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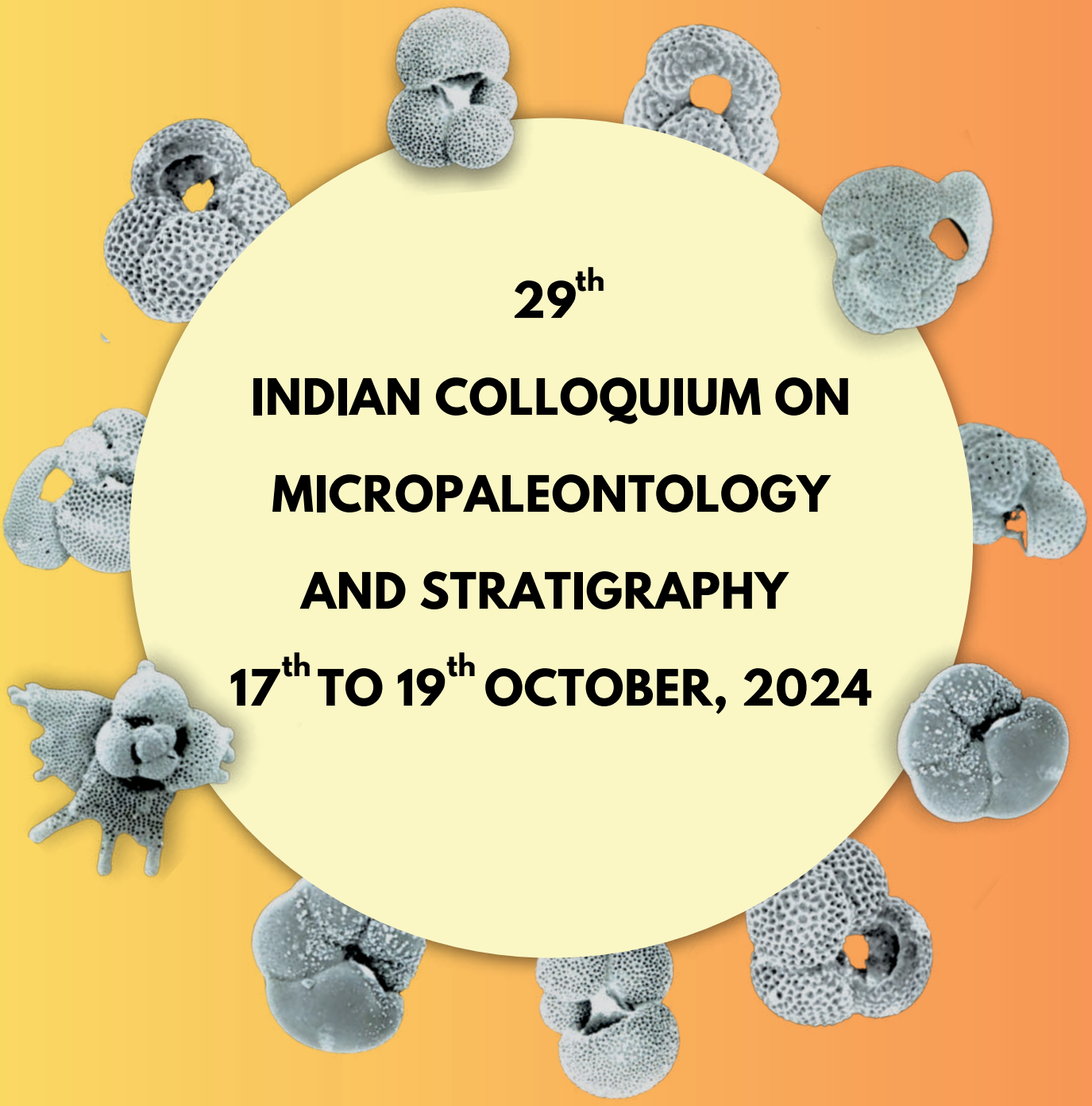

29th INDIAN COLLOQUIUM ON MICROPALEONTOLOGY AND STRATIGRAPHY

17th TO 19th OCTOBER, 2024

DEPARTMENT OF GEOLOGY

UNIVERSITY OF DELHI

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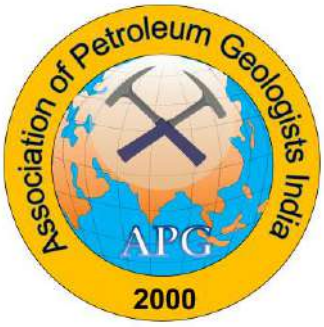

ABSTRACTS

29th Indian Colloquium on Micropaleontology & Stratigraphy

17th – 19th October, 2024

Department of Geology
University of Delhi
Delhi

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Abstract Volume Edited by

Ashutosh K Singh
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University of Delhi

The University of Delhi is a premier university of the country with a venerable legacy and international acclaim for its highest academic standards, diverse educational programmes, distinguished faculty, illustrious alumni, varied co-curricular activities and modern infrastructure. Over the many years of its existence, the University has sustained the highest global standards and best practices in higher education. Its long-term commitment to nation-building and unflinching adherence to universal human values are reflected in its motto: 'Nishtha Dhriti Satyam' 'निष्ठा धृति सत्यम्' (Dedication, Steadfastness and Truth). The University of Delhi completed 100 years of its existence, and the year 2022-23 was celebrated as the Centenary year and culminated with the gracious presence of the Honourable Prime Minister of India at the Valedictory function. The University of Delhi has been recognized as the Institution of Eminence (IoE) by the UGC, and in the IoE, the university has established many Centres of Excellence as Schools. These include the Delhi School of Climate Change and Sustainability, Delhi School of Public Health, Delhi School of Public Policy and Governance, Delhi School of Transnational Affairs, Delhi School of Skill Enhancement & Entrepreneurship Development, and the Delhi School of Analytics. Through IoE the University has been able to provide Research Grants to all its departments through a peer review process. The IoE has also provided funds for buying new equipment and maintenance grants for the existing equipment. Many faculty members have benefitted from generous grants from the IoE. Aboy 50 Maharshi Kanad Post Doctoral fellowships have been awarded under various Institutions of eminence. Recently, Delhi University has improved its position in the QS World ranking.

Department of Geology
University of Delhi

Department of Geology at the University of Delhi is one of India's premier learning centres for geoscience. It was established in 1966 by Prof. A.G. Jhingran (former DG GSI) to provide useful education, conduct high-quality original research, and provide leadership in various geosciences disciplines. The department was one of the five University centres awarded Centre of Advanced Studies. The Department is committed to providing the highest levels of education through continuous revisions and expansion of our educational, research, and interactive programs to produce well-trained, competent, academic, and professional geologists capable of scaling new heights in the frontiers of geoscience. There are many good laboratories in the Department with excellent facilities. The Micropaleontology laboratories include advanced stereo zoom binocular microscopes with image analyzers, a Scanning Electron Microscope, Advanced Polarizing Microscope for Nannofossil studies with an image analyzer, and an international standard deep sea core processing. Laboratory. The Department offers a full course on Micropaleontology and Paleoceanography, including Theory and Practicals. The Department has over 30 good research-grade stereo zoom binocular microscopes for M.Sc. for practical purposes. Students. The other facilities include TOC Analyser, XRD Lab, XXRF Lab, Remote Sensing Lab, Advanced Perology Lab, OSL Lab, Quaternary Lab, Clay Mineralogy Lab, Sedimentology Lab, metamorphic Petrology Lab, and Hydrogeology Lab. All the class rooms of the Department have smart board and modern facilities for audio-visual teaching.

From Convener's Desk

I feel great pleasure in bringing out the Abstract Volume, which consists of 215 abstracts of oral and poster presentations, including 13 Keynote addresses to be presented at the 29th Indian Colloquium on Micropaleontology and Stratigraphy (ICMS 2024, Delhi) at the Department of Geology, University of Delhi.

The ICMS started in 1971 in Bangalore, and since then, the event has been organized by enthusiastic Micropaleontologists from various parts of the country. Delhi University had the privilege of organizing the 12th ICMS in 1986. The hosts have been from Universities, Research Institutes, and Industries, which gives testimony to its wide acceptance by the Micropaleontological fraternity.

With the passage of time and advancements of new techniques, the ambit of the ICMS has been widening, and the diversity of research topics has been increasing manifolds. In recent years, more presentations have been on applied aspects of micropaleontology, especially stable isotope and trace element chemistry of microfossils in palaeoceanography, paleoclimate, and environmental studies. The application of microfossils in solving stratigraphic problems has been known for a long time. The famous discovery of Conodonts from Tal Phosphorites brought one of the remarkable age revisions of the Krol-Tal-sequences from the Mesozoic to the Precambrian-Cambrian age. All important stratigraphic boundaries, including the Permian-Triassic and Cretaceous-Paleogene boundaries, have been resolved with the help of microfossils. Detailed biostratigraphic work from Palaeozoic, Mesozoic, and Cenozoic sequences of India has paved the way to divide the stratigraphic successions into fine time intervals, enabling global correlations. The application of stable isotopes in micropaleontology brought a revolution in Neogene Paleoceanography. The concept of the Marine Isotope Stage has been possible only with the help of worldwide stable isotopic data generated from foraminifera, which is the backbone of global correlation up to the base of the Pliocene. The trace element geochemistry of microfossil shells has been utilized in many ways to decipher various oceanographic parameters in the geological past.

