nine from VM3504-PC and 47-PC) between δ 18OG.ruber and global stack LR04. The study covers a period of ~172 kyr BP and ~196.6 kyr BP from the core VM3504-PC and 47-PC, respectively.

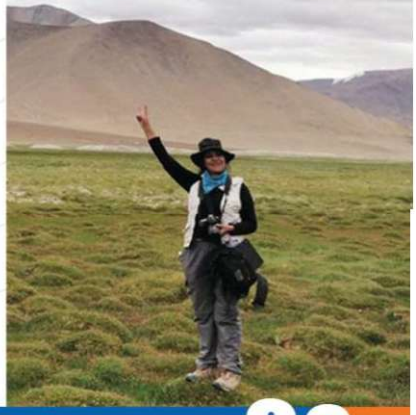
The results from the Western Arabian Sea show glacial signs of a warming signal based on the lighter δ18OG. ruber, increased relative abundance of eutrophic species, and the concomitant decrease in the relative abundance of oligotrophic species during mid-MIS 4. Interestingly, this study also reports relatively stronger Atlantic Meridional Overturning Circulation (AMOC) and monsoonal wind strengthening during Heinrich Events H6 and H4, marked by higher productivity and enhanced organic matter preservation attributable to poor ventilation of intermediate water masses (AAIW/SAMW) and upper thermocline in the Western Arabian Sea.

Assemblages and oxygen isotope studies in the core from the Mozambique Channel highlight the presence of a Pulleniatina Maximum Event (PME) recorded during the mid-Holocene (8 to 5 kyr BP). It may be correlated with a negative IOD-like mean state and La Niña event, which strengthens the ITF (Indonesian Throughflow) volume transport near the coast of the Mozambique Channel. The highest productivity was recorded in the lower to upper thermocline, which could be because of the vertical mixing of different water masses and northward migration of the Southern Hemisphere Frontal System, as indicated by increased relative abundance of eutrophic species during glacial (MIS 4 & 2) and stadial periods (MIS 5d & 5b).
The δ13Corg value in both core locations (VM3504-PC and 47-PC) suggests that there existed mixed sources of organic matter, such as marine phytoplankton and input of terrestrially derived organic matter through the aeolian process from nearby continents.

D.Sc. Awarded

Dr. Binita Phartiyal *was awarded the Doctor of Science (D.Sc.) Degree in Geology at Kumaun University in May 2024.*

She is the first D.Sc. from the Geology Department at Kumaun University. She worked on Late Quaternary Sedimentation in the Ladakh Region, Trans-Himalaya: Implications on Climate and Tectonics.



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REPORTS

India Hosted the 46th ATCM and 26th CEP Meeting: A Landmark Global Event in Antarctic Governance.

Forty-sixth Antarctic Treaty Consultative Meeting: Twenty-sixth Meeting of the Committee for Environmental Protection, Kochi, India, May 20–30, 2024.

India successfully hosted the 46th Antarctic Treaty Consultative Meeting (ATCM-46) and the 26th Committee for Environmental Protection (CEP-26) from May 20 to 30, 2024, in Kochi, Kerala. The Ministry of Earth Sciences organised it through the National Centre for Polar and Ocean Research (NCPOR). The ATCM46 and CEP26 served as a crucial forum for the international community to engage in dialogue and forge partnerships aimed at protecting the Antarctic's unique environment and its global significance. For Antarctica, this meeting holds unparalleled significance as it shapes the rules and procedures governing activities on the continent. The 46th Antarctic Treaty Consultative Meeting was held with the overarching theme of "Vasudhaiva Kutumbakam," a Sanskrit phrase that means one Earth, one family, and one future. This idea resonates deeply with the Antarctic Treaty System – promoting peace, scientific cooperation, and preservation of Antarctica for humankind.

The meetings included in-person and virtual attendance of over 400 delegates, of which 328 attended in-person and 76 virtually from 56 countries. The ATCM-46 was inaugurated by the Honourable Union Cabinet Minister, Shri Kiren Rijiju, alongside Ambassador Pavan Kapoor, Secretary (West) of the Ministry of External Affairs, and Dr. Shailesh Nayak, former Secretary of the Government of India, MoES. They emphasised India's commitment to the Antarctic treaty, scientific research, climate change studies, and international cooperation. Shri Kiren Rijiju expressed India's honour to host the 46th ATCM and contribute to the global dialogue on peace, science, and environmental stewardship in Antarctica for preserving the most pristine wilderness on the planet. Ambassador Pavan Kapoor expressed the need to advance scientific knowledge to find solutions to climate change and global warming, focused on polar ecosystems and India's readiness to collaborate in Antarctic affairs. Dr. Shailesh Nayak discussed three major climate-change issues pertaining to Antarctica: polar ice melting and sea level rise, regional warming and ocean acidification.

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for preserving the most pristine wilderness on the planet. Ambassador Pavan Kapoor expressed the need to advance scientific knowledge to find solutions to climate change and global warming, focused on polar ecosystems and India's readiness to collaborate in Antarctic affairs. Dr. Shailesh Nayak discussed three major climate-change issues pertaining to Antarctica: polar ice melting and sea level rise, regional warming and ocean acidification.

Ambassador Pankaj Saran, the former Deputy Adviser to the National Security Board, chaired the ATCM, while Dr. Anoop Tiwari and Dr. Heike Herata chaired the CEP meeting. Dr Vijay Kumar acted as the Head of the Host Country Secretariat (HCS), and Dr Rahul Mohan was the Deputy Head of the HCS. Dr. M. Ravichandran, Secretary to the Government of India, MoES and Head of the Indian delegation (host country), informed us that India will soon be submitting comprehensive environmental evaluations to establish Maitri-II. He said, "The successful hosting of the 46th ATCM and 26th CEP in India underscores our collective resolve to safeguard Antarctica's unique ecosystems and promote global environmental sustainability. Through dialogue, cooperation, and concerted action, we can ensure that Antarctica remains a beacon of peace, science, and environmental protection for generations to come."

India submitted 04 Working Papers (WPs) and 15 Information Papers (IPs) for the ATCM and CEP meetings. During the meeting, WPs require discussion and action by the parties, while IPs support information or context outlined in the WPs and do not necessarily need discussion or action. Key discussions at the ATCM covered the Antarctic Treaty System's operation, liability, biological prospecting, information exchange, education, strategic work plans, safety, inspections, science challenges, cooperation, climate change impacts, and tourism management. The Parties emphasised the importance of education and outreach activities as an essential element of cooperation enshrined in the Antarctic Treaty and the Environmental Protocol. A significant outcome was the adoption of a decision on development of an ambitious, comprehensive, flexible and dynamic framework for regulating tourism and non-governmental activities in Antarctica. Parties also discussed consultative status requests from Canada and Belarus, but no consensus was reached.

The CEP meeting addressed a range of issues and contributed to the implementation of the Environmental Protocol in Antarctica. The Committee agreed to prioritise further work on the management implications of sea ice change, enhancing environmental impact assessment of major activities, protecting the emperor penguin, and developing an international framework for environmental monitoring in Antarctica. Following the advice of the CEP, the Parties adopted 17 revised and new management plans for ASPAs (Antarctic Specially Protected Areas) and several modifications /additions to the list of Historic and Monument Sites (HSMs). The ATCM also encouraged efforts to increase renewable energy use and to ensure robust implementation of biosecurity measures to minimise the risks of Highly Pathogenic Avian Influenza (HPAI).

The HCS, through the NCPOR, conducted several side events to mark the ATCM-46 and CEP-26. A seminar was organised entitled 'Changing Antarctic and Challenges Ahead' jointly with the Korean Polar Research Institute and Polar Cooperation Research Centre, Kobe University, on May 20, 2024, comprising of two panel discussions

themed 'Challenges in Antarctic governance' and 'Shared responsibilities and commitments for Antarctic future'. A specially customised MyStamp with the ATCM-46 logo was released in collaboration with India Post. On the occasion of the ATCM-46, the Antarctic and Southern Ocean Coalition (ASOC) and Environmental Action Germany teamed up with the NCPOR to organise a youth program called "Species-rich Antarctica". The program consisted of a workshop about Antarctic biodiversity that was both scientific and creative and aimed at enhancing awareness of Antarctica. A terracotta mural created by children was unveiled during the event. As a part of the outreach event, NCPOR organised a panel discussion titled 'Antarctic Synergy: Driving Scientific Progress through Diplomacy, fostering Cooperation through Research' moderated by Dr. Rahul Mohan, Scientist F and Group Director Polar Sciences, NCPOR. The panel discussion featured experts from India, Norway, France, and Germany, engaging around 60 students from three colleges and universities from Kochi, Kerala. The program also included an exhibition on India's Antarctic contributions, a photo gallery titled "Echoes of Antarctica," and a virtual reality tour to Antarctica, which was a significant attraction for delegates.

During ATCM, a Memorandum of Understanding (MoU) was signed between NCPOR, India and Norwegian Polar Institute, Norway, to boost cooperation in Polar Sciences and Operations. This partnership aims to foster collaboration on vital research topics, advancing our understanding of the polar region. The event concluded with the parties expressing gratitude to India for its hospitality and successful organisation. On successfully hosting ATCM, Dr. Thamban Meloth, Director, NCPOR, said, "Our active and strategic participation in Antarctic affairs, India's polar programme and its role as host showcased our dedication to fostering global partnerships and advancing the cause of environmental conservation on a global stage".

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2nd IQC, at IISER Mohali, 3-6 June 2024

Total number of participants: 127
Keynote Speakers: 4
Expert lecture: 1
Oral Presentation: 75
Poster presentation: 46

Financial Assistance from IISER Mohali; MoES, New Delhi; SERB, New Delhi; BSIP, Lucknow; and AOQR is acknowledged.

Convener: Dr. Anoop Ambili, IISER, Mohali

The 2nd Indian Quaternary Congress conference titled "Quaternary Sciences for A Sustainable Future Earth (Q-SAFE)" was organised at the Indian Institute of Science Education and Research (IISER) Mohali from June 2–6, 2024. This conference was funded by the Indian Institute of Science Education and Research Mohali, the Ministry of Earth Sciences, the Birbal Sahni Institute of Palaeosciences, the Science and Engineering Research Board (SERB), and the Association of Quaternary Researchers (AOQR). This conference provided a unique platform for young scientists to share their fresh and innovative ideas, learn from leading experts, share their research, and build a network to support their academic and professional journeys. This conference addressed the burning issues of climate change around the world, and its impacts on the Indian subcontinent were covered, with a particular emphasis on the interactions between land-use dynamics, cultural changes, and climate change. The long-term climate reconstruction efforts, seeking to unravel the complex interactions between environmental changes, human activities, and ecosystem dynamics, were also explored. By adopting a multidisciplinary approach that integrates climate modelling, paleoclimate reconstructions, and historical analysis, the event aimed to enhance our understanding of Quaternary science and provide valuable insights into the long-term effects of climate change on human societies. The discussed insights were beneficial for shaping adaptive strategies, policy interventions, and sustainable development initiatives that can mitigate the adverse impacts of climate change and enhance resilience in vulnerable communities. After the conclusion of the talks and breakout sessions, several early-career scientists at IISER Mohali led tours through their laboratories, and fieldwork was also conducted in and around Kalka, Pinjaur Dun, Kiratpur alluvial fan, Jhajjar Thrust, and Pinjaur Garden Fault.

Milestones achieved by the conference are:

1. Advance Knowledge in Quaternary Science: Through climate modelling, paleoclimate reconstructions, and historical analysis, the conference aimed to deepen the understanding of the long-term climate dynamics of the Indian subcontinent.

2.Foster Interdisciplinary Collaboration: This conference offered the chance to bring specialists from various sectors together to close knowledge gaps and advance a thorough discussion on climate change and its effects.
3.Inform Policy and Adaptive Strategies: The conference provided crucial insights for policymakers and stakeholders, aiding in the development of effective strategies to combat climate change and promote sustainability.
4.Enhance Public Understanding: Public lectures and exhibitions were open to the general public to increase awareness and understanding of climate science and its implications.

The conference explored five major themes within Quaternary science, covering both terrestrial and marine environments:

1.Terrestrial Processes through the Quaternary: This theme investigated land-based environmental changes and their impacts.
2. Oceanic Realms in the Quaternary: Investigating changes in marine environments and their broader implications.
3. Human-Climate Interaction: Understanding how climate change has historically influenced human societies and vice versa.
4. High Altitudinal Zones in the Quaternary: Studying climate and environmental changes in mountainous regions.
5. Indian Subcontinent: Last Two Thousand Years: Focusing on recent climatic events and their effects on the region.
Subthemes and Research Focus:

Each theme was further divided into various subthemes, offering a platform for detailed discussions on Quaternary Science's latest research methodologies and findings.

Plenary Talks: This session featured leading experts who provided comprehensive overviews of key topics in Quaternary. These talks were typically held in a main hall or central location during conferences, and attendees were offered the opportunity to hear from distinguished professionals in the field.

Invited Talks: These talks, delivered by esteemed scientists and researchers, have significantly enriched our knowledge and provided valuable insights into Earth and Environmental Sciences advancements.
1. Quaternary Sciences in India: Reminiscing Past Developments and Anticipating Emerging Challenges

Prof. A. K. Singhvi, Honorary Scientist, Physical Research Laboratory, Navrangpura, Ahmedabad, Gujarat
2. Application of Omics in Earth Sciences
Dr. Pradeep Srivastava, Department of Earth Sciences, Indian Institute of Technology, Roorkee, Uttarakhand.
3. The Anthropocene Sans Boundaries: Possible Links with Sustainability (A Perspective)
Prof. Sampat K. Tandon, Adjunct Professor, Department of Earth and Environmental Sciences, Indian Institute of Science Education and Research, Bhopal, Madhya Pradesh
4. Genomic Lens to Discover Who We Are: Role of Ancient DNA in Archaeology
Padma Shri, Prof. R. N. K. Bamezai, Former Professor and Dean, School of Life Sciences; and School of Computational and Integrative Sciences, JNU, New Delhi

Participant Presentations: In this session, participants shared their research findings and learned in depth from renowned scientists.
Poster Presentation: This session was designed for early-career researchers and post-graduate students to quickly convey their work and get some insights from experts working in different fields
Audience and Participation: The conference targeted a diverse audience, including scientists, early-career researchers, postdocs, PhDs, and Master's students across India. Public lectures and exhibitions will be accessible to everyone, aiming to elevate public understanding of climate science.
Impact and Future Directions: By fostering interdisciplinary collaboration and advancing knowledge in Quaternary science, the conference aims to significantly contribute to addressing the challenges posed by climate change in the

Anthropocene period. The insights gained will be crucial for building a more sustainable and resilient future for the Indian subcontinent and beyond. The organised conference promised to be a landmark event in the climate science field, offering a comprehensive platform for researchers to exchange knowledge, share expertise, and collaborate in tackling some of our time's most pressing environmental challenges.