Documenting punctuated equilibria and phyletic gradualism in microfossil evolution has revised many microevolution concepts. Advancements in molecular micropaleontology have raised many questions about morpho species vs biological species in extant forms.

At Delhi University, our research group is involved in establishing high-resolution planktic foraminiferal biostratigraphy of the Neogene Deep Sea sequences from the world oceans. The biostratigraphic data has been used to identify synchronous and diachronous events by integration with magnetochorology. This has helped to understand the planktic foraminiferal evolution, speciation, and migration to places other than their seat of evolution. Further, our group is involved in understanding the impact of the closing and opening of ocean gateways on global climate, variation in the strength of surface ocean currents, and migration of polar fronts from the geological past due to major climate changes. Recently, we have started working on other groups of microfossils like Calcareous Nanno Fossils and Radiolaria to establish multiple microfossil biostratigraphy for the deep-sea sequences located in diverse oceanographic setups.

The abstracts received in the ICMS emerge from all the fields of application of microfossils in inferring paleoceanography and paleoclimate at various time scales. In addition, the valuable microfossil data from Indian stratigraphic horizons ranging from Cambrian to Holocene have been presented in the abstracts.

Organizing such a big national Conference was a huge task and couldn't have been possible without the valuable cooperation of the University of Delhi and many generous Sponsorships. I am grateful to Hon. Vice-Chancellor Prof. Yogesh Singh for his consent to be the Chief Patron of the 29th ICMS. The generous financial grant from the University of Delhi to organize the ICMS is thankfully acknowledged. I am grateful to all the Department of Geology faculty members for always supporting me in preparing for the ICMS. The non-teaching staff of the Geology department were of extreme help in many official formalities. The administrative staff of the University of Delhi were always ready to extend their support whenever required. The sponsorship from ONGC (APG), ONGC Videsh Ltd., Oil India Ltd., Beicip FranLab India, CSIR New Delhi, SERB (DST) New Delhi, MoES, New Delhi, NCESS, Thiruvananthapuram, NCPOR, Goa, INSA, New Delhi is thankfully acknowledged. I thank all our students, research scholars, and PDFs who have extended their support.

I am highly satisfied to present a valuable collection of abstracts provided by researchers in diverse fields before the Micropaleontological fraternity. I am sure this abstract volume will serve as a state-of-the-art summary of the high-quality research carried out in micropaleontology and stratigraphy by Indian researchers.

ASHUTOSH K SINGH
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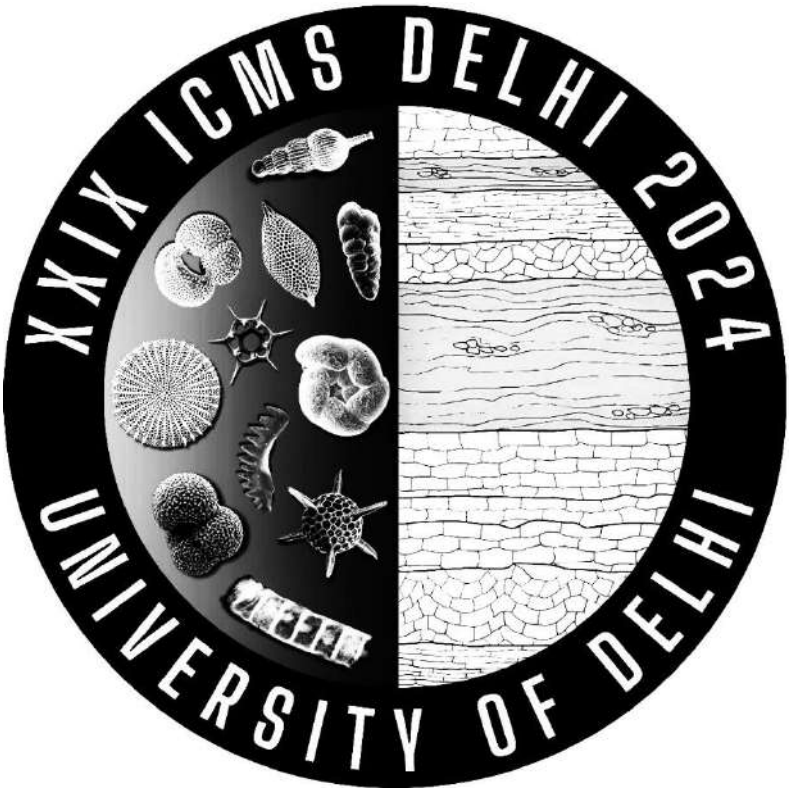
XXIX ICMS DELHI 2024
UNIVERSITY OF DELHI

CONTENTS

Abstract no: ICMS 2024/ DU/ 1 **Mode of Presentation: POSTER**

LITHOSTRATIGRAPHY OF THE RALAM FORMATION IN KUMAUN TETHYS HIMALAYA, INDIA

A.J. Joshi and R. Upadhyay
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The present study aims to understand better the Ralam Formation's architecture in the northeast region of the State of Uttarakhand, India, and its implications for depositional environments. The Higher Himalaya extend northwards up to the Tethyan Thrust zone, juxtaposed over which the highly deformed, largely incompetent Martoli Group is present. Northwards, the Ralam Formation was initiated and mapped along the Gori Ganga and Darma Ganga valleys. About 30 samples were collected from this Formation spanning 5 lithological logs for petrography, along with 7 traverses across the Ralam Formation-Martoli Group contact, and recording of clast orientation, other paleocurrent indicators, biogenic structures along with other features.

It was found that the rutaceous-silicious sequence transgressing over the early Paleozoic unconformity has more than a kilometer-thick deposit preserved in this region, trending a minimum of 70 kilometers. Within this distance, the contact varies from an angular unconformity to displaying conformable signatures and sometimes showing a faulted nature.

The competent sequence riding above this contact shows stark variation in facies along and across the strike. The thick conglomerate beds have interbedded red quartzites and are rarely capped by discontinuous shale beds. Along with the red quartzites, this unit is missing along some traverses and shows a regional trend of decreasing thickness towards the east. Along one such traverse, the conglomerate clasts have preferential alignment due to deformation and are sandwiched between the grey-green arenites. These arenites are formed from dominantly cross-laminated and trough-laminated beds and house their thickest exposures in Darma Ganga valley with beds about 30-45 centimeters thick, interbedded with very thin discontinuous slaty-silty beds. This unit grades into thin quartzite-slate intercalations, which are found to be trace fossil-rich in the Kolganga Valley. The entirety of which is categorized as the Ralam Formation.

Abstract no: ICMS 2024/ DU/ 2 **Mode of Presentation: ORAL**

ANTARCTIC ICE SHEET DYNAMICS DURING EARLY OLIGOCENE

A. S. Maurya* and Rakesh Kumar
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The Oligocene is often seen as a pivotal time, bridging the ancient tropical ecosystems of the Eocene with the more modern environments of the Miocene. This study examines how marine benthic foraminifera responded to early Oligocene climate shifts at Ocean Drilling Program (ODP)Hole 1138A in the Southern Ocean's Indian Sector. By analyzing diversity metrics, the relative abundance of dominant benthic foraminifera, and isotopic data, we aimed to reconstruct past oceanographic conditions. These changes were also connected to waning and waxing Antarctic sheets during the early Oligocene. Our findings indicate that the early Oligocene experienced unstableconditions, characterized by species thriving in high oxygen levels, intermediate food supplies, and cold, well-ventilated, corrosive bottom waters. A significant drop in species richness towardsthe end of the period corresponds with a major glaciation event in the Southern Hemisphere. During this glaciation, species were adapted to colder, more carbonate-corrosive bottom waters. The study also shows that the early and late stages of the interval were marked by cooling in the Southern Ocean, interrupted by a brief warming period. This research contributes to our understanding of paleo-marine ecology by examining how deep-sea benthic foraminifera responded to global climate change sandwiched between warm Eocene and cold Miocene.

Abstract no: ICMS 2024/ DU/ 3 **Mode of Presentation: ORAL**

RECONSTRUCTION OF MODERN ENVIRONMENTAL CHANGES BASED ON BIOMAPPING OF RECENT OSTRACODES FROM ALL ECOSYSTEMS

A.S. Vaidya, Asha, Gajendra.G.M, Narayanaswamy Y, Namratha.N.C, Prashantha.M.T.

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Ostracodes are bivalved microcrustaceans proven to be useful in understanding the climate change. They occupy all aquatic habitats, including freshwater forms; paddy fields are smooth and thinly calcified, while brackish and marine forms are thickly calcified or ornate. Although many published articles are available from India, their potential to delineate environmental changes has yet to be fully developed. The microcrustaceans are very sensitive and respond quickly to changes in pH, water chemistry, temperature, substrate characteristics, nutrient availability, and human intervention and tend to survive even in toxic, pesticides, herbicides, and heavy metal polluted waters. They adapt morpho changes and find thin/thick, tumid, spinose, and nodose shells. The depth of the water can be inferred based on the eye spot. Thus, they can be used to identify the stressed environment viz. Global warming, oxygen deficiency, oil and gas seepages, mining, and anthropogenic pollution. Besides, many of them are known to be either endemic or cosmopolitan and benthic. Behavioral changes of Ostracodes vary according to different ecosystems. They are useful in palaeoenvironmental reconstruction and biostratigraphic zonation and are considered nitrogen fixers in paddy fields. Also, very limited work has been noted on Ostracodes from cold water zones and paddy fields of India. Further, specific species-isomorphs remain to be identified from such prevailing conditions. Ostracodes are also used as proxies in deciphering effectively to reconstruct modern and past environmental changes and relative rates of sedimentation. Further, there is hardly any work on their fossil counterparts so far, and there is an urgent need to fill up the gap. Keeping this in view, James Hutton's theory of Uniformitarianism, "Present is key to the past," an attempt has been made by us to understand whether there is any close association of living Ostracodes with their fossil counterparts. These days, lots of Freshwater bodies, reservoirs, particularly important lakes, and ponds have been dried, either polluted or lost due to city expansion, deforestation, and anthropogenic activities, resulting in a threat to their occurrence. Conservation of water bodies and documentation of microcrustaceans is essential and need of the hour soon.

Abstract no: ICMS 2024/ DU/ 4 **Mode of Presentation: ORAL**

LATE NEOGENE-QUATERNARY MULTI-PROXY RECORDS OF EL NIÑO VARIABILITY: IMPLICATIONS ON TROPICAL INDIAN OCEAN PALEOCLIMATE AND PALEOCEANOGRAPHY

Ashutosh K. Singh and Devesh K Sinha
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The El Nino affects the Western Pacific Warm Pool (WPWP) in such a way that during strong and persistent El Nino in the Geological past, the WPWP strength has been reduced, and the thermocline and mixed layer planktic foraminifera have responded to El Nino, forcing. These forces influence the Indonesian throughflow and strength of the Leeuwin Current and Sea Surface Temperature in the Northern and Eastern Indian Oceans. Some important and intriguing questions about El Nino variability are still debatable. Some workers, based on their SST data, suggested that the El Niño/Southern Oscillation (ENSO) system during the Pliocene warm period (PWP; 3–5 million years ago) may have existed in a permanent El Niño state with a sharply reduced zonal sea surface temperature (SST) gradient in the equatorial Pacific Ocean which was later challenged by other group based on Coral Records. Detailed planktic foraminiferal biostratigraphy has been established for the ODP Site 762B (Eastern Indian Ocean), which records the changing variability of the Indonesian Throughflow influenced by El Nino. The Indonesian Throughflow region connects the tropical Pacific Ocean with the eastern Indian Ocean, and variability of the Throughflow during the Plio-Pleistocene has been related to major climate shifts at the global level. Biostratigraphy has been integrated with magnetostratigraphy, and a robust age model has been developed for the Indonesian Throughflow region to scale paleoceanographic and paleoclimatic events over time. Intervals of weakening of the Leeuwin Current have been identified based on multi-proxy data (stable isotope and planktic foraminiferal census counts) The weakening of the Leeuwin Current would affect the sea surface temperature in the Indian Ocean as the Indonesian throughflow generally warms the Indian Ocean; thus, these cold intervals could probably be the intervals of considerable lowering of SST in the Indian Ocean and would have influenced Indian Monsoonal intensity.

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LATE QUATERNARY PALEOMONSOON RECORD FROM THE BAY OF BENGAL AND THE ANDAMAN SEA

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The northeastern Indian Ocean Sea receives a huge amount of rain and river discharge during summer, resulting in strong stratification and pervasiveness of oligotrophic conditions, which are reflected in the planktonic foraminifera distribution, providing an opportunity to study the effect of monsoon forcing and stratification history. We investigated planktonic foraminifera, pteropods abundances, and their isotopic, elemental compositions of cores retrieved from the Bay of Bengal and the Andaman Sea to document the Indian summer monsoon variability during the late Quaternary. The cores analyzed span from a few kilo years to 1.2 million years, documenting centennial – millennial – orbital scale changes in the evolution of the Indian summer monsoon.The records show that intensified monsoon periods have witnessed lower productivity, similar to prevalent oceanographic conditions in the study area. The prominent stratification events were observed during interglacial periods, whereas periods of enhanced productivity and well-ventilated water column were observed during glacial periods. During the last glacial cycle, strong stratification and intense ISM were seen during MIS 3 and Bølling/Allerød (B/A). Indian summer monsoons were strong during the Eemian interglacial and early to mid-Holocene periods, which slowly muted upwelling and productivity. The intense summer monsoon periods have resulted in poor preservation of pteropods. Pteropods' better preservation and abundance are observed during glacial periods marked by weak stratification and well-ventilated water column. Overall, the late Quaternary productivity variations in the Andaman Sea are primarily modulated by salinity-related stratification and have been controlled by variations in the northern hemisphere insolation, internal forcings, Atlantic teleconnection on Heinrich and D/O time scales, and shifting feedback associated with the summer-winter monsoon interaction.

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ENVIRONMENTAL MONITORING IN COASTAL REGIONS THROUGH BENTHICFORAMINIFERA ANALYSIS ALONG THE SOUTHWEST COAST OF INDIA

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Foraminifera are highly sensitive to the specific environmental conditions in which they reside, making their study crucial for understanding environmental characteristics. In the study area, the geological age map indicates that the Kerala coast is of Quaternary age, which began 2.6 million years ago and continues to the present. This age is associated with mild weathering and deposition processes typical of the Kerala coast, which can also be correlated with the geomorphology map, where the younger coastal plain is evident. The Kerala coast primarily features calcrete formations, while charnockite is more prevalent along the Tamil Nadu coast. Magnetic susceptibility was employed to study the magnetism of rocks and minerals. At the same time, X- ray fluorescence (XRF) was utilized to identify the weathering grade of the samples, which ranged from high to low. Foraminiferal analysis of 13 samples revealed nine species: *Ammonia dentata*, *Ammonia beccarii*, *Amphistegina sp.*, *Elphidium macellum*, *Elphidium crispum*, *Quinqueloculina sp.*, *Globocassidulina subglobosa*, *Lenticulina sp.*, and *Jadammina macrescens*. Among these, *Amphistegina sp.* was predominant in most samples, indicating its preference for warm, shallow waters, typically found between the coastline and coral reefs. The hard test of *Amphistegina sp.* allows it to survive in wave-agitated waters. *Ammonia dentata*, commonly found in tidal flat muddy sediments, and *Elphidium crispum*, a species abundant from coastal regions to the continental slope, were also prevalent. These findings suggest that the coastal environment in the study area is characterized by tidal fluctuations and warm temperatures, as evidenced by the presence of *Amphistegina sp.* in most samp

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MIDDLE EOCENE NANNOFOSSIL BIOSTRATIGRAPHY AND PALAEOENVIRONMENT FROM WESTERN GARO HILLS, MEGHALAYA

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One of the global characteristic features of the Eocene is extensive development of Carbonate Platforms in various regions of Tethys. Paleogene sequences of the Shillong Plateau from west to east are exposed in the steep Garo, Khasi and Jaintia Hills. In the Khasi and Jaintia Hills, Paleogene successions are represented by alternating carbonate and clastic deposition and provide datable micropaleontological markers. Whereas, in the Garo Hills, which is in the south-western part of the Shillong Plateau, the Paleogene succession is mainly represented by clastics and lesser development of carbonates. The carbonates in this area are mostly marly in nature hence provide difficulty to have datable carbonate micropalaeontological proxies like foraminifera and calcareous nannofossils. However, in the present study well preserved and fairly diversified calcareous nannofossils were recorded from the CTD section (25° 23' 41.3' N, 90° 17' 20.7" E) western Garo Hills, exposed near Dagugre village. Nannofossil biostratigraphy was performed on 50 samples from the 18 m thick sedimentary succession of the Siju Formation. Recorded nannofossil assemblages indicate the middle Eocene (Bartonian) age for the studied succession based on the presence of *Discoaster barbadiensis, Discoaster saipanensis, Reticulofenestra bisecta, Reticulofenestra erbae* and *Reticulofenestra reticulata*. The assemblage is mainly dominated by the genus *Reticulofenestra* which in general, dominates in the coastal and shallow marine depositional settings. The abundance of small Reticulofenestrids especially *Reticulofenestra minuta* indicates an increased freshwater impact and terrigenous input during sea-level falls.

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DECIPHERING CLIMATE HISTORY: THE ROLE OF DIATOMS IN UNDERSTANDING ANTARCTIC SEA ICE VARIABILITY

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Diatoms represent a major phytoplankton group in polar and sub-polar marine environments, alongside green algae and chrysophytes. These organisms consist of organic cells enclosed within a two-valved frustule composed of amorphous silica. Diatom species in these environments typically exhibit narrow ecological tolerances, particularly with respect to sea-surface temperature and sea ice conditions. The preserved diatom assemblages in deep-sea sediments faithfully reflect the composition of the living phytoplankton communities, allowing for the extrapolation of relationships between diatom assemblages in surface sediments and modern-day environmental parameters. This approach facilitates reconstructing past changes in sea-surface temperatures and sea ice conditions by analyzing down-core fossil diatom assemblages.