Report compiled By: Anoop Ambili

The Annual General Body Meeting of the Association of Quaternary Researchers-2024

Compiled by Binita Phartiyal, BSIP, Lucknow

The Annual General Body Meeting was held on June 5, 2024, at IISER, Mohali, in a hybrid mode. The meeting was conducted in the concluding session of the 2nd India Quaternary Congress (IQC) at IISER Mohali. Dr. Vandana Prasad, AOQR President, presided over the function, and Dr. Pradeep Srivastava, AOQR Vice-President, convened the meeting. Participants of the IQC, including 42 AOQR members, attended the meeting both offline and online. As per the agenda, Dr. Vandana Prasad talked in her welcome address about how the 2nd IQC, constituted under the umbrella of AOQR, is well-organised and has brought together young and senior researchers of myriad disciplines included in the Quaternary. Dr. Binita Phartiyal, AOQR Secretary, presented an online brief on how the failed IN-QUA-INDIA bid in 2019 successfully brought together Indian researchers under the AOQR umbrella and the AOQR activities in the years since. She also briefed the non-AOQR members present in the IQC about the AOQR structure and the Governing Body (GB). Dr. Phartiyal further elaborated that the first IQC, online due to the pandemic, had participation from more than 250 people. Different groups from IITM, BSIP, and NIO arranged multiple training schools under AOQR to expose students and researchers to newer techniques, such as sampling, analysis, and interpretation. The AOQR publication, Quaternary Chronicles newsletter, which covers research news, facilities, ideas, and short summaries in 300–500 words with 15 published volumes, was mentioned, and future contributions were invited.

Prof. S. K. Tandon appreciated the quality of research from young researchers and the novel ideas coming up. Prof. S. K. Tandon also mentioned that IGC was first hosted in India in 1964. It was only the second time here in 2020 that we had to convert to online due to the pandemic. So, INQUA-2027 is an excellent opportunity to showcase Indian research to the world. Working together with Indian researchers is a challenging but rewarding experience. He opined that 2027 will soon come knocking, and a lot is to be done to make it a great show.

The house paid homage to the members, Prof. R.K. Pant and Prof. B.S. Kotlia, who had left us the heavenly abode in the last year. All the members and participants remembered these icons of Quaternary Science and kept a two-minute silence as an expression of remembrance for the departed souls. Members gave ideas for further work under the AOQR banner and discussed membership issues and the forthcoming INQUA 2027. An expression of interest in holding the 3rd IQC in the year 2026 was received from Dr. Naveen Gandhi, IITM, Pune. Dr. Gandhi detailed the proposal to the House, which was unanimously agreed upon. The meeting ended with a vote of thanks to the Chair.

Pre-INQUA Activities: Starting from September 2024 onwards

Online Bimonthly Lecture Series-Around the Theme of INQUA 2027: Quaternary Science as Societal Services, 1st & 3rd Saturday of each month

INQUA India Podcast

We will be publishing a podcast with the hope of spreading awareness among common man as to what is Quaternary, how humans evolved and what role did the climate of various regions play in geological conditions and human existence in the Indian subcontinent…..and several such interesting topics and stories. This will be a part of the INQUA India outreach activity.

National Training on "PALAEO Archives and proxies" at IITM Pune, November 25–29, 2024.

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AOQR ASSOCIATION OF QUATERNARY RESEARCHERS

Conference on Integrated Earth 2024 (CITE-2024)

...celebrate science and share knowledge

IISER PUNE

A National Conference organized by IISER-Pune September 1 – 2, 2024

Earth is an open thermodynamic system where its constitutive spheres, viz Atmosphere, Biosphere, Cryosphere, Geosphere, and Hydrosphere, exchange mass and energy across spatiotemporal scales, ultimately providing habitable conditions. Understanding these spheres individually and their coupling not only in the present but throughout geological history is a prerequisite to make informed decisions for sustainable utilization of the earth resources and potentially understanding other planets in our solar system and beyond.

Understanding the Earth system demands an integrated approach where multi-disciplinary, multi-scale data and processes are understood. With this philosophy, the Department of Earth and Climate Science (ECS) IISER Pune started in 2014 and is completing its 10 years. To celebrate this journey, ECS is organising a national conference CITE-2024 from 1st to 2nd September 2024, providing a platform to explore and discuss the different aspects of Earth system.

Conveners:-
Ajay Kumar & M. Ismaiel

Organizing committee:-
Anish Patil, Argha Banerjee, Joy Merwin Monteiro, Krishnanand, Medha Murti, Ruby Soni, Shreyas Managave, Shuvashree Maity, Vibhas Shevde, Vaibhav Pachaulee

For more information contact:-
ecsevents@iiserpune.ac.in

We invite contributions from researchers across disciplines for oral and poster presentations at **CITE-2024** under the following broad themes.

Themes:

- ✓ **Weather and Climate**
  Glaciology, Tropical Meteorology Climate modelling, Extreme Events, Hydrology
- ✓ **Earth Surface Processes**
  Tectonic Geomorphology, Weathering and erosion, River & ocean chemistry, Atmosphere chemistry, Natural Hazards
- ✓ **Earth Structure and its Evolution**
  Geophysics, Seismology, Geodynamics, Mineralogy & Petrology, Tectonics
- ✓ **Paleoenvironment and Paleoclimatic Evolution**
  Paleoclimatic reconstruction, Paleontology, Paleoecology & Biodiversity, Sedimentary basin analysis

To submit your Abstract please scan the QR code or visit following link
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Venue:-
Earth and Climate Science,
Indian Institute of Science Education and Research – Pune, Maharashtra, 411 008

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To join QuatChron_AOQR Google Group:

Open https:// groups.google.com, login (using Gmail account), search for "QuatChron_AOQR" and ask to join.]

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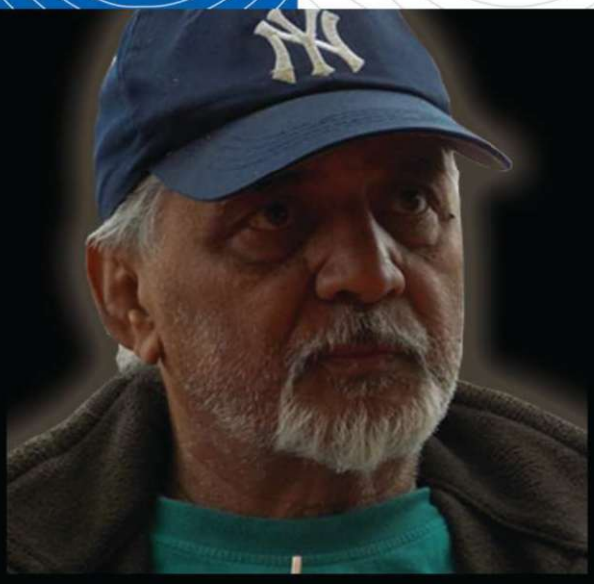
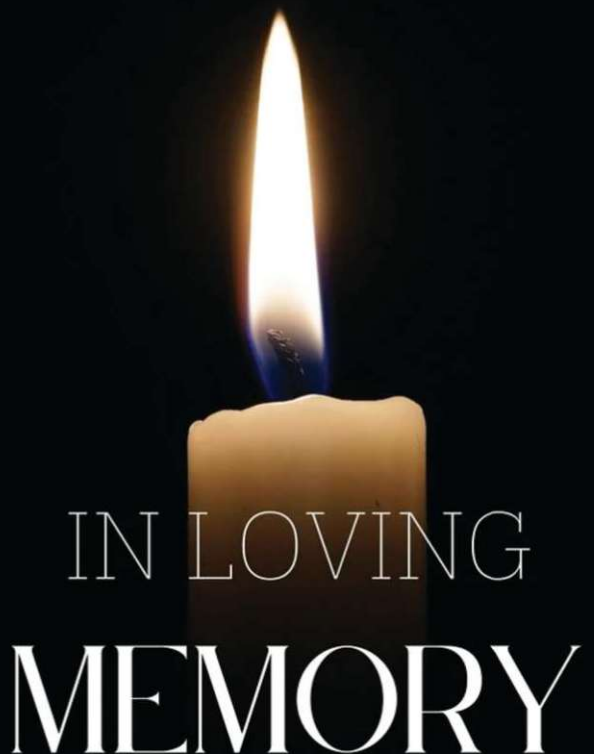


Dr. Rajendra Kumar Pant
(1934 - 2024)



Dr. R. K. Pant, a renowned Quaternary Scientist at the Physical Research Laboratory, Ahmedabad, passed away on May 4, 2024, in Pune due to health issues. He was born on April 1, 1934, in the Kumaoni Brahmin family of Nainital, Uttarakhand. He earned a Master's in Archaeology from Banaras Hindu University in 1959 and a Post Graduate Diploma in Archaeology from the School of Archaeology, Delhi, in 1962. He joined the Archaeological Survey of India in 1962 and discovered the megalithic and neolithic sites in Kashmir. The subject of archaeology got a tremendous boost from the discovery of carbon-14, which opened up new possibilities for archaeologists to place their observations within a definite time frame through radiocarbon dating. Dr. Pant had the foresight to seize the new opportunity, and he joined the Radiocarbon Laboratory of PRL in 1973. He immediately grasped the essence of the technique and dated numerous archaeological deposits. He also had a great interest in the development of the human brain and wanted to know how early humans learned to make tools. He spent two years working on this research project, which resulted in him receiving a PhD from BHU in 1976 for showing how early humans might have made their tools. Later, he went to France, where he received a second Ph.D. in Quaternary Geology from Marseilles, France, in 1979. Dr. Pant was the first person to propose the study of paleoclimate based on the sediments of the residual lake in Kashmir, locally called Karewas. He travelled extensively and is probably the only person who has seen almost all the Loess profiles across the globe. He, along with Bronger and Singhvi, could establish Pleistocene climatic changes and landscape evolution in the Kashmir basin. Dr. Pant was a sincere field geologist who believed in precise field mapping of Quaternary landforms and deposits to reconstruct Quaternary sedimentation history and landscape evolution. He suffered a heart attack while in the field in Kashmir, Himalaya, but it did not deter him, and he continued the fieldwork. In central Himalaya, he and Navin worked on snow line subsidence by exploring moraines, calculated changes in the equilibrium line elevation in the past, and converted them into paleo-temperature changes. They could also establish the monsoon variability during the last 20 ka in the Central Kumaun Himalaya.

Dr. Pant apprehended the scope and importance of the exposed Quaternary successions of central Gujarat and the Saurashtra peninsula. He started investigations on exposed Quaternary successions in central Gujarat in the mid-1980s. He wrote a landmark paper on the sedimentation pattern and process of terrain evolution during the Middle Pleistocene in the Mahi River basin. Together, we took several traverses in the major river basins of Gujarat and identified a number of significant sites for detailed Quaternary continental studies. All later workers in this area owe him a lot, as he initially identified the sites on which they worked and got recognition. Dr. Pant's death is a great loss to the Quaternary Geology Fraternity and a personal loss to me. I took my first lesson from Dr. Pant on the significance of Quaternary deposits in the Mahi River basin in 1984. Dr. Pant wrote several research papers in the most reputed national and international journals and guided several students. He will be remembered for his contributions to the Quaternary geology of Himalaya and Gujarat and will always be affectionately remembered by fellow Quaternary scientists. Always smiling and keen on research work, Dr. Pant was dear to all of us. He is survived by his wife, Mrs. Vimla Pant, a retired teacher and a great human being, two engineer sons (Amitabh and Amit), two daughters-in-law, and their children. Wish him farewell on his journey to eternity.

- L. S. Chamyal, Vadodara

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ASSOCIATION OF QUATERNARY RESEARCHERS

IN MEMORY OF

Prof. Edward Derbyshire
(1932-2024)

It is with a deep sense of sadness and with a sense of personal loss that I share news of the demise of Prof. Edward Derbyshire (Former Secretary General of INQUA, Emeritus Professor of Physical Geography, University of Leicester, UK; Visiting Research Prof., Quaternary Science, Royal Holloway, University of London, UK; Hon. Res. Prof. Geol. Hazards Institute, Gansu Acad. Sciences, Lanzhou). His wife and collaborator, Maryon Derbyshire, and their three sons survived him; he passed away on July 9, 2024, in Cheltenham, United Kingdom. Prof. Derbyshire was a Quaternary scientist acclaimed for basic science and for his stewardship of several societally relevant international programs, including the IGCP and the International Year of Planet Earth (IYPE), all of which encompass the themes INQUA espouses.

SCIENCE AND CAREER: Edward Derbyshire began his career as a lecturer at the University of New South Wales in Australia, followed by a lectureship at Monash University in Melbourne. His initial research was in Tasmania and the Antarctic. He joined his Alma Matar, the University of Keele in the U.K., in 1967. Shortly after that, Edward Derbyshire began his foray into Chinese-European collaboration in glacial and aeolian research, which was greatly boosted by his inclusion in 1977 as a member of the first Royal Society visit to China in 1976. He was a known expert in Loess deposits and aspects of global dust. One of his seminal contributions was to understand the extent of Ice Cover over Tibet. Prof. Derbyshire used geological evidence to test the extent of the Last Glacial ice cover (LGM) in the highlands of China and the Tibetan Plateau at a time when massive debris flows in China were widely assumed and erroneously assumed to be glacial till. The presence of an ice sheet covering the whole of the Tibetan Plateau in the LGM was a contentious issue within and outside of China for more than a century. Prof. Derbyshire's work set the debate to rest by showing it to be discontinuous, e.g. Derbyshire, E. et al. (1991) Quaternary glaciation of Tibet: the geological evidence. Quaternary Sci. Rev., 10: 485–510.

This recognition led to his working at the Institute of Glaciology and Cryopedology of the Chinese Academy of Sciences, together with Lanzhou University, China, on the sedimentology and stratigraphy of the thickest known loess on Earth. His work provided some of the most important publications on the Chinese loess and served to inspire and drive multiple directions in future loess research. He comprehensively dealt with bulk properties, their stability, and the behaviour of loess across the land hemisphere, which were widely cited. During the mid-nineties, Prof. Derbyshire helped Prof. Ludwig Zoeller initiate a Loessfest, a series of meetings, and these continued to facilitate the exchange of ideas and research results effectively. This group held ED@80, an international conference on loess research in China and Europe, as a "Tribute to Edward Derbyshire for his pioneering promotion

of international research for close to four decades. The conference was held in Novi Sad, Serbia, near the famed site of Dolin Vestonice in September 2012. As a natural extension of his work on loess (wind-blown silt), he wanted to understand the impact of airborne mineral dust on human health. Working with thoracic specialists in hospitals in China and Europe, his initial article on the quality, composition, distribution, and bulk properties of loess and global silt and its profound societal relevance opened a new dimension to his research. His work grew and culminated in three outstanding books: Selinus et al. (2005), Essentials of Medical Geology (awarded three prestigious awards, including the commendation of the British Medical Association), Plant, J.A., et al. (2012), Pollutants, human health, and the environment: a risk-based approach, and Selinus, O., et al. (2013), Essentials of Medical Geology. With Olle Selinus and Peter Bobrowsky as co-leaders, he led IGCP 454 on Medical Geology from 2000 to 2004. He authored close to 300 research papers and edited close to a dozen books.

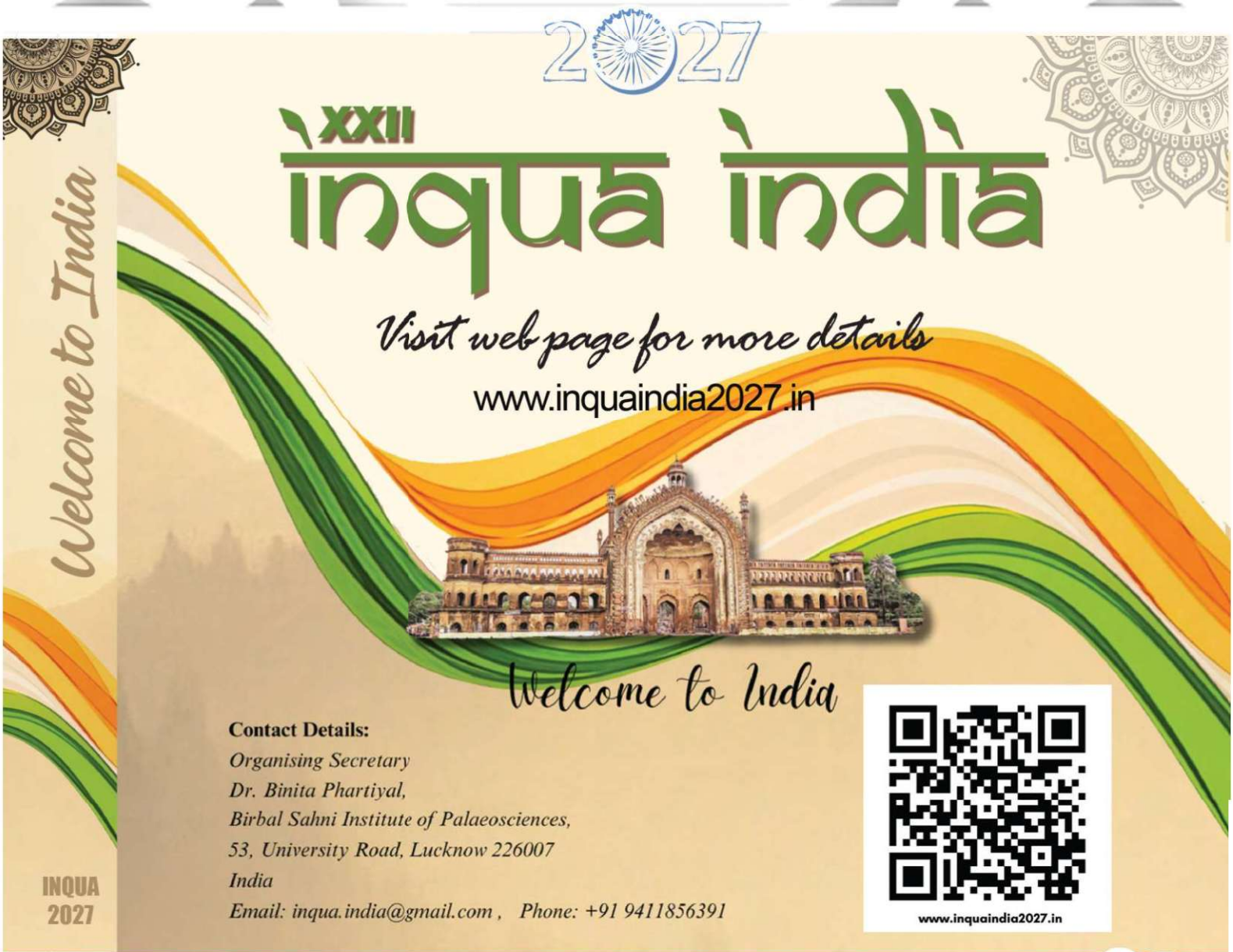
SERVICE TO THE COMMUNITY: Prof. Derbyshire was the Secretary-General of INQUA from 1991 to 1995, during a time when INQUA was still an affiliated body of the IUGS. In order to give this office the attention that it deserved, he made the rare decision to retire early from Leicester University at the age of 58. He joined IGCP 252 on Past and Future Evolution of Deserts: 1987–1991. Prof. Nicole Petit-Maire led this, and he served as the U.K. national correspondent. The final meeting of this IGCP was held at PRL, Ahmedabad, and gave me the opportunity to meet Prof. Derbyshire in person. As a follow-up to the PRL meeting, he, along with myself and An ZhiSheng (Xi'an, China), developed IGCP 349 on Desert Margins and Palaeomonsoons since 135 ky BP: 1993–1997. This development was followed by IGCP 413 by D.S.G. Thomas and A.K. Singhvi on Understanding Future Dryland Changes from Past Dynamics: Linkages Between Fluvial, Lacustrine, and Aeolian Systems. IGCP-349 was consistently rated as excellent and attracted over 300 scientists from around the world. A key element of IGCP 349 was the emphasis on human resource development, particularly in the developing world, with training programs through several special issues of journals, the outcomes of several annual meetings, and an acclaimed book on Methods for Paleoenvironmental Research in Drylands, which we both co-edited. He served as a member of the IGCP's Scientific Board in 1995 and as its chairman from 1996 to 2001, the longest tenure ever for an IGCP chair. Also, during the 1990s, he actively contributed to the IUGS Commission on Environmental Management (COGEOENVIRONMENT) as a member of the Medical Geology Working Group. In early 2000, Edward Derbyshire collaborated with medical scientists, including clinicians, toxicologists, and epidemiologists, in research on various aspects of dust as a health hazard. As a member of the External Relations Committee of the Geological Society of London, he proactively worked with the Association of Geoscientists for Integrated Development and the International Consortium on Landslides, all with a view to promoting the geosciences for societal well-being. Prof. Derbyshire steered a co-initiative by IUGS and UNESCO, namely the UN-International Year of Planet Earth. He chaired the Science Program Committee of the 'Year', comprising a panel of 21 distinguished scientists called to establish the 8 (but ultimately 10) scientific themes of extreme importance and relevance to human society. I had the privilege of working with him on this committee, and it was an education to see him develop convergence in a room full of seemingly divergent ideas. He was quick to grasp the essence of arguments and was able to develop an overarching, standard narrative. India actively participated in IYPE programs. He took copious notes during all the meetings.

He edited and produced the 40th Anniversary volume for IGCP, which was an exceptional contribution by global scientists to the joint IUGS-UNESCO-IGCP legacy. In 2012, IUGS honoured Prof. Derbyshire with the Harrison Medal. His other honours included Antarctic Service Medal of the U.S.A. (1974); The Back Award of the Royal Geographical Society of London "for contributions to glacial geomorphology and research in China (1982); the Exemplary Foreign Expert Award, Government of Gansu, China (1992); Honorary Life Member, International Union for Quaternary Research (INQUA) (1999); Prix de l'Excellence pour les sciences de la Terre, Organisation mondiale de mineralogy, Monaco (2004); and The Varnes Medal of the International Consortium on Landslides (UNESCO &

IUGS) (2008). Prof. Derbyshire exemplified the voluntary service of INQUA, which was cherished and appreciated by its members. He has maintained an all-inclusive approach with an emphasis on human resource development and community service. Few will match his zeal and vigour in serving the community by way of a train of international scientific bodies, including INQUA, IUGS, IGCP and IYPE, and their synthesis. Indian Quaternary owes a special sense of gratitude to Edward for his help in ensuring Indian membership in INQUA. He travelled to Delhi to join me in successfully convincing the then President of INSA of the benefits of India's membership in INQUA. Close to two decades hence, it feels good that India has vibrant Quaternary Research groups, a biannual Quaternary Congress, a Quarterly Newsletter- the Quaternary Chronicles and that India will be hosting the INQUA Congress in 2027.

A specific focus on societal delivery from Quaternary Sciences will be an appropriate tribute to Edward Derbyshire, his science and his stewardship.

- A.K. Singhvi,
Physical Research Laboratory,
Ahmedabad



Quaternary Chronicles
Happenings in the Sub-continent
AOQR ASSOCIATION OF QUATERNARY RESEARCHERS

Quaternary Chronicle (QC) publishes three issues a year seeks to publish perspectives, recently published peer-reviewed papers in Quaternary science, new developments in Quaternary science methods/ techniques, past events, awards, abstracts of recently awarded Ph.D./MS thesis; Quaternary publications, obituaries and details on forthcoming conferences/opportunities/fellowships the world over. Each issue of the newsletter will therefore, comprise news on on/from the Indian sub-continent;. It will also have a platform for discussion on emerging questions and ideas in Quaternary science and details on new books/ monographs/ reviews. QC seeks to share original results, new ideas and innovative development for the common good and a possibility to serve as a catalyst for the initiations of major and coordinated initiatives in the country.

We now accept submissions for our upcoming issues. Submit all the contributions to ***aoqr2019@gmail.com****. Themes for contributions are given below:*

1.Perspective: *Perspective write-ups on emerging trends and new possibilities in Quaternary Science (500 words).*

2.Sneak-peek and Discussion: *Share any exciting findings/questions from your ongoing (unpublished) work already to facilitate discussion. Any other intriguing facts/ unanswered questions are also welcomed for discussion (150 words).*

3.Significant new manuscripts/ books/ monographs/ reviews: *Corresponding authors of recently published peer-reviewed papers are invited to submit a brief summary of their work (not published abstract) with complete reference, web-link, and corresponding email address (200-300 words). Also, include a PDF copy of the paper in the email (for reference only).*

4.Facilities and Instruments: *A list of available facilities at various Indian institutes will be given and updated as contributions are received. In-charge of the available facilities, mentioning whether it is open access or available on payment basis, may submit the details with contact details.*

5. Achievements: *Share national or international awards/ fellowships/ recognitions with the larger Quaternary community. Also, approved SERB/ DST/CSIR/ national/ international Quaternary projects with the title, affiliation details of the awardee and a brief abstract (200 words) may be submitted with a copy of the award letter (for reference only).*

6.Projects/Collaborations: *New projects and collaborations related to Quaternary Science may also be sought for enhancing the quality of ongoing/proposed research. Submit a brief summary of the project, collaborations required and the contact details for correspondence (200 words).*

7. New Thesis: *Abstracts of awarded PhD/MS degree are invited for contribution (250 words).*

8.Opportunities: *Submit details with web-link of any new openings and opportunities for wider circulation.*

9. Social media: *Follow, discuss and share Quaternary India News on https://twitter.com/ AOQRIndia (Twitter) and https://www.facebook.com/AOQRIndia (Facebook).*

Come join us!

The Association of Quaternary Researchers (AOQR) invites you to register for AOQR Membership and ask your colleagues and students to make the AOQR Fraternity stronger and become a part of the AOQR family.
See the details in https://www.aoqr.org/#

ISSUES	Deadlines (Last date for submission)
Issue -1 (April)	**March 10**
Issue -2 (August)	**July 10**
Issue -3 (December)	**November 10**

Quaternary Chronicles
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Vol.6 No.3 December 2024

FROM THE AOQR DESK:

A Promising Start to Pre-INQUA 2027 Activities

- Pradeep Srivastava
Vice President, AOQR
& President
INQUA 2027

The XXII Congress of the International Union for Quaternary Research (INQUA), scheduled to take place in Lucknow in 2027, has three key objectives: (i) to raise awareness within the extensive Quaternary research community and achieve significant advancements in Science of Quaternary in India, (ii) to celebrate global and national contributions to Quaternary Sciences, and (iii) to enhance support for Quaternary enthusiasts, particularly in the Global South. This is a monumental responsibility, and with the trust of the international community placed in us, we must stand together, organise this event effectively, and demonstrate a mature sense of global leadership. In preparation for this highly anticipated INQUA 2027, Prof. M.G Thakkar, Director of the lead institution BSIP-Lucknow and the organising team, besides other important tasks, has launched an engaging bi-monthly lecture series and an innovative podcast platform. These initiatives aim to foster dialogue and understanding about key themes related to the Quaternary period and the Anthropocene era, while also promoting the congress to both the scientific community and the public.

The lecture series began on September 7, 2024, with a talk by Prof. Shailesh Nayak, who discussed "Wetland Ecosystems and Climate Risk: Policy and Governance." Held at 11:00 AM IST, this inaugural lecture shed light on the vital role of wetlands in addressing climate risks and the challenges of their governance. The second lecture followed on September 28, 2024, featuring Dr. Sunil Kumar Singh from CSIR-NIO. His talk, titled "Indian Ocean Circulation and Climate Variabilities during the Quaternary," provided valuable insights into the interplay between ocean dynamics and climate changes over the Quaternary period. On October 5, 2024, Prof. L. S. Shashidhara delivered the third lecture from NCBS, Bengaluru. Titled "From Archean to Quaternary Period: Origin of Life to Evolution of Self," this talk traced the evolutionary journey of life on Earth, from its earliest beginnings to the complexities of the Quaternary period. The fourth lecture took place on October 19, 2024, led by Dr. M. N. Rajeevan of Atria University, Bengaluru. His presentation, "South Asian Summer Monsoon: Past, Present, and Future," explored the history and future implications of the monsoon system in the context of climate change. Prof. S. K. Tandon spoke on November 23, 2024, from IISER-Bhopal. Titled "Anthropocene sans boundaries - Human Transformation of the Earth," this talk took us to the profound impact of human activity on the planet during the Anthropocene era.