Investigating the variability of Antarctic sea ice is crucial for understanding the Southern Ocean's role in the climate system and carbon cycling. However, accurately simulating recent sea-ice changes remains challenging, making it difficult to confidently project future changes and their impact on the global climate system. Reconstructing past sea-ice cover changes can offer valuable insights into climate feedback within the Earth system across different timescales. Currently, only a limited number of marine sea-ice proxy records cover the full 130,000-year (130 ka) last glacial cycle. The pattern of sea-ice advance and retreat during glacial-interglacial cycles appears to be relatively consistent across the various basins of the Southern Ocean. Sea ice retreated rapidly during Terminations II and I, whereas its expansion during the last glaciation was more gradual. Marine records indicate that sea ice reached its maximum extent during Marine Isotopic Stage 2. However, additional sea-ice records and transient model simulations are necessary to better identify the drivers and feedback mechanisms behind Antarctic sea-ice changes over the past 130 ka.

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VARIATION IN BENTHIC FORAMINIFERAL ASSEMBLAGES RECORDED FROM THE SEDIMENT CORESAMPLE IN CHILIKA LAGOON (ODISHA, INDIA)

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Chilika, the second-largest lagoon in the world, gained international recognition as a significant wetland under the Ramsar Convention in 1981. A study was conducted in the southern sector (Barkul) of Chilika lagoon, where benthic foraminiferal species were studied from a sediment core sample sliced at 1cm core intervals. The preserved calcitic tests of the foraminifera in the sediment have the potential to record the past environmental conditions, which play an important role in paleoclimatic and paleoenvironmental reconstruction. During the study, we observed significant differences in morphological features of foraminifera, specifically the Greatest Spiral Diameter (GSD) from the core sample. The peaks in foraminiferal abundance were mainly recorded at depths of 2cm, 5cm, and 15cm along the core. The abundance and the test size in foraminifera were found to increase at a depth of 15cm. The total foraminiferal number (TFN) decreased with increased sand percentage inthe core sample. We recorded that *Ammonia parkinsoniana* was the dominant species, followed by *Ammonia tepida* and *Ammonia sobrina*. However, *Ammonia sobrina* is scarce at a depth of 16 cm and beyond. We can interpret that the species of *Ammonia*, known to be stress-tolerant and opportunistic, have potentially adapted themselves to the change in environmental conditions. Among the three, *Ammonia sobrina* is the least tolerant species. The variation in the environmental condition is due to high influx ofrivers, present in the northern sector of the lagoon, increased intensity in monsoon and high inflow during tidal activities from the Bay of Be

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OVERVIEW OF EOCENE ARTHROPODS IN INDIAN AMBER: PALAEOENVIRONMENTAL RECONSTRUCTION,ECOLOGY AND GEOLOGICAL IMPLICATIONS

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More than thirty taxa of fossil arthropods preserved in amber nodules, ranging in age from 54 to 40 million years have been reported from the open-cast lignite mines of the Kutch and Cambay basins in Gujarat. The amber assemblage is dominated by 55% of canopy, 32% xylophagous and terrestrial, 3% litter-dwelling and sub-soil, and 10% of aquatic biota. The amber assemblage enables the precise identification of trapped fossils and the palaeoenvironmental reconstruction of their habitats during the Eocene, providing insights into ancient biodiversity and environmental conditions. The most dominant group of insects are true flies including non-biting and biting midges (Families Chironomidae, Cecidomyiidae and Ceratopogonidae) that makeup the major proportion of flying biota. The arboreal taxa of social insects comprise of nine taxa of ants (Family Formicidae) and some unidentified groups of wasps and termites. Arachnid fossils include spider taxa and a new pseudoscorpion taxon *Geogaranya valiyaensis* in amber. Spider genus *Rugathodes* exhibits traits of parental care with evidences of unidentified egg sacs. *Baalzebub* in amber resin represents the oldest representative of Family Theridiosomatidae. *Geogaranya valiyaensis* (Family Geogarypidae) is the first ever phoretic taxa recorded from Indian amber from a warm-temperate biome. Of special significance is the occurrence of chrysomellid beetles and oribatid mites as representatives of the litter- dwelling sub-soil biota. Plant remains in amber are vital in understanding the symbiotic relationship or otherwise between plants and insects. Freshwater ostracod families comprising of uniquely preserved soft parts intact, which include anterior appendages and adductor muscles. The arthropod assemblage is an indicator of dispersal in and out of India with affinities to Europe, Asia and Gondwana. India lay as an island subcontinent at the equator at a time when the earth was experiencing episodic thermal heating. The Eocene saw an intense biotic radiation with many of the lineages surviving up to the present day.

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DEEP-WATER AND THERMOCLINE VENTILATION CHANGES IN THE EASTERN ARABIAN SEADURING THE LAST 30 KYR

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Deep-water ventilation is responsible for regulating heat and biogeochemical cycling of nutrients withinthe ocean and it also controls the concentration of oxygen, temperature and salinity within the basin. Thus, it is crucial to understand the deep-water ventilation dynamics of the Indian Ocean. However, high-resolution proxy records dealing with the ventilation dynamics of the Indian Ocean are still scarce. Here, we present $\delta^{13}C$benthic foraminifera record from a sediment core (SSD60/GC10), retrieved from the eastern Arabian Sea (14°9' N, 72°17' E; water depth=2055 m). Age model of the core is based on nine radiocarbon C^{14} dates. For benthic isotope measurements, we picked 20 shells of *Cibicides wuellerstorfi* (epifaunal species) from each sediment sample >125 µm size-fraction. A gas-bench Thermo-IRMS at SATHI facility, CDC-BHU was used for analysing the $\delta^{13}C$ and $\delta^{18}O$. The precision was 0.05‰ for $\delta^{13}C$and 0.02‰ for $\delta^{18}O$ obtained by repeated measurements of NBS-18 standard. $\delta^{13}C$ varies from -1.41‰to 0.55‰ with an average value of -0.42‰. Additionally, we developed pteropod preservation record from the same core. Our study indicates increased ventilation during the cold periods (H3, H2, LGM, H1, and YD), whereas the warm period (B/A) is characterised by reduced ventilation in the eastern Arabian Sea. Increased influence of Antarctic Intermediate Water (AAIW) could be the reason for enhanced ventilation during these cold intervals, while during B/A, influence of AAIW was much reduced resulting in sluggish ventilation. The comparison of our records with earlier records from the Arabian Sea basin reveals spatial and temporal heterogeneity in the deep-water ventilation of the Arabian Sea.

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MIDDLE TO LATE JURASSIC FORAMINIFERA FROM JHURA DOME, KACHCHH BASIN, INDIA: SYSTEMATICS AND PALAEOENVIRONMENTAL IMPLICATIONS

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The Middle to Late Jurassic, Jhura Dome, Kachchh, India yielded foraminiferal assemblages comprising 87 species, dominated by the family Vaginulinidae. This work is a systematic account of the 27 species recorded for the first time from this region. The foraminiferal assemblages are employed to determine the palaeoecology and palaeoenvironment of the Jhurio and Jumara formations. The benthic associations wereestablished employing Q-mode cluster analysis of the species' present/absent data set in the benthic foraminiferal assemblages. Parameters like dendrogram and nMDS (Nonmetric Multidimensional Scaling) plots are used to investigate the relationship between the biota andthe environment among different sects. The sedimentation zone ranges from the shallower partof the mid-shelf to the deeper part of the outer shelf, having fluctuating salinity, oxygen levels, and nutrient accessibility. The study shows that the examined stratigraphic intervals were beingdeposited at the time, indicating that the environmental conditions at the depositional site werenot remarkably stable.

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THE VERTICAL DISTRIBUTION AND AMOUNT OF CARBON IN THE MANGROVE FORESTS SEDIMENTS FROM PICHAVARAM, EAST COAST OF SOUTH INDIA

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Mangroves are widely recognized as key ecosystems for climate change mitigation as they capture and store significant amounts of sediment organic carbon. Mangrove forests are crucialin the carbon cycle, capturing atmospheric CO_2 and storing it in plant biomass and sediments. This study assessed carbon sequestration and climatic variability in the Pichavaram mangrove forest (latitude 11°26'24.62" N, longitude 79°47'54.44" E), situated along the southwestern partof Bay of Bengal, Tamil Nadu. An approximately 132 cm-long sediment core was analyzed to determine carbon stocks and carbon sequestration rate. Key measurements included sediment bulk density, which averaged 1.1617 g/cm³, and average concentrations of totalcarbon (0.3670 wt. %), inorganic carbon (0.0822 wt. %), and total organic carbon (0.2929 wt. %). The carbon stock of the entire study area is estimated as 409.928 $MgCha^{-1}$ of sediment, with a CO_2 equivalent of 1504.436 $MgCO_2ha^{-1}$. The carbon sequestration rate (CSR) is 0.1013 g C cm^{-2} yr^{-1}, while the carbon sequestration potential is 111.439 g C cm^{-2} yr^{-1}. This CSR is significantly lower compared to the global average of 17.4 g C cm^{-2} yr^{-1}, representing only 0.5% of the global rate. The results show 1504.436 Mg of carbon dioxide could either be removed or released to the atmosphere by the mangrove forest of Pichavaram through forest degradation. Depth-related reductions in carbon concentration are attributed to decrease organic matter supply, mineralization, decomposition, and leaching. The study also highlights the impact of tidal fluctuations, northeast monsoonal patterns, and anthropogenic activities on carbon sequestration. Increasing coastal aquaculture and the resultant rise in salinity may affect salt-tolerant vegetation. Mangrove organic carbon is primarily stored in soils, which contain more than two-thirds of total mangrove ecosystem carbon stocks.

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FORAMINIFERA: CLUES FOR MTD AND GAS HYDRATE GENESIS

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Gas hydrates are solid crystalline ice-like matter consisting of water molecules and methane. These are metastable and extremely sensitive to pressure-temperature variations. Shallow marine environments with coarse-grain-rich sediments are considered ideal sites for submarine gas hydrate nucleation. Syngenetic gas hydrates or methane-rich environments can influence foraminiferal distribution and $\delta^{13}C$ variations in their calcitic test. Gas hydrate investigation through the National Gas Hydrate Program (NGHP) -01 in the Bay of Bengal reveals accumulation of gas hydrates in relatively deeper sites within clay to silt-rich environments. Here, we performed benthic foraminiferal investigations within the gas hydrate- rich NGHP sites in the Bay of Bengal. The benthic foraminiferal population shows 2-fold distributions in our generated record. The mid-depth sediments are rich in shelf foraminiferal assemblages (*Ammonia* spp., *Bolivinita subangularis*, *Loxostomum amygdalaeformis*, and *Quinqueloculina seminulum*). In contrast, the lower and upper sequences are with expected deep-water foraminifera (*Cassidulina carinata*). The mid-depth sediments are also rich with detritivore species *Bulimina marginata* and oxic environment indicator *Cibicides wuellerstorfi*. The $\delta^{13}C$ values of B. marginata vary between 0‰ to -1.5‰, considered the normal excursion range. Whereas the $\delta^{18}O$ values of the same species range from -1‰ to 5‰. All those foraminiferal census data and isotopic values indicate (1) the mid-depth sediments are transported one, may have been formed as mass transport deposits (MTD), (2) transportation of those sediments from the shelf zone having more input of detrital sediment and organic carbon (3) accumulated gas hydrates in these sediments are post-genetic. The seismic reflection profile along line DGSW-16 shows the presence of a chaotic zone within the mid-depth sediments with well-developed sigmoidal structures. The development of the chaotic zone and the sigmoidal structures (commonly generated along the toe zone of MTD) corroborates our observations of the development of MTD. We also suggested that the enhanced supply of sediment-loaded riverine waters during intense monsoon (climatic warmth) triggered the formation of gravity-drive MTD. The upward migrated methane from the subsurface gas hydrates probably nucleated within the fracture and intergranular pore spaces within the MTD, and the MTD thus acted as a host of gas hydrates.

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IMPACT OF CHANGING NEOGENE CLIMATE ON THE PLANKTON COMMUNITY: EVIDENCE FROM THENORTHEAST INDIAN OCEAN (ANDAMAN AND NICOBAR BASIN)

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The Neogene Period (23.03-2.58 Ma) that includes Miocene and Pliocene epochs experienced number of significant events globally. Major climatic changes ranging from greenhouse climate to ice-house climate took place during the Neogene Period and these changes possibly occurred due to various factors, e.g., CO_2 concentration in the atmosphere, orbital orientation, heat transport in the oceanic realm etc. Climate changes in the Miocene were influenced by the oscillations in the magnitude of obliquity and eccentricity of the Earth. Palaeogeographical changes were mostly influenced by the tectonic activity that affected the Neogene climate and pattern of oceanic circulation, more specifically opening and closing of the oceanic gateways. During the Miocene Epoch, exceptionally a warmer climatic event i.e., Miocene Climatic Optimum (MCO), a global phenomenon occurred specifically in the Middle Miocene that is characterized by elevated global atmospheric pCO_2 and global temperature as well as decline of polar ice volume. Progressively cooler climate persisted after the MCO event and during the late Miocene to early Pliocene further cooling and minor expansion of ice sheet in both the poles took place. During the Pliocene Epoch, overall cooling trend continued. The topography of the continents and the ocean floor were influenced by tectonics when the climatic migration from Miocene to Pliocene took place. The tectonic activity and variability in climatic condition during the Pliocene was responsible for the distribution and evolution of flora and fauna in the oceanic realm. During the Neogene, i.e., from Miocene to Pliocene in the Indian subcontinent specifically the Andaman and Nicobar Islands experienced major tectonic, physiographic, floral and faunal as well as oceanographic changes. The flora and fauna either adapted to the change in climatic condition or became extinct as a result of variation in climatic condition as well as tectonic activity. Andaman-Nicobar Basin in the northeast Indian Ocean represents the marine deep- water facies with a few shallow-water sequences. The Neogene sediments of the basin archives well preserved fossil phytoplankton and zooplankton represented by diatoms, radiolarians, silicoflagellates, calcareous nannofossils as well as planktic and benthic foraminifers etc. Retrieval of proxy biotic records from the marine realms are very useful for the reconstruction of past oceanographic changes, paleotemperature, nutrient availability and other environmental parameters. The Neogene marine sediments exposed on different islands in the Andaman and Nicobar Group and the dataset generated from the deep-sea sediment cores provided an excellent opportunity to establish a comprehensive biostratigraphy and to reconstruct paleoenvironment as well as overall paleoceanography based on qualitative and quantitative analyses of the marine biotic components. The significant events that the analysis of microfossils has identified are: Miocene Climate Optimum (MCO) during the Middle Miocene, Ocean upwelling and intensification of Indian

Summer Monsoon (ISM) during the late Miocene, low biogenic silica and cooling event during the early Pliocene. Morphometric analysis was done using biostatistics and paleontological statistics software on the calcareous nannofossil species that continued their existence during ~16.4 to ~4.54 Ma. The analysis reveals that their size variation was constrained by various oceanic environmental factors e.g., sea surface temperature, monsoonal variation, productivity/nutrient availability and sea level fluctuations during. The shell volumes of suitable *nassellarian* and *spumellarian* radiolarian species recovered from the sediments of deep-sea drill cores in the Andaman and Nicobar Basin that ranges in age from ~9.86 to ~4.19 Ma have been measured based on two dimensional microscopic studies using mathematical formula. Gradually decreasing radiolarian shell volume suggests that competition for the intake of dissolved silica, a shared nutrient for both radiolarians and marine diatoms, resulted in biological co-evolution between radiolarians and marine diatoms, which enhanced substantially in the late Neogene. Increased low–latitude ocean stratification and the abundance and diversity of silica consuming diatoms were responsible for the decrease of radiolarian shell weights in the low–latitude. Diversity analysis (Shannon Diversity Index i.e., H) of the radiolarians from the late Miocene of the deep-sea sediment core has been correlated with the diversity of diatoms from the same core. As far as diversity of radiolarians and diatoms are concerned, most of the samples show opposite relationship between radiolarian and diatom diversity based on the H values. The overall palaeotemperature of the sea surface during the late Miocene was estimated throughout the studied sequence of the deep-sea sediment core. So, the different fossilized phytoplankton and zooplankton analysed both from the onshore and offshore sediments of northeast Indian Ocean (Andaman and Nicobar Basin) provides useful information about the overall Neogene palaeoceanographic scenario.

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RECONSTRUCTION OF THE HOLOCENE CLIMATE VARIABILITY FROM THE WESTERN HIMALAYA: A CASE STUDY FROM THE CHOPTA-TUNGNATH REGION, UTTARAKHAND, INDIA

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Palynological, granulometric and magnetic susceptibility (χlf) data of two sub-surface profiles were analysed from the Chopta-Tungnath region, Higher-Western Himalaya, India for the better understanding of the short-term climatic variability and contemporary vegetational changes during the Holocene. The various vegetation and climatic zones have been defined by the relative frequencies of arboreal pollen (tree) and non-arboreal pollen (herbaceous) taxa (AP/NAP ratio), along with the subtle differences of the broad-leaved arboreal taxa. The sub-surface pollen assemblages were calibrated using modern pollen analogues that were derived from the surface samples in the study area. These modern analogues were found to be compatible to the fossil pollen records.

Between 11810 and 8750 yr BP, a cold and dry climate prevailed in the region, resulting in open vegetation dominated by the herbaceous taxa, probably indicating lower monsoon precipitation. Magnetic susceptibility measurements are trending downward, which is consistent with this dry and cold climatic phase. Thereafter, a well-recorded warming trend was initiated from 8750 yr BP, which continued till 4550 yr BP. Under the prevailing relatively warm and humid climate, a broad-leaved forest came into existence, with increased monsoon precipitation. This phase is correlatable with the global Holocene Climatic Optimum (HCO) event. Subsequently, a declining trend of broad-leaved taxa and low magnetic susceptibility values were recorded around 4550 to 4080 yr BP; which is well related to the 4.2 ka cold-dry event. The subsequent warm and humid phase between 4080 yr and 820 yr BP recorded the imprints of the Roman Warm Period (RWP) and Medieval Climatic Anomaly (MCA) climatic events, with the rejuvenation of thermophilous broad-leaved taxa. A cold and arid phase has been recorded during the time-frame of 820 to 190 yr BP, as evidenced by the declining trend in the broad-leaved taxa, marking the Little Ice Age (LIA) event in the region. Based on the high AP/NAP ratio in the palynological assemblages, a general warming trend is observed after 190 yr BP; revealing the onset of the Current Warm Period (CWP).