Complementing the lecture series, the INQUA 2027 team has also introduced a podcast to further spread awareness and simplify complex scientific concepts. Season 1 of the podcast offers an accessible introduction to Quaternary science and the goals of the upcoming congress in Lucknow, India. This include Episode 1: INQUA 2027 INDIA: THE BEGINNING (September 7, 2024) – An overview of the Congress and its vision. Episode 2: The Quaternary Period - Time of the Recent Past (October 5, 2024) – A dive into the significance of the Quaternary period. Episode 3: India: The Story Unfolding - A Peek into its Quaternary Period (November 9, 2024) – Insights into India's geological and environmental history. Episode 4: The Quaternary Studies in India - Overview of Institutes and Laboratories (December 7, 2024) – A spotlight on Indian research institutions advancing Quaternary science. These efforts mark a significant step toward engaging diverse audiences, fostering collaboration, and setting the stage for a transformative INQUA 2027 Congress. These podcasts are hosted on Spotify and INQUA INDIA YouTube Channel.

Recently, Thijs van Kolfschoten, Past President of INQUA and Emeritus Professor at Leiden University, Netherlands, visited Lucknow to assess the preparations for INQUA-2027. During his visit, he toured the congress venue, the Indira Gandhi Pratishthan, and described it as an excellent choice for hosting an event of this scale. Prof. van Kolfschoten also participated in a field excursion from Lucknow to Kalpi, gaining insight into the regional geology, which is set to feature as one of the mid-conference field trips. In a formal meeting, Prof. Thakkar provided an update on the congress preparations, which received Prof. van Kolfschoten's commendation.

The organising team extends its heartfelt gratitude for the invaluable contributions and mentorship that have supported the successful coordination of these pre-INQUA Congress activities. We eagerly anticipate continued proactive engagement in the journey ahead.

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AOQR MEMBERSHIP CALL

Researchers of Quaternary Science of Indian sub-continent are welcome to submit your application. Be a part of a multidisciplinary team of researchers, and practitioners of Quaternary Science and represent Indian Quaternary Science at an international level. Members can get priorities at our annual e-conferences, publish in the edited books/ journal volumes by the members of the AOQR, access to webinars, e-conferences and specialized thematic workshops etc.

Write to us at **aoqr2019@gmail.com** *for membership application form.*

The membership of the AOQR is open to all individual of academia and industry subject to verification.

Welcome!

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Talk Series as Pre-INQUA Activity

Talk 1:

Wetland Ecosystems and Climate Risks: Policy and Governance

Shailesh Nayak
National Institute of Advanced Studies (NIAS), Bengaluru

Abstract: *Wetland ecosystems provide many ecological services and influence the livelihood of people. The increase in global temperature and carbon dioxide and the resulting changes in rainfall patterns and ocean acidification can adversely affect fauna, flora, and fisheries. The ecological services provided by wetland ecosystems, such as coral reefs, mangroves, etc., have economic value, and hence, their loss or degradation can affect the livelihood of people. It is necessary to set up a wetland information system to model the impacts of climate change on wetlands at local, national and regional levels. The watershed and coastal management approaches, such as the Ramsar Convention and UN Sustainable Development Goals (SDGs), are key to preserving and conserving these habitats to ensure the continuity of ecological services for the benefit of people. The data and current status in India have been taken as an example to address the challenge of climate risks.*

Talk 2:

Indian ocean circulation and climate variabilities during the Quaternary

Sunil Kumar, CSIR-NIO, Goa.

Abstract: *Global ocean circulation play a critical role in climate system of the globe as it influences the oceanic transport of salt, carbon, nutrients, oxygen and hear on global scale. Cold and salty surface waters at high latitudes, in north Atlantic and Antarctic, sink to form deep/bottom waters spreading across the Atlantic, Pacific and the Indian Ocean. These deep/bottom waters are defined by flow of dense water northward under the lighter water flowing southward. The deep/bottom waters control the carbon and heat budget of the global ocean and hence the climate variability. The contemporary ocean circulation pattern has undergone through large variabilities over the millennial to million-year time scales impacting the global climate. The Indian Ocean serves as an integral link in the global circulation between the Atlantic and Pacific oceans impacting heat and carbon budget on different time scales. Present day ocean circulation and its past variabilities in the Indian Ocean impacting the local and global climate was discussed in the talk.*

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Talk Series as Pre-INQUA Activity

Talk 3:

From Archean to Quaternary period: Origin life to evolution

Prof. L.S.Shasidhara, NCBS, Bengaluru

Two ends of the story of life on Earth are the least understood: the beginning of the current cellular form of life and the evolution of our ability to experience ourselves (self-awareness). The recent advances in life sciences suggest the answers are just around the corner.

Talk 4: South Asian Summer Monsoon: Past, Present and Future. Madhavan Nair Rajeevan, Atria University, Bengaluru

The South Asian Summer Monsoon (SASM) is a subsystem of the Asian summer monsoon and an important part of the global climate system that is linked to the land, ocean and atmosphere. The lives of billions of people in the South Asian subcontinent are closely intertwined with the vagaries of the SASM. In this presentation, I will discuss various aspects of monsoons in the past, present and future scenarios of global warming based on observations and results of coupled climate models. The instrumental rainfall records over the South Asian mainland are limited to about 200 years. Numerous studies have been conducted using proxy data to understand our past monsoon climate and overcome record length limitations. In the past, the monsoon fluctuated on geological time scales due to continental drift, solar radiation, volcanic influences and CO2 concentration in the atmosphere. The Indian plate collided with the Eurasian plate about 55-45 Ma (millions of years ago). The variability of the monsoon has a cascading effect on the overall economy, food inflation and thus on the quality of life and cost of living of the population. Based on observations and coupled climate model results, I will discuss the observed variability of the monsoon on different time scales (from diurnal to several decades) and its physical mechanisms. The monsoon extremes (precipitation, droughts, and floods) and their physical mechanisms will also be discussed, as well as how well we can predict them. Global warming due to increasing greenhouse gases could affect SASM in our future climate. Using the IPCC model results, I will discuss the predictions for our monsoon in the future climate. What can we expect in the future monsoon climate, and what uncertainties are there? Finally, I will discuss the gaps in our understanding of the monsoon and how we can improve monsoon predictions.

Talk 5: Anthropocene sans boundaries – Human Transformation of the Earth. Prof. SK Tandon, IISER-Bhopal

Prof. SK Tandon, IISER-Bhopal

The Anthropocene Concept is based on the notion that human forcings have overwhelmed natural forcings that act upon the Earth's surface systems including the habitats of the biosphere. What is the Earth' s surface? It constitutes a complex system in which there is an interplay between tectonics, climate, and the biosphere in addition to feedbacks amongst them. Humans with their intelligence have modified the Earth's surface systems in multiple ways over several millenia since the beginnings of agriculture, but particularly so in the post-1950 period. This phase of human transformation of the Earth has been named The Great

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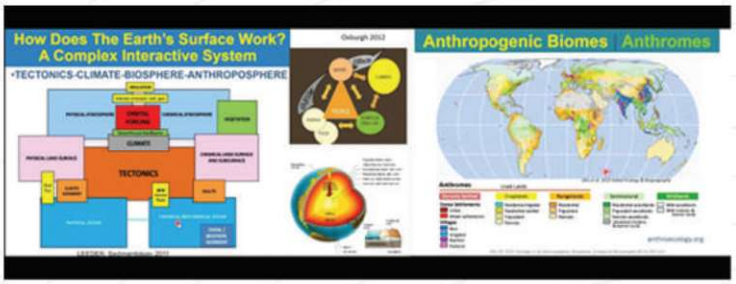

Acceleration. Further the concept of the Anthropocene is multi-dimensional and includes diversified themes such as Geological Time Scale, Civilizations and Used Planet, Planetary Boundaries. Tipping Points. Safe Operating Space , Planetary Stewardship and Sustainability. Whilst highlighting the nine recognized planetary boundaries under scientific scrutiny , this talk will focus on the human Disturbance of the Terrestrial hydrosphere through millenia.

Talk Series

Anthropocene sans boundaries - Human Transformation of the Earth

Nov-2024
23
11:00 AM IST

www.inquaindia2027.in

Meeting Link

@inqua2027india

Meet Veera, the voice of the INQUA INDIA 2027 podcast.

Veraa is a female Podcaster and Radio Professional based in Lucknow, India. Communication for her is not a job but a passion! Her favourite line is, Connecting through audio is in my DNA! She has been associated with the audio industry for more than 30 years; Veera is not just a voice-over artist but a brand in herself. She has been constantly experimenting with all avenues of the field. Be it FM shows, voiceovers for commercials or documentaries, YouTube or podcasting, she has done it all successfully, too. Her podcast channel Stotras and Shlokas, recited by Veraa, has already made more than 439k impressions, while her other travel podcast, Meri Duniya With Veraa, is getting critical acclaim not only in India but abroad as well! A Limca Book of World Record holder as a longest serving morning jock for Radio City Lucknow, Veraa began her stint with private FM by interviewing Mr Amitabh Bachchan himself! She is known for her strong, instant connection and soothing style. Exploring, improvising, and learning are her greatest assets, and they have made her excel in whatever she does. Now, she is the official podcasting voice of INQUA India 2027, which has made her feel honoured and humbled! As she says, it is an opportunity that has manifested itself as she has an immense fascination with humans and Earth's history, and her association with the INQUA India team is going to be a milestone in her career!

Veera can be found on Youtube - RJ Veraa; Instagram - rj_veraa; Twitter- verasingh03; Linkedin - Veraa Singh Spotify - Meri Suniya With Veraa and Stotras and Shlokas Recited by Veraa

Ms. Veraa Singh
verasingh@gmail.com

PhD Awarded

Shivangi Tiwari, Earth and Atmospheric Sciences, Université du Québec à Montréal, (UQAM), Montréal, Québec

Title of the thesis: Remote Impacts of the mid-Holocene Green Sahara on Global Climate

Supervisors: Profs. Francesco S. R. Pausata (UQAM), Anne de Vernal (UQAM) and Hugo Beltrami (St. Francis Xavier University)

Paleoclimatic reconstructions have shown that the present-day Saharan desert region was vegetated in the early and middle

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PhD Awarded

Dr. Pooja Nitin Saraf
Birbal Sahni Institute of Paleosciences, Lucknow.

Title of Thesis: Species Distribution Modelling to Project the Past and Future Potential Habitats Based on the Current Distribution of Tropical Deciduous Forest Species in India

Supervisor: Dr. Jyoti Srivastava, Scientist-D, Birbal Sahni Institute of Paleosciences, Lucknow
Co-supervisor: Prof. François Munoz, Biometrics and evolutionary biology laboratory, Université Claude Bernard Lyon 1, France.

Holocene (~11,000 - 5,500 years Before Present or BP). A change in the orbital parameters led to an increase in summer and fall insolation in the Northern Hemisphere, leading to an intensification of the West African Monsoon, which brings precipitation to northern Africa. In the present day, the northern extent of the West African Monsoon is up to the Sahel (the region southwards of the Sahara, which receives 100-400 mm of rainfall annually). During the early and middle Holocene, paleoclimate reconstructions indicate a northward movement of the isohyets, leading to the development of grass and shrub vegetation across the Sahara and a northward expansion of all vegetation in northern Africa. This phenomenon is referred to as the Green Sahara, with the corresponding time period referred to as the Green Sahara Period or the African Humid Period. The Green Sahara was accompanied by a reduction in terrigenous dust fluxes and an expansion of lakes, wetlands and rivers across northern Africa.

While the changes due to the Green Sahara in regional climate over northern Africa have been extensively studied and are relatively well understood, the remote impacts on other regions of the world warrant further study. Recent studies have indicated the possibility of teleconnections between the Green Sahara and different regions of the world such as the tropical Atlantic and Pacific oceans, the Arctic region and the domains of Asian monsoons. In that context, the aim of the present thesis is to deepen our understanding of the far-afield impacts of the northern African vegetation changes on three key regions of the world : South America, the equatorial Pacifiic and the Arctic.

To this end, five fully coupled global climate models and one atmosphere-only global climate model have been used to simulate the mid-Holocene (6,000 years BP) with and without incorporating Green Saharan changes. Isolating the impact of the Green Sahara has shown considerable impacts in all three regions, which are similar in direction and comparable in magnitude to the impacts of the orbital changes. The Green Sahara led to extensive and year-round reduction in precipitation over South America, a reduction in the variability of the El Niño Southern Oscillation and a nudge towards a La Niña-like mean state in the equatorial Pacific, and a warming in the Atlantic-influenced sector of the Arctic.

The findings presented in this thesis are supported by proxy-model comparisons, and highlight the importance of incorporating the Green Sahara in modelling studies of the early and middle Holocene.