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IDENTICAL STABLE ISOTOPIC SIGNATURES IN *Globigerinoides ruber* MORPHOTYPES FROMNORTHEASTERN INDIAN OCEAN CORE-TOPS

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Globigerinoides ruber (white) is a mixed layer planktic foraminifera cosmopolitan to the tropical and subtropical oceans. It is widely used as a proxy to reconstruct past sea surface temperatures (SST) and stable oxygen isotopic composition ($\delta^{18}O$) of sea water. *G. ruber* (white) has two principal morphotypes; sensu stricto (ss) and sensu lato (sl). Previous geochemical studies have suggested that differences in its geochemistry ($\delta^{18}O$, Mg/Ca) may arise from seasonal preferences (sl: cold/winter-biased) or distinct calcification depth habitats(ss: ~ 0-25 m; sl: ~25-50 m). Contrary to this, recent studies have demonstrated that there are no systematic or significant offsets in coeval ss-sl $\delta^{18}O$ and $\delta^{13}C$. However, no such study hasbeen conducted in the northern Indian Ocean to determine whether selective or non-selective mixtures of *G. ruber* are suitable for paleoceanographic reconstructions. In this study, we perform individual foraminiferal analyses (IFA) on coeval ss-sl $\delta^{18}O$ and $\delta^{13}C$ using core-tops and late Holocene samples from the northeastern Indian Ocean (Cores: U1446 - northwestern Bay of Bengal; MGS30 - eastern Bay of Bengal and SK343 - Gulf of Mannar). We report a total of 362 IFA measurements each for $\delta^{18}O$ and $\delta^{13}C$ of ss (n = 201) and sl (n = 161) from three sediment cores. Our observations and statistical approach confirm that there are no significant offsets in coeval ss-sl morphotypes of *G. ruber*. Hence, we suggest minimal biasesfor the use of non-selective mixtures of *G. ruber* morphotypes for paleoceanographic reconstructions of mixed-layer variability in the northern Indian Ocean, at least for Holocene samples, or for periods with similar biogeochemical and oceanographic conditions allowing for *G. ruber* morphs to calcify within the same ambient waters.

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INTERRELATION BETWEEN BIOTIC AND ABIOTIC COMPONENTS CONCERNING DIFFERENT ENVIRONMENTAL SET-UPS: A COMPARATIVE CASE STUDY FROM THE TWO REGIONS WITHIN RANI-GARBHANGA RESERVE FOREST, ASSAM

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Twelve surface sediment samples have been studied on micropaleontological and sedimentological aspects from Rani-Garbhanga Reserve Forest, Assam to establish the ecological and morphological influence on the biological processes. Surface samples were collected from Forest, Margin area, and Open land areas from two widely separatedregions, namely Nalapur and Sukurbaria. Total diatom count, relative abundance of individual diatom species, relative abundance of pollen species, sand-silt-clay percentage, and quartz grain morphology and microtexture show that the population of diatom and pollen is low and sand percentage is maximum within forest area, whereas in margin area, biological entities are increased and sand percentage are decreased compared to forest area,and in open land area diatom and pollen is maximum and sand percentage is low. Quartz grain microtexture also exhibits more aeolian signatures of transportation in forest areas and more aqueous signatures in open land areas. CONISS cluster analysis based on diatom and pollen assemblages along with quartz grain microtexture from both Nalapur and Sukurbaria shows three distinct zones, which are defined as the distinct morphological setups of the forest. The study infers that biological and sedimentological parameters vary with the different settings within the forest. This study can be useful for deciphering past forest setups from the core collected around the study areas.

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CALCAREOUS NANNOFOSSILS: APPLICATIONS IN BIOSTRATIGRAPHY AND HYDROCARBON EXPLORATION

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Calcareous Nannofossils have been the mainstay of biostratigraphic studies from the initiation of the Deep-Sea Drilling Program and its successors the ODP and later IODP. Since their first appearance in the Triassic, these golden-brown, scale-bearing planktonic marine algae, with their unique ability for biomineralization, have dominated the world's oceans by sheer numbers. It is this ability for fixing calcite, blooming in large numbers and a very short lifespan (<1 to 4 days) ensure a rapid turnover which gives rise to what is known as the plankton snow over ocean bottoms. It is the beauty and power of nature that these nano organisms (av. Dia ~10μm) have deposited huge thickness of rocks on the sea floor, ex. the Maastrichtian Chalk of Low Countries in Europe (Benelux). Further, their short lifespan, ability to migrate and populate oceans, and sensitivity to changes in environmental conditions have ensured a rapid evolution and short geological ranges, rendering their utility in biostratigraphic applications. Study and preparation of samples for nannofossil studies is rapid and takes just a fraction of an hour giving the ability for real time studies during drilling.

In the hydrocarbon exploration industry, the applications of nannofossil are many fold and of critical importance. The main forte is the application in high resolution biostratigraphy of the Jurassic to Recent marine sediments. In this time interval nannofossils offer the highest chronostratigraphic resolution than any other microfossil group. The only disadvantage is that due to their small size they are the first 'victims' of diagenesis, whether in coarse clastic environments or carbonates. The resolution offered by nannofossils is on an average ~1My but improves to <0.25 My in some Jurassic, Cretaceous and Late Miocene to Pleistocene times. With the advent of deepwater exploration and horizontal drilling, both of which are cost intensive, nannofossils are widely used for what is now known in the industry as biosteering, wherein nannofossils are used during drilling to keep the trajectory of the borehole within the desired zones, sometimes as narrow as a couple of meters, at a drilled length of over 4,000 to 5,000 meters. Further minor variations in relative nannofossil populations can be used to detect subtle changes in the depositional processes and also climate. In the case of oceanic anoxia, nannofossil populations are able to discriminate thin layers with varying circulation patterns/sediment type/organic content.

In India the earliest nannofossil studies were initiated in the Geological Survey of India. Later the nannofossil studies group evolved in the Birbal Sahani Institute of Palaeobotany (now Palaeosciences) under the able leadership of Dr. S. A. Jafer. ONGC, during the eighties trained a small group of geoscientists for nannofossil studies which later became dormant due to retirements or other requirements. During the mid-2000-2010 decade another batch of geoscientists were trained at KDMIPE, Dehradun, under the guidance of Dr. Jafar and a permanent nannofossil laboratory was established. This was done to the need being realised for catering to the high capital investment for the deep water exploration forays of ONGC. In all credit to Dr. Jafar, he later helped train scientists from National Centre for Polar and Ocean Research (NCPOR) and establish a group of nannofossil specialists.

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DEEP SEA CARBONATE PRESERVATION: IMPLICATION TO THE CO2 EMISSION AND ASSOCIATED CIRCULATION

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The last deglaciation period is marked by the end of the most recent glacial cycle and is associated with the melting of ice sheets and glaciers. Just after the Last Glacial Maximum (LGM), a rise in carbon dioxide (CO_2) levels in the atmosphere resulted in marked increase in global temperatures during deglaciation. This warming is considered as a primary cause of deglaciation in the 21st century. Warming initiates a reduction in ice mass on continents, therebycausing a global rise in sea levels. Thermohaline circulation and associated deep water masses, transports cold (salty) water and CO_2 from deep sub-polar oceans to tropical oceans and warm relatively less saline waters from the tropics to the polar region. Here, we present the surface ultra-structure of selected planktic foraminiferal test from the tropical Indian Ocean, which reflect a condition of increased calcite preservation during the last deglacial period. The enhanced carbonate preservation suggests increased deep-water carbonate ion concentrations during the deglaciation. This increase in the carbonate ion concentration in the deeper part of thetropical Indian Ocean is associated with an increase in the pH levels (alkaline condition) due to the emission of CO_2 from the deep sea to the atmosphere (which was stored during LGM) due to the breakdown of stratification in water column. Such preservation has been documented across the world's oceans, including the northern Indian Ocean, at various water depths. Preservation of calcite test and associated deep ocean CO_2 exchange plays an important role in carbonate budget and stark contrast between end of the recent ice age and current deglacial warming in the global ocean are very much significant.

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LATE GLACIAL HOLOCENE RECORD OF BENTHIC FORAMINIFERA FROM THE WESTERN BAY OF BENGAL, CENTRAL EAST COAST OF INDIA: PALEOENVIRONMENTAL IMPLICATIONS

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A high-resolution palaeoenvironmental investigation was conducted on the benthic foraminiferal record of three continuous sediment cores (SW1, UR2, PR2) in order to reconstruct the Late Glacial to Holocene history of the western Bay of Bengal. This shallow (max. depth ~75 m), semi-enclosed continental shelf setting has been heavily affected by the latest-glacial to modern-interglacial relative sea-level and climate oscillations that strongly affected the benthic foraminiferal community. Altogether, 124 species belonging to 47 genera and 6 orders are identified in the present study. The following species *A.radiata, A.beccarii, E.crispum, Q.seminula, Q.bicarnita, C.wullerstrofi, T.agglutinans, A.pulchella, R.gaimeridii, H.concentrica* and *E.advenum* are the most abundant forms in the analyzed core subsamples. The inner shelf cores 1 and 3 consists of high to very high foraminiferal population which indicates that the oxygen concentration and higher organic matter can be responsible for these differences. The granulometric analysis reveals that the cores 1 and 2 sediments are characterized by sand to slightly muddy sand indicating these sediments were deposited at the recent time under the influence of moderate to high-energy condition. The high amount of mud content in the core 3 reflecting the undisturbed sedimentation without any turbulence, and these sediments were deposited under relatively low-energy condition. The significant amount of organic matter (OM) in the upper layer of core sediment is due to higher sedimentation of terrigenous material. The strong association between OM with mud (silt + clay) content indicates that they are mainly controlled by the finer fractions. The significant number of premodern and relict forms in the core sediments indicating different sea strands, suggesting episodic sea level changes during Last Glacial Maximum (LGM) to the early Holocene.