Climate change is a significant driver of global transformations, poised to profoundly affect species distributions. To create effective conservation and adaptation strategies, understanding climate change impacts at both ecosystem and species levels is essential. Although tropical dry deciduous forests have adaptations that allow them to endure long drought periods, their potential response to future climatic shifts remains uncertain. This study evaluates the projected ranges of key tree species in this forest type in India, specifically Butea monosperma (Lam.) Taub., Diospyros melanoxylon Roxb., Aegle marmelos (L.) Correa, Buchanania lanzan Spreng., Madhuca longifolia (J. Koenig ex L.) J. F. Macbr., Phyllanthus emblica L., and Terminalia bellirica (Gaertn.) Roxb. We analyzed their habitat suitability under current climate scenarios and modelled their past (mid-Holocene, approximately 6000 years BP) and projected future distributions for the 2050s and 2070s under RCP 2.6 and RCP 8.5 emission scenarios. Our results indicate that the distributions of these species are mainly influenced by key bioclimatic factors, including annual precipitation (Bio_12), mean annual temperature (Bio_1), isothermality (Bio_3), and precipitation of the coldest quarter (Bio_19), which collectively account for approximately 70% of the species' distribution. Currently, the most suitable habitats for these species are concentrated in regions such as the Western Ghats, Central India (Chhattisgarh and Madhya Pradesh), and the Siwalik Hills. Under the high-emission scenario (RCP 8.5) projected for 2070, A. marmelos and T. bellirica are expected to see an expansion in suitable habitat, while B. monosperma, D. melanoxylon, B. lanzan, M. longifolia, and P. emblica are likely to experience declines. A. marmelos and T. bellirica demonstrate resilience to anticipated climatic shifts, facing minimal impacts, whereas B. monosperma, D. melanoxylon, B. lanzan, M. longifolia, and P. emblica are more vulnerable to high temperatures and changes in rainfall

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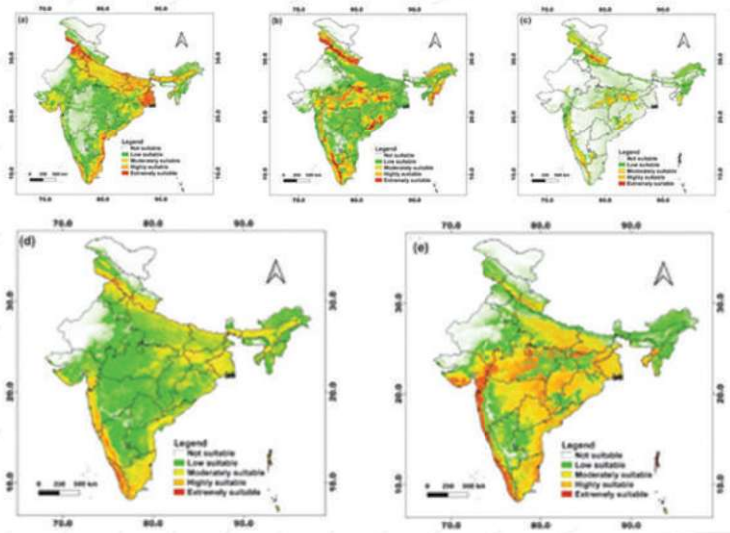

Maps showing the future distribution under RCP 8.5 (2070) for (a) A. marmelos (b) B.lanzan (c) M. longifolia (d) P. embilica (e) T.bellrica

patterns predicted for future climates. Further supporting these model projections, fossil pollen data confirm that these species were present in suitable habitats during the mid-Holocene, suggesting their adaptability to warm and humid conditions of the past. The broader distribution observed in mid-Holocene models highlights the past capacity of these species to thrive under such climatic conditions. Assessing the potential future distributions of these species under accelerated climate change is vital for formulating conservation and restoration strategies. This predictive framework assists in pinpointing critical areas for conservation focus, optimizing resource allocation in the face of climate change. Overall, this study contributes significantly to strategic ecosystem protection and restoration efforts by integrating ecological and conservation priorities amid evolving climate challenges.

Anayat Ahmad Quarshi

Glaciogeomorphological study in parts of Eastern Karakoram, Nubra Shyok Valley, Ladakh, India

Under the Joint Supervision of Prof. Benidhar Deshmukh and Dr Rakesh Chandra

The glaciers of the Hindu Kush and Karakoram region are critical indicators of climate change and essential sources of water for downstream communities. However, limited glaciological and meteorological data have hindered a comprehensive understanding of glacier-climate interactions in this region. This study examines the response of glaciers in the Rongdo Basin, eastern Karakoram, to climate change over the past five decades, using remote sensing data (CORONA, Landsat, and ASTER DEM) and field observations to establish a glacier inventory and assess area changes. Findings reveal heterogeneous glacier behaviours, with a net 6.8% decrease in the glacier area, yet a period of glacier expansion observed between 1989 and 2020 aligns with the Karakoram anomaly. Topographic factors and debris cover have contributed to glacial stability by reducing summer ablation rates. Mass balance analysis, using Accumulation Area Ratio (AAR) and geodetic methods with TanDEM-X and SRTM DEMs, indicates variability among the glaciers, with some gaining and others losing mass from 2000 to 2015. Additionally, mapping of glacial- geomorphological features, including moraines, trimlines, and U-shaped valleys, offers insight into past glacial dynamics and suggests a shift from interglacial to alpine glaciation, likely influenced by Himalayan uplift and changing precipitation. This research highlights the complex interactions between glaciers and climate and emphasizes the critical role of topography in shaping glacier dynamics. The findings enhance regional knowledge of glacier response in the Karakoram, providing valuable insights for water resource management. Future studies incorporating high-resolution DEMs, advanced field instrumentation, long-term monitoring, and geochronological investigations are recommended to further elucidate glacial processes and their relationship with climate in this vital region.

Dr. Joju George Sebastian
Manipal Institute of Technology, Manipal Academy of Higher Education.

Title of Thesis: Holocene climate variability reconstructed from lacustrine sediments of Schirmacher Oasis and Larsemann Hills, East Antarctica

Supervisor: Dr Anish Kumar Warrier, Professor of Geology, Department of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education.

The Antarctic continent plays a significant role in controlling the global climate. The East Antarctic Ice Sheet (EAIS) is the largest ice sheet on Earth and contains a huge volume of grounded ice, sufficient to elevate the global sea level by approximately 53 metres. Therefore, it is important to understand the behaviour of the EAIS post-deglaciation.

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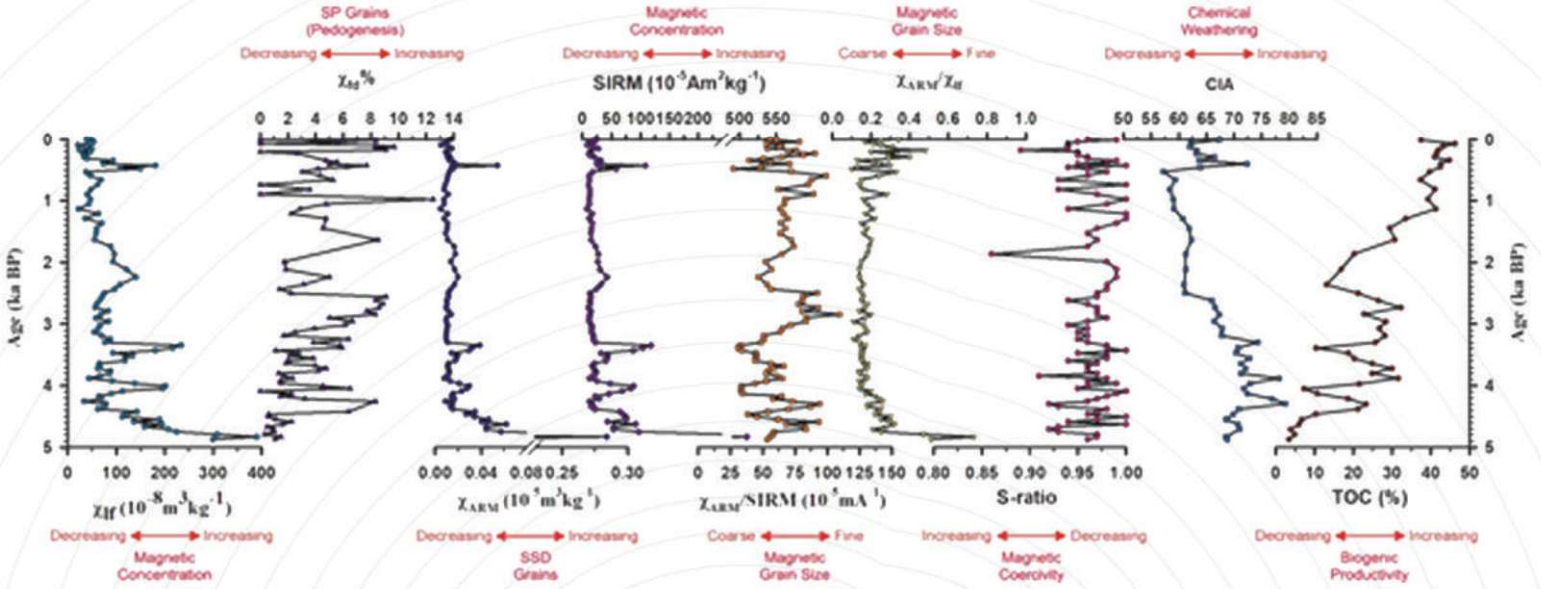

Numerous lakes present in the ice-free Antarctic oases act as sentinels of change. Sedimentary records from these lakes would provide valuable information about the paleoclimate and paleoenvironment. In this study, environmental magnetic, geochemical, and sedimentological investigations were carried out on lacustrine sedimentary records from Schirmacher Oasis and Larsemann Hills, which are two ice-free oases in East Antarctica. Lake L6 is a landlocked lake in the Schirmacher Oasis, East Antarctica. Accelerator mass spectrometry (AMS) radiocarbon (14C) dating revealed that the sediment core spans the past 4.87 ka. The magnetic minerals in the lake sediments were found to be primarily terrigenous. No lines of evidence for the presence of bacterial magnetite, authigenic greigite, or anthropogenic magnetite were observed. The magnetic minerals were found to be principally low-coercivity ferrimagnetic grains with minor proportions of ultrafine superparamagnetic (SP) grains. The chemical weathering indices reveal a moderate degree of chemical weathering. The multi-proxy analysis revealed the signatures of several global climate events such as the Mid-Holocene Hypsithermal, Neoglacial cooling, Medieval Climate Anomaly, Little Ice Age in the lacustrine sedimentary record. Stepped Lake is a coastal lake in the Larsemann Hills, located at a distance of around 200 m from the coast of Broknes Peninsula. AMS 14C dating of the sediment samples revealed that the Stepped Lake sediment core covers the period between 0.25 ka and 6.37 ka. The magnetic minerals of Stepped Lake were found to be primarily terrigenous. The chemical weathering indices reveal a low to moderate degree of chemical weathering in the sediments of Stepped Lake. The TOC values remain generally low, suggesting a low degree of productivity in the lake. Highest levels of TOC are observed towards the core-top, which could be due to the presence of cyanobacterial mats.

The sediment core was divided into three zones based on the results from the diatom analysis. In Zone 1 (6.37-3.07 ka), marine diatoms dominate, suggesting that the lake existed as a submarine basin during this interval. Zone 1 is marked by higher values of magnetic concentration-dependent parameters reflecting colder conditions in the region. In Zone 2 (3.07-1.75 ka), a mixture of marine and lacustrine diatoms is observed, indicating that Zone 2 represents a transition zone. Multi-proxy analysis indicate that warmer conditions existed in the region during this period. The diatom data from Zone 3 (1.75-0.25 ka) shows the dominance of freshwater diatoms, indicating that the lake was free from marine influence and started to accumulate freshwater lacustrine sediments. The region experienced continuing warming conditions during this period. Between 1 and 0.7 ka, increasingly warming conditions are observed, coeval with the Medieval Climate Anomaly.

Surface sediment and soil samples from the Schirmacher Oasis and Larsemann Hills were also studied to investigate the moder processes influencing the magnetic mineral formation and distribution in the region. The surface sediment samples from Schirmacher Oasis, also reflect the predominance of low coercivity ferrimagnetic grains. The iron oxide minerals were found to be primarily lithogenic and the sediments show high concentrations of magnetic minerals. The environmental magnetic analyses also revealed that even though pedogenesis may be occurring in the Lake L-55 catchment, the intensity is not strong enough to form ultra-fine grained magnetic superparamagnetic grains. The soils of Larsemann Hills also show a high concentration of coarse-grained magnetic minerals. The magnetic minerals were found to be lithogenic, and no evidence for any significant pedogenic activity was observed for the soils from Larsemann Hills.

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Dr Abdul Adil Paray
AOQR97998486

A Study of Landscape and Settlement Patterns of Neolithic and Megalithic Cultures of Kashmir Valley

Under the supervision of Dr Manoj Kimar
Indira Gandhi National Tribal University, Amarkantak, Madhya Pradesh.

This Ph.D. research provides an in-depth analysis of the landscape and settlement patterns of the Neolithic and Megalithic cultures in the Kashmir Valley, revealing significant insights into the prehistoric lifestyle and environmental adaptations of its inhabitants. By employing a multidisciplinary approach, this study integrates archaeological, geoarchaeological, and scientific analyses to reconstruct the socio-cultural and ecological contexts of ancient Kashmir. Radiocarbon dating of bone, charred seeds, ash, and charcoal samples was conducted at the Inter-University Accelerator Centre (IUAC), New Delhi, establishing a precise chronology for these cultural phases. Advanced geoarchaeological techniques applied to Neolithic pottery, including Inductively Coupled Plasma Mass Spectrometry (ICP-MS), X-ray Diffraction (XRD), Scanning Electron Microscopy with Energy Dispersive Spectroscopy (SEM-EDS) at the Birbal Sahni Institute of Palaeosciences (BSIP) in Lucknow, and Fourier Transform Infrared Spectroscopy (FTIR) at Central University of Haryana, allowed for a comprehensive understanding of compositional and mineralogical aspects. These analyses uncover patterns in resource usage, settlement preferences, and environmental adaptation across time periods, illustrating the dynamic interactions between early human communities and their environment. This research contributes to Quaternary science by offering a detailed perspective on prehistoric lifeways in high-altitude regions, serving as a model for similar studies in comparable terrains. The study's findings provide essential data on cultural transitions from the Neolithic to the Megalithic in Kashmir, underscoring the critical role of scientific methods in deepening our understanding of India's rich archaeological heritage.

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SIGNIFICANT FINDINGS

Climate Changes Linked to Rise and Fall of Ancient Indian Dynasties

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Reference of paper: https://doi.org/10.1016/j.catena.2024.108424

Climate-driven vegetation changes played a crucial role in shaping human history in the Indian subcontinent. Over the last two millennia, the Earth has experienced alternating warm and cold episodes, which significantly impacted vegetation patterns. These shifts in the environment forced human populations to migrate and may have contributed to the rise and fall of prominent Indian dynasties, including the Guptas, Gurjar Pratiharas, and Cholas etc. This study utilized pollen analysis and other multiproxy approaches, combined with the Earth System Paleoclimate Simulation (ESPS) model, to reconstruct historical patterns of the Indian Summer Monsoon (ISM) over the last 2,000 years. By correlating these climate changes with key events in Indian history, the research provides insights into centennial-scale climatic oscillations in the monsoon-dominated regions of the subcontinent.

Focusing on a sediment profile from Sarsapukhra Lake in Varanasi, located in the Central Ganga Plain, 52 pollen samples alongside other proxy data from a 274 cm deep core were analysed. The findings reveal distinct vegetation changes that correspond with climatic fluctuations. Precipitation data from the monsoon season (JJAS: June, July, August, September) were selected to analyze percentage changes in the Indian Summer Monsoon (ISM) rainfall patterns, with anomalies computed every 50 years over the past two millennia in the Indian subcontinent. Eleven ESPS models were utilized to compare with pollen-based multiproxy climate data, aiming to establish the relationship between climate and its impact on dominant ancient Indian civilisations. From approximately 1800 to 1600 cal yr BP, coarser silty sand with few Poaceae and Asteraceae pollen indicates a strong ISM. Following this period, from

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1600 to 1350 cal yr BP, the presence of mixed moist deciduous taxa, including Shorea robusta, Madhuca indica, Rubiaceae, Morus alba, Syzygium, and Moraceae, suggests a moderate ISM. In contrast, between 1350 and 1200 cal yr BP, the dominance of dry deciduous taxa like Acacia sp., Bombax ceiba, and Mangifera indica etc. points to weakened ISM conditions. A pulsative ameliorating trend from ~1200 to 1030 cal yr BP showed the dominance of deciduous taxa such as Holoptelea, Rutaceae, Ziziphus, Rubiaceae, Maytenus and Acanthaceae etc. indicating warm and moist climatic conditions, followed by another period of weakened ISM until around 900 cal yr BP and improved ISM until 620 cal yr BP. An upward trend in the ISM continued from 620 to 450 cal yr BP, characterized by an increase in wetland taxa. However, this was succeeded by a significant dry phase beyond 450 cal yr BP, reflecting poor ISM conditions.

These alternating warm and cold episodes directly affected vegetation patterns, forcing human civilizations to migrate from their original settlements and contributing to the decline of prominent Indian dynasties. This study thus establishes a foundation for future research into the dynamics of vegetation change, shifts in the ISM, and the relationship between human culture and climate. It also provides essential records for addressing uncertainties regarding the timing and regional significance of climatic transitions, their potential impact on early human societies, and the extent of anthropogenic influence on the climate over the past two millennia.

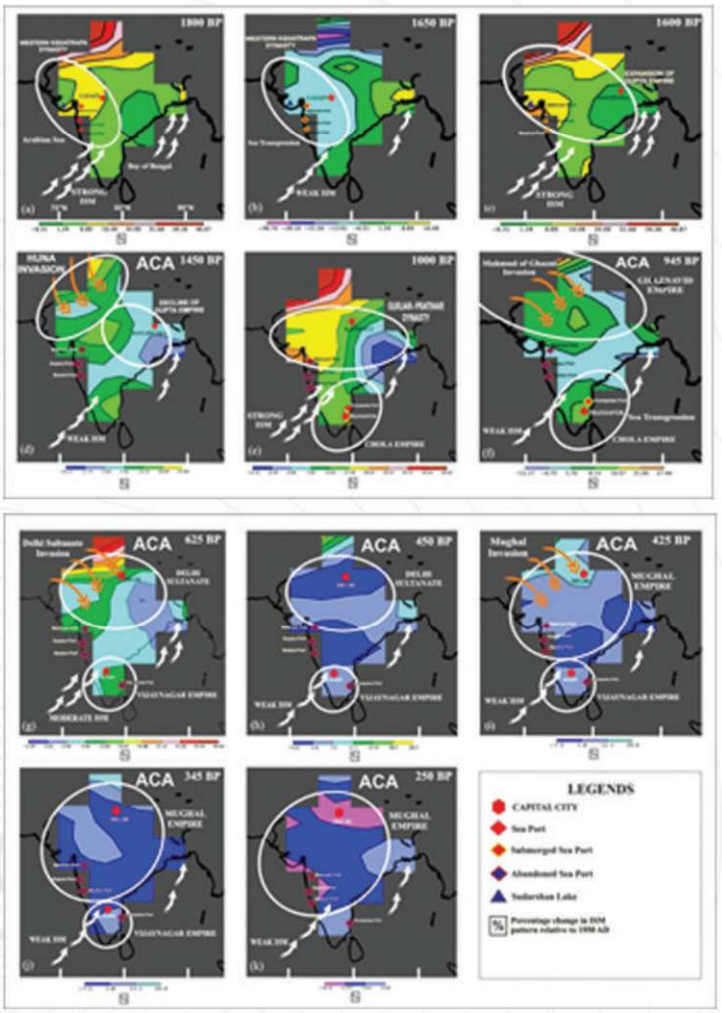

Figure: (a-f), (g-k): Diagram showing mapping and modelling of Indian Summer Monsoon region and their impact on ancient prominent dynasties over the past two millennia.

Research paper title: Wildfire-enhanced Plio-Pleistocene CO_2 drawdown through terrestrial organic carbon burial

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https://www.sciencedirect.com/science/article/abs/pii/S0277379124003263

Wildfires serve as a significant, albeit underappreciated, carbon sink over decadal to longer timescales through various mechanisms. These include the production of pyrogenic carbon such as charcoal, which is notably resistant to oxidative weathering compared to the original biomass (Li et al., 2021). Additionally, wildfires contribute nutrients to the soil, such as ammonium, which supports vegetation regrowth during the post-fire period (Kashian et al., 2006). The shift towards grassland vegetation following fires can be particularly impactful, as grasslands store approximately ten times more carbon below the soil compared to forests in similar climatic conditions (Retallack, 2001). Moreover, storm events often triggered by post-fire atmospheric aerosol injections into the atmosphere promote soil erosion, facilitating the transport of terrestrial organic carbon (OC) to ocean basins (Gautam et al., 2021). Post-fire rainfall events also enhance the delivery of micronutrients from the continent to coastal oceans, intriguingly boosting marine primary productivity and contributing to oceanic OC burial (Liu et al., 2022). Despite these significant roles in OC burial and CO2 drawdown, the influence of paleo-wildfire on CO2 drawdown during geological period has remained largely unexplored.

Our research presents the first "smoking gun" evidence of wildfire's role in driving continental erosion, terrestrial OC burial, and CO2 drawdown during the Plio-Pleistocene transition, both regionally over South Asia and globally. We assessed wildfire activity across the Indo-Burma Range and the Andaman-Nicobar

Islands by analyzing stable nitrogen isotopes of fixed ammonium in clay minerals and measuring pyrogenic carbon mass accumulation rates. To establish a global perspective, we compiled wildfire proxy record stack from 19 sites, normalized using Z-score statistics. Our data indicate that wildfire activity increased 3.2-fold regionally and 4.8-fold globally during the Plio-Pleistocene transition compared to the Early Pliocene.

This heightened wildfire activity coincided with a 2.9-fold increase in continental erosion over South Asia, leading to a 2.4-fold rise in terrestrial OC burial within the Nicobar Fan. To extend our findings, we calculated terrestrial OC flux from 23 ODP and IODP sites. The global terrestrial OC burial flux during the Plio-Pleistocene transition increased to 3.52 ± 0.80 Mt C a−1 from 2.29 ± 0.48 Mt C a−1 in the Early Pliocene. Our findings represent a clinching piece of evidence with substantial implications for understanding the potential impacts of intensified future wildfire activity on carbon cycling, especially in the context of anthropogenic CO2 accumulation and strategies for CO2 drawdown.

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The extreme monsoon climate and associated ancient communities, kingdoms, irrigational advancement in Deccan India during the late Holocene

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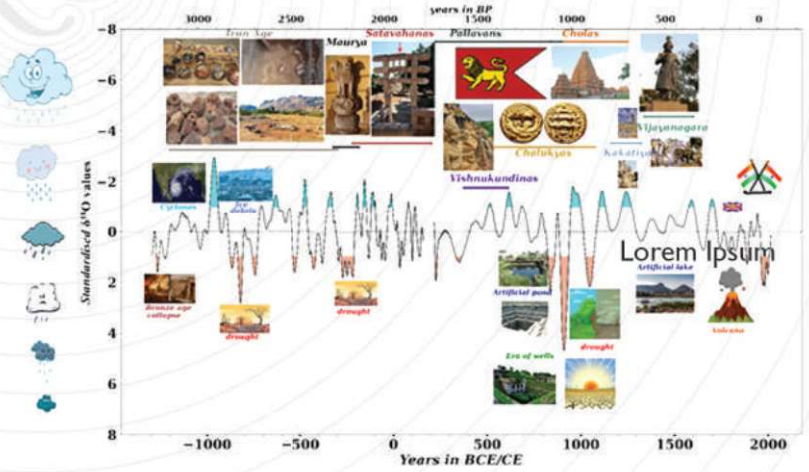
Regional Environmental Change (2024) 24:169 https://link.springer.com/article/10.1007/s10113-024-02323-3

This study used the past 3200 years of high-resolution monsoon records (speleothem records) with historical and inscriptional data to understand the impacts of long-term droughts & floods over the water sources, rivers, human settlements, migrations, kingdoms, and water irrigation. It has been observed that the settlements far from water bodies were abandoned during multi-decadal droughts, while those near rivers migrated to riverbanks, especially in the Tungabhadra corridor. Conversely, during the Vedic era, settlements in low-lying or cyclone-prone areas on India's eastern coast were abandoned during high rainfall periods.

The results suggest that major empires like the Mauryans and Satavahanas struggled to maintain irrigation during internal conflicts, contributing to their decline. Later monarchs, particularly the Pallavas, Cholas, Kakatiyas, and Vijayanagara, prioritized constructing and maintaining irrigation facilities. The period from 1000-1330 CE, known as the 'golden era of tanks,' experienced severe droughts and floods, underscoring the importance of tank-based irrigation. Data show that three major advancements in artificial irrigation over the past two millennia were closely linked to extreme monsoon climates. Revitalizing traditional water retention features, such as tanks and ponds, is crucial for addressing contemporary water scarcity in India. These ancient structures offer sustainable solutions for groundwater recharge and irrigation, benefiting both rural and urban communities and ensuring a more resilient future in the face of climate change.



Caption: The Z-scores of oxygen isotopic values from Kadapa stalagmites illustrate monsoon rainfall variability over the past 3200 years, alongside the archaeological chronology, Indian polity, ancient water conservation, irrigation practices, and climatic aspects. The sources and references for the images and cartoons used in the figure are listed in Supplementary Table S1 online. The light blue and red shaded areas on the time series represent foods and droughts, respectively, defined by Z-scores less than 1 and greater than 1. The numbers 1–3 indicate three pulses of irrigation advancements over the last two millennia, strongly correlated with drought periods

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Awards and Prestigious Memberships

Congratulations to Dr. Rahul Mohan, NCPOR, Goa *on being conferred the* ***L Rama Rao Birth Centenary Award*** *(2024) for his significant contributions to palaeontology by the Geological Society of India*

Congratulations to Dr. Karthick Balasubramanian, *Scientist E, Biodiversity & Paleobiology Group, Agharkar Research Institute, Pune, for being selected for* ***NASI- Membership 2024 Fellow*** *of the Allahabad Academy, National Academy of Sciences, India*

NASCENT PROJECTS:

Studying African Baobab trees on the Mandav (Mandu) plateau, Madhya Pradesh

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2Institut de Recherche pour le Développement, UMR PALOC, National Museum of Natural History, Paris, France
3Université Lumière Lyon 2, CNRS UMR EVS, Lyon, France
4School of Arts and Sciences, Azim Premji University, Bhopal, India

A recent collaborative fieldwork campaign was conducted as part of the MANDU Project, an interdisciplinary initiative dedicated to exploring the dynamic relationships between society and the environment, particularly in the context of water management, the making of a vast agro-urban centre, and hydroclimatic variability over the past millennium. This project is the result of a scientific collaboration between France and India, bringing together researchers and experts across archaeology, palaeosciences, hydrogeology, geography, ethnography, architecture, and history. Investigations are being carried out from a landscape archaeology perspective, focusing on the famous historical area of Mandav, Dhar District, MP, in west-central India. Mostly spared until recently from recent urbanisation, the landscape of Mandu encompasses rich archaeological and environmental records and signatures of long-term processes, including human occupation, cultural activities, and society-nature interactions. Mandu, or Mandav Gad, is a tabletop plateau within the Malwa Deccan Traps, acting as a natural fort occupied by multiple ruling dynasties. This fortified town extends across a basalt outcrop ~560 to ~680 meters high, with a view over the Malwa plateau to the north and the Nimar Plains in the watershed of the Narmada River of southwestern Madhya Pradesh, India. This well-contained plateau spans over approx. 20 km² and is connected to a vast hinterland that contains numerous archaeological records. The site has temple remains dating to the Paramara period but rose to prominence as the capital of the Malwa Sultanate from the 1400s to the 1500s. The Mandav region is unique in displaying the presence of several giant baobab trees that have attained circumferences of up to 12 m and impressive heights. It is estimated that there are about 300 Baobab trees on the plateau. This woodland and farming area is probably the only location in India where such trees are abundant. The fruit of the baobab holds significant importance for the local tribal Bheel communities, providing a source of income for families who rely on its sale to improve their livelihoods. These Baobab appear to be very old and should deliver a palaeoclimatic record of at least several hundred years. Determining the ages of these trees could be crucial from an archaeological and historical perspective as it would help to understand their origins in this area.

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The genus Adansonia contains eight species of medium to large deciduous trees. They belong to the Bombacoideae subfamily of the Malvaceae family. These exotic trees are native to Madagascar, Australia, and the African mainland and, therefore, were probably introduced to South Asia by humans. They have distinctive features like a bottle-shaped, broad trunk that gets narrower with height and splits into a few branches. This tree's distinctive structure enables the species to hold a lot of water. Despite their potential 2,000-year lifespan, Adansonia is globally endangered due to global warming. The locals of Mandu believe that baobab seeds were brought by Arab traders and planted during the time of the Malwa Sultanate. The state government is currently planning to file for a GI (Geographic Indication) tag for the baobab fruit, locally known as Khorasani Imli, to safeguard this uncommon tree, improve its identification, and provide financial benefits to the local communities.

As part of the multifaceted MANDU project, the recent fieldwork focused on the study of African Baobab trees (*Adansonia digitata*), which are numerous and iconic natural landmarks in Mandav and serve as valuable archives of environmental and climatic information.

The study started in October 2024 and focuses on analysing tree age and stable isotopes in the hope of generating proxy moisture records for the period of interest.

We are interested in ascertaining the exact age of baobab trees in this region through dendrochronological analysis and radiocarbon dating. For this purpose, we collected core samples at breast height using long increment borers, reaching the centre (pith) on several occasions. Tree-ring analysis and isotope-based dendroclimatology of the cores should provide a wealth of crucial information, including the tree's ages and palaeoclimatic conditions along the Narmada escarpment. We acknowledge with gratitude the Principal Chief Conservator of Forests, Government of Madhya Pradesh, Bhopal, for the permission granted to us for the collection of these samples. We also express our sincere thanks to the Divisional Forest Officer, Dhar, Madhya Pradesh, and the Range Officer, Mandav, for the ground information and access.