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LINKING INDIAN MONSOON VARIABILITY TO GLOBAL WARMING LIKE SCENARIO DURING THE BØLLING–ALLERØD INTERSTADIAL: INSIGHTS FROM CORE MONSOON ZONE SPELEOTHEM RECORD

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A U-Th dated composite $\delta^{18}O$ record from a stalagmite in Kailash cave, Central India, captures significant variations in the Indian Summer Monsoon (ISM) intensity between approximately 14.62 and 12.97 thousand years before present (present=1950 A.D.) encompassing the Bølling–Allerød (B-A) interstadial. The record indicates a strengthening ISM intensity during the Bølling interval, followed by stabilization during the Allerød, as reflected by the secular trend of $\delta^{18}O$ values with low-frequency oscillations. Petrographic analysis of our sample from Kailash cave (KG-1), which covers the period from ~13.98 to 14.44 kyr BP, demonstrates a strong coherence between the stable isotope data and petrographic characteristics, further confirming the robustness of the findings. During the B-Ainterstadial, an inter-hemispheric temperature contrast triggered the bipolar see-saw effect, shifting the Intertropical Convergence Zone northward and intensifying the ISM. High-frequency ISM variability on sub-decadal to multi-decadal scales likely reflects flood and drought events, corresponding with increased and decreased solar activity periods. Notably,a drought event around ~14 kyr BP, coinciding with the Bølling to Allerød transition and the Older Dryas cold period, is linked to a solar event similar to the Maunder Minimum. These findings strongly suggest that solar activity played a crucial role in driving changes in the ISM during the Bølling–Allerød interstadial, with significant solar forcing observed during the transition from Bølling to Allerød. Additionally, the rise in greenhouse gas concentrations during this time period likely triggered extreme climatic events, which were more frequent during the warmer Bølling period, offering a modern analog for the current global warming scenario.

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PALYNOFLORAL RECORDS FROM THE DEVONIAN AND CARBONIFEROUS SEQUENCES OF SPITI BASIN, TETHYAN HIMALAYA AND THEIR BIOSTRATIGRAPHIC IMPLICATIONS

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Indian Devonian-Carboniferous exposures are constrained in Tethyan realm of Himalayan region. which are sandwiched between the Higher Himalayas and the Trans Himalayas known for substantial marine fossil records. The present study elucidates the first records of palynomorphs from the Lipak Formation (late Devonian- early Carboniferous) and Ganmachidam Formation (Late Carboniferous-? early Permian), exposed in Spiti and Pin valleys. The study has been carried out to look for the signatures of terrestrial plants in the Tethyan realm and also to assess the relative palynodating of the studied sediments. The recovered palynoassemblage from the three different exposures of Lipak Formation (near Takche, Guiling and Muth villages), mainly comprises of spores and have dominance of *Verrucosisporites, Dictyotriletes, Lophozonotriletes, Convolutispora, Spelaeotriletes, Tricidarisporites, Calamospora, Callumispora* followed by subordinate occurrences of *Rugospora, Cymbosporites* and *Knoxisporites* along with reworked pollen grains. The recovered palynoflora is correlated with palynofloral records of the Tethyan realm of India and palynofloral records from coeval sequences across the world. The recovered palynocomposition shows the close resemblance *Retispora lepidophyta-Verrucosisporites nitidus* (LN) and *Vallatisporites verrucosus-Retusotriletes incohatus* (VI) Assemblage zones of western Europe and Cordylosporites-Verrucosisporites Biozone of Argentina which indicates studied section of the Lipak Formation is upper Famennian to early Tournaisian age.

The unfossiliferous Ganmachidam Formation has a debatable age assessment ranging from late Carboniferous to Early Permian. Here three distinct palynoassemblages have been recorded. Recovered palynoassemblage shows abundance of *monosaccate* pollens *(Parasaccites (Cannanoropollis), Crucisaccites, Divarisaccus, Densipollenites), bisaccate (Scheuringipollenites, Crescentipollenites, Protohaploxypinus, Lunatisporites, Striatopodocarpites, Striatites,)* and trilete spores along with woody fragments. The palynocmoposition shows close correlation with the *Crucisaccites monoletus* Zone and *Vittatina costabilis* Interval Zone in the northeastern area of the Paraná Basin, Brazil and lower Barakar palynozone *(Scheuringipollenites barakarensis* Assemblage Zone) of Peninsular India which indicates the studied section of the Ganmachidam Formation is Late Carboniferous (late Pennsylvanian) to early Permian in age. Devonian–Carboniferous palynomorphs include spores of affinities of *Zygopteridiales, Marratiales, Botryopteridales, Equisetales/Noeggerathiales/Sphenophyllales* group of plants, whereas palaeobotanical affinities of pollen grains are linked with Filicales, *Cordaitales* and *Glossopteridales* group of plants suggesting that diverse plant communities were growing in the vicinity of Spiti basin. Presence of pollens of *glossopterid* affinity suggests that *glossopterids* might have evolved during Carboniferous time.

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PLANKTIC FORAMINIFERAL BIOSTRATIGRAPHY, BIOCHRONOLOGY, AND MAJOR FAUNAL TURNOVERS IN LATE NEOGENE TO QUATERNARY SEDIMENTS OF ODP HOLE 1085A, SOUTHEAST ATLANTIC

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The late Neogene and Quaternary section of ODP hole 1085A, cape basin, southeast Atlantic, has been biostratigraphically subdivided into eight planktic foraminiferal zones. The zones were similar to those of temperate southwest pacific, southern Australia and southern Atlantic Ocean. The sequential order of planktic foraminiferal events has been determined, and 33 late Neogene and Quaternary planktic foraminiferal events have been identified. Three major faunal turnover events have been observed, two in the Pliocene and last one in the mid-Pleistocene. These events may be related to the stress transmitted to the upper ocean due to the closing of Indonesian seaway and global cooling associated with Northern hemisphere glaciations. Based on the integration with magnetostratigraphy, numerical age estimates of planktic foraminiferal events from the southeast Atlantic Ocean have been determined for the first time. A comparison with the published dates for these events from temperate deep sea cores from southern Australia, southwest pacific and south Atlantic suggests that 9 events are reliable for correlation over a wide geographic range. The useful synchronous events are the *Dentoglobigerina altispira altispira* LO (2.96 Ma), the *Sphaeroidinellopsis kochi* LO (3.58 Ma), *Globorotalia inflata* FO (4.01 Ma), *Globorotalia margaritae* LO (4.14 Ma), *Globigerina nepenthes* LO (4.76 Ma), *Globorotalia crassaformis* FO (5.75 Ma), *Globorotalia pliozea* FO (5.9 Ma), *Globorotalia puncticulata* FO (6.12 Ma), *Globorotalia. sphericomiozea* FO (6.29 Ma). In contrast, the other events are diachronous and considered unsuitable for inter-oceanic correlation. The Pliocene-Pleistocene boundary is approximated at ODP hole 1085A by the evolutionary last occurrence of *Dentoglobigerina altispira altispira* close to the top of magnetic chron (C2An.1n; 2.58 Ma).The Miocene-Pliocene boundary is approximated by the evolutionary first appearance of *Globorotalia crassaformis* occurring close to the base of Thvera magnetic event (C3n.4n; 5.23 Ma). Recognition of both these epoch boundaries is in accord with the International Commission on Stratigraphy. The detailed planktic foraminiferal biochronology developed for Hole 1085A will aid correlation and dating of various paleoceanographic events over the last 6 million years in the southeast Atlantic Ocean.

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UPWELLING VARIABILITY AND INTEROCEANIC EXCHANGE IN THE SOUTHERN BENGUELA REGION DURING QUATERNARY: INSIGHTS FROM PLANKTIC FORAMINIFERAL ASSEMBLAGES AT ODP SITE 1085A

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Planktic foraminiferal assemblages from ODP site 1085A were analyzed to reconstruct upwelling-induced productivity and interoceanic exchange in the southern Benguela region of the southeastern Atlantic during the Late Quaternary. These two key oceanographic processes influence global climate on glacial-interglacial time scales. Upwelling along Africa's southwestern coast affects global climate by modifying atmospheric carbon dioxide levels, while interoceanic water exchange via the Agulhas leakage impacts the strength of the Atlantic Meridional Overturning Circulation. The intensity of Benguela upwelling, as recorded by foraminiferal assemblages in the mid-Cape Basin of the southeast Atlantic, varied significantly during the mid-Pleistocene Transition (MPT), which occurred between ~1.1 and ~0.9 Ma. During ~1.1 to ~1.8 Ma, species thriving in nutrient-rich, high-productivity waters were less abundant. In contrast, species associated with tropical Indian Ocean waters (known as Agulhas leakage fauna, ALF) were more prevalent, indicating weaker coastal trade winds and increased interoceanic exchange between the Indian and Atlantic Oceans. The higher abundance of subpolar species Neogloboquadrina *pachyderma (Sin)* during the MPT suggests an equatorward shift of the subpolar front, supporting evidence for West Antarctic ice sheet expansion during this time. A marked increase in eutrophic foraminiferal species after the MPT indicates a strengthening of Benguela upwelling, likely in response to global climate changes associated with the MPT.