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Public Outreach and Skill Development in PalaeoHome Palaeolithic Hominins and Habitats: Out of Africa to South Asia (INQUA-HABCOM multiyear project)

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Skill development, training, and science communication/public outreach are key components of our INQUA-HABCOM multi-year project PalaeoHome (Palaeolithic Hominins and Habitats: Out of Africa to South Asia). This project seeks to network and build collaborations between experts through global and local hubs to debate questions relating to the 'Out of Africa' story as documented by variability in chronology, palaeoenvironments, and evolutionary trajectories and behaviour in the Lower Palaeolithic (Early to Middle Pleistocene), with a specific focus on India and Africa. Sparse awareness of human origin studies in parts of the Global South necessitates active science communication through multiple platforms. PalaeoHome activities comprise research, science communication and training. Here we focus on the latter two aspects. Our in-person workshops addressed children and teachers by organising prehistory awareness workshops, in collaboration with the SCHE (Chennai, India), IFP (Pondicherry, India), and CNRPAH (Algiers, Algeria) with online activities (Ask an Archaeologist) (Fig. 1). These outreach programs will continue and culminate in a book and online resources.

A skill development interdisciplinary workshop for early career researchers [The Lower Palaeolithic: Lithics and Landscapes (31st August to 4th September 2024)] aimed at building networks between young scholars locally and globally. Ten participants were selected from different disciplines to join us in learning and discussing recent approaches in field and laboratory studies in the Lower Palaeolithic and Pleistocene palaeoenvironments (Fig. 2). The workshop was inaugurated by eminent personalities at the State Department of Archaeology, Government of Tamil Nadu, India. The meeting was presided over by Thiru T. Udhayachandran [IAS, Principal Secretary to the Government of Tamil Nadu, Finance Department, and Commissioner (Full Additional Charge), Department of Archaeology], who delivered the keynote address. Dr. R. Sivanantham (Joint-Director, Tamil Nadu State Department of Archaeology), Dr D. Dayalan (Advisor to the Tamil Nadu State Department of Archaeology), Professor Shanti Pappu (Vice President of INQUA-HABCOM), Dr Vandana Prasad (Former Director of the Birbal Sahni Institute of Palaeosciences, Lucknow) and Dr Anupama K. (Researcher, Ecology, French Institute of Pondicherry, Puducherry) also spoke on this occasion.

The interdisciplinary workshop was organised into different sessions comprising lectures and hands-on activities, resulting in data generation for research purposes (Fig. 2). In-person and online interactive lectures included QA sessions and

Figure 1: Public outreach activities around the theme of prehistory for school children and teachers in A-B. India; C. Algeria

activity sheets to enhance understanding of key concepts. Over 5 days, lectures were delivered by Prof Shanti Pappu (SCHE, India) who discussed issues in Lower Palaeolithic studies in India; Dr Razika Chelli Cheheb (CNRPAH, Algeria; a. Early hominin exploitation of animal resources between 2.4 and 1.7 million years ago: evidence from the Plio-Pleistocene sites of Ain Boucherit and El-Kherba (Ain Henech, Algeria); b. Homo erectus Subsistence behaviour in North Africa: New Evidence from the Acheulean Site of Tighennif (Northwestern Algeria); Dr Rathnasiri Premathilake (University of Kelaniya, Sri Lanka; Palaeobotany and taphonomical issues at prehistoric sites); Dr Doris Barboni (Head of the Department, Ecology, French Institute of Pondicherry; Phytoliths: the Good, the Bad and the Ugly); Prof Pramod Singh and Prof Subhadip Bhadra (Department of Earth Sciences, Pondicherry University; An overview of geomorphology and its applications). Sessions on theoretical and methodological aspects of lithic technology were led by Dr Kumar Akhilesh (an expert knapper) who demonstrated and guided participants in understanding bipolar technologies, detaching flakes from cores, large core reduction, and bifacial flaking. Participants were led through structured activities related to tool-use results, completing worksheets and exploring the significance of tool types while manufacturing wooden digging sticks and processing aquatic fauna. Dr Prachi Joshi guided them through applications of photography, photogrammetry, and 3D geometric morphometrics and the significance of interpreting lithic assemblages and undertaking spatial studies at excavated Lower Palaeolithic sites. Palaeobotanical studies at the French Institute of Pondicherry, Pondicherry, enabled them to experience demonstrations and hands-on activities related to laboratory and microscopy protocols for extracting pollen and phytoliths from sediments and identifying morphologies. They participated in discussions with Dr K. Anupama, Mr S. Prasad, Mr G. Orukaimani (Researcher, Ecology, French Institute of Pondicherry) and Dr Doris Barboni (Head of the Department, Ecology, French Institute of Pondicherry). Some participants also presented their research in the form of posters and shared their knowledge with students of the State Department of Archaeology, Tamil Nadu, and scholars at the French Institute of Pondicherry, Puducherry. The workshop culminated in a field visit to the site of Attirampakkam, Tamil Nadu, where S. Pappu and K. Akhilesh introduced participants to the archaeological, chronological and palaeoenvironmental significance of the site and its importance in the regional Palaeolithic landscape. At the valedictory function, certificates were distributed and discussions were held where the participants shared their feedback and experiences of the workshop.

Figure 2: PalaeoHome ECR workshop based on the theme of "The Lower Palaeolithic: Lithics and Landscapes from 31st August to 4th September 2024".

The workshop set the stage for future collaborations between some of the interested participants, PIs, and invited scholars. One project has been initiated regarding palaeoenvironmental and geomorphological studies in northern Tamil Nadu, India. Discussions between resource persons and participants enabled the creation of research networks, facilitating the exchange of information and ideas in future programs. The workshop was a significant achievement in introducing participants from diverse disciplines to the importance of holistic studies towards reconstructing Lower Palaeolithic hominin behaviour. This forms the beginning of a series of strategized workshops and network hubs that, on a global scale, will result in discussion forums and the generation of multidisciplinary research publications. Further details are available on the website (https://www.palaeohome.com/) and social media pages.

3rd INQUA-PAGES Joint Workshop, 3-7 November 2024

Tropical Hydroclimate Variability in the Quaternary: Insights from proxies and models, and the way forward.

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3- University Of Wisconsin, Madison, USA
4-National Institute of Oceanography, Goa, India
5- Universidad de Tarapacá, Chile
6-University of Lausanne, Switzerland

The Tropical Hydroclimate Variability in the Quaternary (TROPQUA) 2024 Early-Career Researcher (ECR) workshop took place recently with the joint efforts of the International Union for Quaternary Research (INQUA) and Past Global Changes (PAGES). The 3rd INQUA-PAGES joint workshop was held between 3-7 November 2024 at the Council of Scientific and Industrial Research (CSIR) National Institute of Oceanography (NIO) in Goa, India to bring the ECRs working in the Quaternary climate variability in the tropics. Tropical climate plays a crucial role in driving extreme events such as floods, cyclones, droughts, and landslides. These occurrences have profound impacts on livelihoods and food security, and they also intensify conflicts that involve both social and environmental factors. Despite significant research, there are still considerable uncertainties about past changes in low-latitude hydroclimates and the mechanisms driving these changes during the Quaternary. These uncertainties largely stem from the limited number of available oceanic and continental records, thereby hindering our understanding of the natural variability of hydroclimates and their future projections in the context of recent global warming.

The primary goal of TROPQUA2024 was to create a platform for ECRs working with proxies and models over Quaternary timescales. It aimed to encourage these researchers to share their work and explore collaborative approaches. Model simulations of past climates provide crucial insights into the mechanisms and dynamics associated with paleoclimate events. The complementary relationship between proxy and model data is highlighted by the fact that paleoclimate data is one of the best inputs for assessing the performance of climate models beyond the range of instrumental variations. Consequently, the workshop focused on the potential of integrating proxy and modelling efforts to improve our understanding of tropical hydroclimate across Quaternary timescales. It also fostered interdisciplinary collaborations by bringing together paleoscientists from various countries and research backgrounds.

The workshop was effectively conducted over five days and included both oral and poster presentations, as well as focused breakout groups for in-depth discussions. A total of 38 attendees from 10 countries participated at CSIR-NIO-GOA to make TROPQUA a grand success. Additionally, there were five keynote talks delivered by advanced early-career keynote speakers at the forefront of past tropical hydroclimate research. The technical sessions including keynote lectures were organised in hybrid mode, with 29 in-person and 10 online talks. To encourage networking and research collaborations amongst participants, TROPQUA organised collective excursions and social dinners, providing an opportunity for participants to engage with each other in a relaxed social environment. Additionally, the workshop featured field trips to Sinquerim and Dona Paula Beaches, a public outreach activity "Climate Evening on the Beach", a scientific communication workshop, and laboratory visits at CSIR-NIO.

Picture 1. Group photograph of the TROPQUA2024 inaugural session featuring Prof Marie-France Loutre (Executive Director, PAGES), Prof Thijs van Kolfschoten (Past-President, INQUA), Dr Sanil Kumar V.V. (Director Incharge, CSIR-NIO, Goa, in the centre) with the organising committee and delegates of TROPQUA2024.

The technical program consisted of six thematic oral sessions, a session dedicated to flash talks for poster presentation and five invited keynote talks. Each session was thoughtfully organised based on the study area, the proxies used, and the different time periods covered in the research. For instance, one session, "Development in Proxies for Quaternary Research in Tropical Hydroclimate," focused on recent advancements in Quaternary proxies. Topics included clumped isotopes, biomarker-based paleothermometry, carbonate sediment dynamics, benthic foraminifera, and magnetofossils. While, another session, titled "Past Global Changes in the Last 2000 Years," examined the impacts of hydroclimate variability on tropical vegetation, drought occurrences, and agricultural systems over the past two millennia. Additional sessions addressed regional hydroclimate variability in Asia, Africa, and America, featuring presentations from researchers working in these regions. The flash talk session provided each poster presenter with a brief opportunity to outline their research and invite attendees to visit their poster, all within a three-minute timeframe. For the breakout group activity, participants were divided into five groups. This exercise emphasized the significance of interdisciplinary collaboration in enhancing our understanding of paleoclimate. By working together, participants at the workshop gained deeper insights into past climate histories, their drivers, and mechanisms. The focus of the group activity was to analyze, discuss, and present a research article that exemplifies the integration of paleoclimate reconstructions, instrumental records, and climate modelling. Additionally, the activity explored the potential for future collaborations among the group members.

In conclusion, TROPQUA2024 offered a platform for ECRs working in Quaternary science to connect, network, and foster interdisciplinary collaborations. We believe it was highly successful in creating this space, which will lead to collaborative projects in the future among ECRs working with various proxies and models.

Picture 2. TROPQUA organising team and participants spreading awareness about climate change during the "Climate Evening on the Beach" public outreach activity.

NEWS

DISCLAIMER: *As this is a community-driven newsletter, the role of the ECR team is limited to copy editing and reporting only. It will be the sole responsibility of the author/ contributor to ensure the accuracy and authenticity of the contributions. The ECR team is pro-active in collecting as much useful information as possible; however, we rely on community inputs and will not be responsible for any omissions.*

Quaternary Chronicles
Happenings in the Sub-continent
ASSOCIATION OF QUATERNARY RESEARCHERS

5th PALEOSCHOOL 2024 Endorsed by INQUA

The INQUA Executive Committee has officially endorsed the 5th PALEOSCHOOL 2024, a pioneering field training program in paleoanthropology and Quaternary geology in the Indian subcontinent. Led by Dr. Parth Chauhan, paleoanthropologist, and Dr. Prabhin Sukumaran, Quaternary geologist, with support from organisers Tosabanta Padhan and Kshirasindhu Barik, this event marks the fifth instalment in a series focused on providing hands-on, field-based scientific education.

This year's program, which has drawn 129 graduate students from 56 institutions across India, includes a series of focused online lectures followed by a field workshop in Odisha, India, for selected participants. Organized in collaboration with IISER Mohali, CHARUSAT and the PALEOHER Foundation, and hosted by Sambalpur University, Odisha, PALEOSCHOOL 2024 is dedicated to fostering practical skills and inspiring collaborative research in paleoecology and Quaternary sciences.

In the coming years, the team plans to expand PALEOSCHOOL to other South Asian countries, aiming to foster networking and collaboration across the region, and to build a stronger, interconnected scientific community in paleoanthropology and Quaternary research. For more details and to explore collaboration, visit www.paleoher.org.

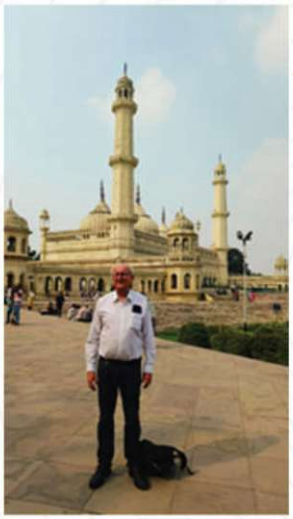
Prof. Dr. Thijs van Kolfschoten, Past President INQUA visited BSIP Lucknow

Prof. Dr. Thijs van Kolfschoten, the Past President INQUA (https://www.inqua.org/), was in Lucknow between 9-15th November. Prof Thijs is presently an Emeritus Professor of Palaeoecology and Quaternary Biostratigraphy, at the Faculty of Archaeology, Leiden University, The Netherlands (E-mail: t.van.kolfschoten@arch.leidenuniv.nl) and a Guest Professor Shandong University, Institute of Cultural Heritage, Cultural Heritage, Shandong University, Qingdao, China. He has been associated with INQUA for long and in many roles. During his stay he interacted with the scientists and students of BSIP, Lucknow University, Ambedkar University Lucknow and also delivered the Sir Albert Charles Seward Memorial lecture on the occasion of the Founders Day at BSIP, Lucknow on the 14th November (Lower Palaeolithic Hominin subsistence and behaviour).

Prof M. G. Thakkar, Director BSIP, Dr. Dhruvsen Singh, Head of Department, Geology, Lucknow University, Dr. Vandana Prasad, President AOQR, Dr. Pradeep Srivastava, INQUA India 2027 President, Dr. Binita Phartiyal, General Secretary INQUA India 2027 and Quaternary Group of BSIP had fruitful discussions with him during his stay in Lucknow. He also visited the Venue of the INQUA 2027-Indira Gandhi Pratishtan and a one-day field trip to Kalpi and Ganga River (Kanpur).

Quaternary Chronicles
Happenings in the Sub-continent
ASSOCIATION OF QUATERNARY RESEARCHERS

Prof. Dr. Thijs van Kolfschoten, Past President INQUA visited BSIP Lucknow



Quaternary Chronicles
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Memorabilia

Ms. Surabhi Verma

We deeply mourn the untimely loss of Ms. Surabhi Verma, a young and dedicated researcher, and extend our heartfelt sympathies to Dr. Yama Dixit, who sustained critical injuries in the tragic landslide at the Lothal Harappan site. This incident (28th November 2024) is a reminder of the inherent risks field researchers face while contributing to scientific knowledge. As a community, it is crucial to prioritize safety by conducting thorough risk assessments, ensuring structural stability during excavations, and adhering to stringent safety protocols. Let us honor their commitment and passion for science by fostering a culture of safety and awareness, ensuring that such heartbreaking incidents are prevented in the future.

4th International Conference on

Geology: Emerging Methods & Applications (GEM-2025)

Annual General Body Meeting of Association of Quaternary Researchers (AOQR), India (2025)

Pre-INQUA 2027 Workshop on "Decoding the Quaternary: New Perspectives on India's Coastal Archives"

ASSOCIATION OF QUATERNARY RESEARCHERS

28-30, January 2025

Pre-conference workshop on "Introduction to Statistics and Data Analyses in Geology using Python"

Organised By,

Department of Geology & Environmental Science

Christ College Autonomous, Irinjalakuda,

NAAC accredited with A++
Affiliated to University of Calicut
Thrissur, Kerala, India

Supported By,

Ministry of Earth Science | National Centre for Earth Science Studies | National Centre for Polar & Ocean Research

TERRAP

About The Conference

The 4th International Conference on Geology: Emerging Methods and Applications (GEM-2025) will be held at Christ College Autonomous, Irinjalakuda, Thrissur, Kerala from January 28-30, 2025. This conference aims to explore recent trends, methods, analytical techniques, and their applications in various areas of Geology and Geophysics. It is unique in its goal to bridge the knowledge-sharing gap between eminent National Institutions and State Universities and Colleges.

The conference also seeks to introduce novel and exciting research questions and topics to postgraduate and research students, helping them choose their interests from a wide range of Earth Science disciplines. GEM 2025 will provide a platform for sharing research experiences among academics, scientists, geologists, young researchers, and professionals from across the country, with selected international participants. The previous conferences in 2017, 2019, and 2023 attracted many participants from India and abroad and were highly effective in knowledge sharing, as evidenced by stakeholder feedback.

This three-day multidisciplinary conference will feature subject experts from diverse fields of Earth Science, representatives from various National and International Institutes and Universities, and directors of major Earth Science research institutions delivering keynote addresses. The conference expects to host around 150 key participants from India and about 15 international scientists. Highlights for students and early career researchers include keynote addresses by field professionals, oral and poster presentations, panel discussions, and interactive sessions.

Conference Highlights

- Keynote addresses by leading experts in Earth Sciences.
- Oral and poster presentations by researchers and professionals.
- Panel discussions and interactive sessions.
- Networking opportunities with national and international participants.

Key Themes

- Polar Sciences
- Artificial Intelligence and Machine Learning in Earth Science
- Climate and Sea-level Changes: Past and Future Predictions
- Hydrogeology and Water Management
- Remote Sensing and GIS in Earth and Planetary Science
- Petrology: Analytical and Field Geology
- Geochronology and Isotope Geochemistry
- Geo-hazards, Mitigation and Management
- Environmental Geology
- Quaternary Geology and Geoarchaeology

Target Audience

The conference is intended for academics, scientists, geologists, young researchers, and professionals engaged in various fields of Geology and Geophysics. It aims to provide a platform for knowledge exchange and collaboration among participants from across the country and selected international delegates.

Important Dates

• Call for scientific abstracts	15-10- 2024
• Finalization of conference partners	25-11- 2024
• Deadline of abstract submission	10-12- 2024
• Review and acceptance of abstracts	20-12- 2024
• Finalization of scientific sessions	30-12- 2024
• Conference dates	28-30-01-2025
• Receipt of full papers for review	31-03- 2025
• Final manuscript	15-10- 2025
• Release of publication	31-12- 2025

CLICK TO REGISTER

Christ College (Autonomous), Irinjalakuda

Christ College was started in 1956, by the Devamatha Province of the Carmelites of Mary Immaculate (CMI), founded in 1831 by Saint Kuriakose Elias Chavara. Founded as per the provisions of the Indian Constitution, part III, Article 30(1) and administered by Christ College Educational Society, (Regd. No. 137/75), this college is a minority institution, affiliated to Calicut University and re-accredited by NAAC with highest grade 'A++'. Christ College has its motto "Jeevitha Prabha", which means "Light of Life". Following recommendation from state government, the college has been conferred the "Autonomous status" by University Grants Commission(UGC) during the year 2015, the Diamond Jubilee year of the college.

Department of Geology & Environmental Science

The Department of Geology was started in 1981. Postgraduate course in Environmental Sciences started in the year 2000. The Department was recognized as a research center of the University of Calicut in the year 2010. The post graduate programme in Applied Geology was started in 2014 and an additional B.Sc. batch with Chemistry and Physics as complementary subjects was started in 2017. The Government of Kerala sanctioned an integrated 5 year postgraduate programme in Geology in 2020.The faculty members of the department regularly get external funding through research projects from state and central government agencies. The Department has also organized national and international colloquiums, conferences and workshops. The Department has Memorandum of Understanding for academic and research collaboration with national and international institutions like Leibniz Institute of Applied Geophysics [Germany], University of Zululand [South Africa] and PAMA for archaeological studies at Thiruvananthapuram.

Pre-Conference Workshop

The Pre-Conference Workshop will be held in the week preceding Conference on the topic, *"Statistics, Data Analyses and Machine Learning in Geology using Python Programming"* for selected 30 students. Certificate endorsed by Ministry of Micro, Small & Medium Enterprises (M/o MSME) & International Accreditation Organization (IAO) will be provided for all the participants.

Key Note Speakers

DR. THAMBAN MELOTH
Director,
National Centre for Polar and Ocean Research
Vasco-da-Gama, Goa

PROF. N.V.CHALAPATHI RAO
Director,
National Centre for Earth Science Studies
Thiruvananthapuram, Kerala

PROF. DR.MAHESH G. THAKKAR
Director Birbal Sahni Institute of Palaeosciences, Additional Charge of Director: Wadia Institute of Himalayan Geology, Dehradun,

PROF. DR. SUNIL KUMAR SINGH
Director,
National Institute of Oceanography
Dona Paula, Goa

PROF. DR. A.K. SINGHVI
Honorary Scientist, JC Bose Fellow and Raja Ramanna Fellow,
Physical Research Laboratory, Ahmedabad

PROF. DR. MANFRED FRECHEN
Head, S3, Geochronology and Isotope Hydrology,, Leibniz Institute for Applied Geophysics, Germany

PROF. DR. DAVID THOMAS
School of Geography and the Environment, University of Oxford,
Oxford, United Kingdom

DR. JULIE DURCAN
School of Geography and the Environment, University of Oxford,
Oxford, United Kingdom

Registration

PG Students	: ₹ 500*
Research Scholars	: ₹ 1000*
Faculty/Scientist	: ₹ 1500*

**Additional ₹ 200 will be charged if you wish to attend the conference dinner.*

To Register CLICK

Abstract Submission Deadline : 10-12-2022

Venue

Christ College (Autonomous)
Irinjalakuda, Thrissur, Kerala

Conference Secretariat

Department of Geology & Environmental Science,
Christ College Autonomous, Irinjalakuda,
Thrissur, Kerala

Convenor & Organizing Secretary

Dr. Linto Alappat
Assistant Professor & Dean of Research
Christ College (Autonomous,Irinjalakuda

Coordinators

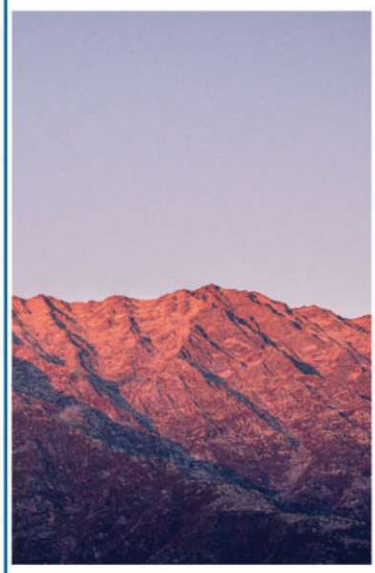
Mr. Tharun R.
Assistant Professor
Department of Geology & Environmental Science
Christ College(Autonomous)

Dr. Anto Francis K
Associate Professor
Department of Geology & Environmental Science
Christ College(Autonomous)

For Further Information

www.gem.christci.in
gem2k17@gmail.com
91 8547201311

"The real voyage of discovery consists not in seeking new landscapes, but in having new eyes"



May you have new hopes, aspirations & resolutions for the coming year,
HAPPY NEW YEAR 2025!

ASSOCIATION OF QUATERNARY RESEARCHERS

Quaternary Chronicles
Happenings in the Sub-continent
ASSOCIATION OF QUATERNARY RESEARCHERS

Quaternary Chronicle (QC) publishes three issues a year seeks to publish perspectives, recently published peer-reviewed papers in Quaternary science, new developments in Quaternary science methods/ techniques, past events, awards, abstracts of recently awarded Ph.D./MS thesis; Quaternary publications, obituaries and details on forthcoming conferences/opportunities/fellowships the world over. Each issue of the newsletter will therefore, comprise news on on/from the Indian sub-continent;. It will also have a platform for discussion on emerging questions and ideas in Quaternary science and details on new books/ monographs/ reviews. QC seeks to share original results, new ideas and innovative development for the common good and a possibility to serve as a catalyst for the initiations of major and coordinated initiatives in the country.

We now accept submissions for our upcoming issues. Submit all the contributions to **aoqr2019@gmail.com**. *Themes for contributions are given below:*

1.Perspective: *Perspective write-ups on emerging trends and new possibilities in Quaternary Science (500 words).*

2.Sneak-peek and Discussion: *Share any exciting findings/questions from your ongoing (unpublished) work already to facilitate discussion. Any other intriguing facts/ unanswered questions are also welcomed for discussion (150 words).*

3.Significant new manuscripts/ books/ monographs/ reviews: *Corresponding authors of recently published peer-reviewed papers are invited to submit a brief summary of their work (not published abstract) with complete reference, web-link, and corresponding email address (200-300 words). Also, include a PDF copy of the paper in the email (for reference only).*

4.Facilities and Instruments: *A list of available facilities at various Indian institutes will be given and updated as contributions are received. In-charge of the available facilities, mentioning whether it is open access or available on payment basis, may submit the details with contact details.*

5. Achievements: *Share national or international awards/ fellowships/ recognitions with the larger Quaternary community. Also, approved SERB/ DST/CSIR/ national/ international Quaternary projects with the title, affiliation details of the awardee and a brief abstract (200 words) may be submitted with a copy of the award letter (for reference only).*

6.Projects/Collaborations: *New projects and collaborations related to Quaternary Science may also be sought for enhancing the quality of ongoing/proposed research. Submit a brief summary of the project, collaborations required and the contact details for correspondence (200 words).*

7. New Thesis: *Abstracts of awarded PhD/MS degree are invited for contribution (250 words).*

8.Opportunities: *Submit details with web-link of any new openings and opportunities for wider circulation.*

9. Social media: *Follow, discuss and share Quaternary India News on https://twitter.com/ AOQRIndia (Twitter) and https://www.facebook.com/ AOQRIndia (Facebook).*

Come join us!

The Association of Quaternary Researchers (AOQR) invites you to register for AOQR Membership and ask your colleagues and students to make the AOQR Fraternity stronger and become a part of the AOQR family.
See the details in https://www.aoqr.org/#

ISSUES	Deadlines (Last date for submission)
Issue -1 (April)	**March 10**
Issue -2 (August)	**July 10**
Issue -3 (December)	**November 10**

M/S ASSOCIATION OF QUATERNARY RESEARCHERS
53 , BIRBAL SAHNI INSTITUTE OF PALAEOSCIENCES
UNIVERSITY ROAD , LUCKNOW U.P

Balance Sheet As on 31st March 2025

LIABILITIES		AMOUNTS Rs. P.	ASSETS	AMOUNTS Rs. P.
Capital Fund			**Current Assets, Loans & Advances**	
Opening Balance	387504.32			
Members Fee	136000.00		Bank Balance	1538043.22
Less: Exps.over Income	1009538.90	1533043.22		
Exps. Payable		5000.00		
Total		**1538043.22**	**Total**	**1538043.22**

For ASSOCIATION OF QUATERNARY RESEARCHERS

President **Seceratory**

For Navdeep Maheshwari & Associates
Chartered Accountants

Navdeep Maheshwari
(Proprietor)
M.No.:419269

Place: Amroha
Date: 21/08/2025

M/S ASSOCIATION OF QUATERNARY RESEARCHERS
53 , BIRBAL SAHNI INSTITUTE OF PALAEOSCIENCES
UNIVERSITY ROAD , LUCKNOW U.P

Receipts & Payment account for the year ending on 31/03/2025

PARTICULARS		AMOUNTS Rs. P.		PARTICULARS		AMOUNTS Rs. P.
To Opening Balance			By	Expenses On AOQR		319017.00
Cash	0.00		By	Proffessional fee		5000.00
Bank	387,504.32	387504.32	By	Bank Exps		1244.10
To Donation Received		1339800.00	By	Closing Balance		
To MmbershipFees		136000.00		Cash	0.00	
				Bank	1,538,043.22	1538043.22
		1863304.32				**1863304.32**

Income & Expenditure account for the year ending on 31/03/2025

To Bank Expenses on AOQR		1244.10	By Donation Receive	1339800.00
To Expenses Others		319017.00		
Conference support Exps	102016.00			
Web Renew & Maint. Exps	12059.00			
Exps on Podcast	174000.00			
Social Media Licencing	16703.00			
Renewal Exps	10000.00			
Mail merge Google Add-on	4239.00			
To Proffessional fee		10000.00		
To Income over Expenditure		1009538.90		
Total		**1339800.00**	**Total**	**1339800.00**

For Navdeep Maheshwari & Associates
Chartered Accountants

Navdeep Maheshwari
(Proprietor)
M.No.:419269

Place: Amroha
Date: 21/08/2025

For ASSOCIATION OF QUATERNARY RESEARCHERS

President **Seceratory**