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BENGUELA UPWELLING RESPONSE DURING PLIOCENE - PLEISTOCENE CLIMATE TRANSITION

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In the present study sedimentary records from the southeast Atlantic ocean were used for reconstructing the variability of Benguela upwelling system as well as the Interoceanic exchange between Indian and Atlantic Oceans during the critical intervals. Planktic foraminiferal assemblage data revealed diminished upwelling in the Benguela upwelling region during the Pliocene warm interval (3.7-3 Ma) which is in contrast to the model reconstructions by Wang et al., 2015 proposing intensification of upwelling with projected future warming. Gradual intensification of Benguela upwelling was interpreted during the Pliocene - Pleistocene transition (3-2.5 Ma). Enhanced Benguela upwelling during the Northern Hemisphere Glaciation is supposed to have played a major role in the drawdown of atmospheric carbon dioxide after the Pliocene warmth interval (3.7-3 Ma). Enhanced Benguela upwelling occurred during Mid- Pleistocene transition (1-0.7 Ma). Reduced interoceanic exchange has been identified between Indian and Atlantic ocean during Northern Hemisphere glaciation (2.5- 2 Ma) and Mid Pleistocene transition (1- 0.7 Ma). Equatorward migration of subtropical fronts during these two intervals were probably responsible for the reduced interoceanic exchange.

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A NEW MURID RODENT FROM THE SIWALIK GROUP OF MOHAND (NWHIMALAYA) AND PALAEONTOLOGICAL IMPLICATIONS

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The significant new murid rodent molar (*Parapelomys sp.*) reported from Mohand Siwalik (NW Himalaya) and exposed in the Mohand area, along the Saharanpur-Dehradun road. The fossil represents a species apparently more primitive and older than *Parapelomys robertsi*. The occurrence of this murine mouse lineage, *Parapelomys*, is consistent with Late Miocene age based on paleomagnetic reversal stratigraphy. The find documents the geographicrange of this mouse lineage 500 km southeast of the type area for the species in the Potwar Plateau, Pakistan. This age estimate for *rodent* from Mohand II appears to be younger than Mohand I locality (*Parapodemus sp.*). The associated fauna comprises gastropods, ostracods, cyprinid fish and crocodiles in our collection and significant for palaeoenvironmental studies.

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PALEOCLIMATE VARIABILITY IN EASTERN INDIA DURING THE HOLOCENE: A MULTIPROXY APPROACH USING LAKE SEDIMENTS

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The Indian Summer Monsoon (ISM) not only plays an important role in cross-equatorial moisture transport but also governs the agricultural productivity of South Asia. Even small-scale variability in monsoon precipitation will have severe effects on ecology and infrastructure. For this study, we have selected Hansadanga lake, which is a closed type oxbowlake of the Jalangi River - a tributary of the Ganga River. It is situated on the Lower Ganga plains which is made up of unconsolidated Quaternary sediments overlying Precambrian basement. A sediment core having length of ~ 5 m was collected from this lake and then analysed for various physical and chemical parameters including grain size and geochemistry (major and trace element). The chronology of the lake is established based on 5 AMS ^{14}C datesand range up to 11000 years. The notable rainfall variability periods recorded in this study are(i)10900 to 10800 cal yr BP shows high concentration of sand and coarser silt demonstrating the time period of cut off of the lake from the river and conversion to lacustrine environment from fluvial environment (ii) 8300 to 7200 cal yr BP typified by low rainfall due to the dominance of fine particles with low Chemical index of alteration (CIA) value and decreasingtrend of Rb/Sr, Al/Ca ratio indicates the prevalence of 8.2 ka event arid event, (iii) 4500 to 3500 cal yr BP with low rainfall, corresponding to the 4.2 ka arid event. The findings from thisstudy indicate a comparable pattern of rainfall variability occurred globally, suggesting that Hansadanga lake sediments were capable of retaining these climatic fluctuations as well.

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PALEOCLIMATE RECONSTRUCTION OF THE NORTHWESTERN HIMALAYAN FOOTHILL REGION SINCE LIAUSING MULTI-PROXY LAKE RECORD

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The Indian summer monsoon (ISM) is crucial to billions of people as it controls the hydrodynamics of the Asian region and is the primary source of precipitation for rain-fed cropsover the Asian landmass. The Siwalik hills, a component of the outer Himalaya and the Himalayan foreland basin, significantly impact the climate of northern India as its orographic pull controls the precipitation pattern over the northwestern states of India. We examined a high-resolution multi-proxy record from a closed lake to better understand monsoon strength during the previous six centuries. The chronology of the sediment core was established using the AMS ^{14}C dating method. As proxies, we examined stable isotope ratios ($\delta^{18}O_{carb}$, $\delta^{13}C_{carb}$, $\delta^{15}N$ and $\delta^{13}C_{OM}$), grain size distribution (GSD), and geochemical parameters in bulk sediment samples. The Little Ice Age (LIA), which lasted from ~1350 to 1800 CE, coincides with the Current Warm Period (CWP) (~1850 CE to present) is visible in our dataset. A relatively feebleISM condition dominated India's northwest region from ~1360 to 1500 CE (early LIA phase). The study area experienced more consistent precipitation from about ~1600 to 1780 CE (later LIA phase). After ~1950 CE, the present study indicates a decline in ISM strength. Spectral analysis was performed on multiple time series ($\delta^{18}O_{carb}$, $\delta^{13}C_{carb}$, $\delta^{15}N$ and EM3), indicating solid periodicities of 9 to 66 years strongly reflect the influence of solar variability and El Niño-Southern Oscillation (ENSO) forcing over the studied region. The studied area experienced a considerable moisture flow during the LIA period due to enhanced Western disturbance (WD) events, which increased the amount of winter precipitation under the control of the positive North Atlantic Oscillation (NAO) index.

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MODERN POLLEN ANALOGUE FROM MAJULI ISLAND (THE WORLD'S LARGEST RIVER ISLAND)IN ASSAM, NORTHEAST INDIA: IMPLICATIONS FOR PALAEOECOLOGY

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The study compared the pollen dataset of 26 surface sediment samples collected from the varied depositional sites (Garamur, Pharam wetland, and Lohit River). Majuli Island is known as the world's largest River Island and falls under the Indo-Burma Biodiversity Hotspot, comprisingmany small wetlands ecosystems having diverse vegetation. The pollen assemblage recovered from the Garamur wetland displays tropical semi-evergreen to moist deciduous vegetation,comprising *Mesua, Schima, Ilex, Adina, Dillenia, Syzygium, Careya,* and *Sapotaceae* pollen indicating a warm and humid climate. Along with this, the frequent monsoonal fluctuation was also deciphered by the presence of *Onagraceae*, *Euphorbiaceae*, and *Convolvulaceae* pollen. Whereas the high occurrence of anthropogenic pollen taxa such as cereal (avg value: 20.2%), *Brassica*, *Coriandrum,* and *Solanaceae* along with some ruderal taxa like *Amaranthaceae*, *Caryophyllaceae*, and *Asteraceae* could be observed in the Pharam wetland, suggesting domestic settlement and severe agricultural impact around the region. The pollen assemblage from the Lohit River margin indicates the fluvial influence as evident by abundance in highland and aquatic taxasuch as *Pinus*, *Alnus*, *Ulmus*, and *Symplocos* along with some frequent fungal remains like *Gelasinospora*, *Nigrospora*, and *Glomus* which indicates high erosional activity. The box plot andPrincipal Component Analysis (PCA) were performed in the pollen frequency datasets from different soil samples, showing significant variation and similarity in vegetation types. We observed evidence of biological degradation, as evidenced by degraded and deteriorated pollen and spores coupled with fungal remains. There is a noticeable variation in pollen assemblage fromdifferent sites and a correlation has been established between the local vegetation and the recoveredpollen data. To generate the modern pollen analogue, pollen dispersal, and its preservation has been examined in the different depositional sites of Majuli Island, aiming to provide insights intothe vegetation cover, agricultural practices, and forest degradation. Moreover, this pollen data would help in accurately understanding palaeoecological changes in the upper Brahmaputra valleyof Assam.

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ADDITIONAL VERTEBRATES FROM SAURASHTRA, GUJARAT, INDIA: IMPLICATION ON PALEOENVIRONMENT, PALAEOBIOGEOGRAPHY

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The recent field work at the Late Miocene Gaj Formation of Bhavnagar, Gujarat could recover certain shark teeth. The fossiliferous conglomerate and greyish mudstone bed of Gaj Formation yields teeth of sharks, batoids, certain invertebrates and microfossils. An isolated tooth of a Miocene mammal *Dorcatherium* sp. is collected from Bhumbhili area. This finding is interesting and significant as it is the first mammalian report form the Miocene Gaj Formation of Bhavnagar area. The elasmobranch fauna from study areacomprises of *Carcharadon carcharias, Sphyrna zygaena, Carcharhinus perseus, Hemipristis serra, Rhizoprionodon* sp., *Isurusoxyrinchus, Isurusdesori, Isurus pagoda, Myliobatis* sp., *Aetobatis* sp. and crocodilian tooth. The collected fossils are correlated with the other Neogene elasmobranch bearing site of India such as Baripada Beds in the eastern coast of India, Kutch in the western site, and Mizoram in the Northeastern India. The finding of *Dorcatherium* sp. associated with elasmobranch faun shows that deposition of Gaj bed took place near coastal environment in brackish to shallow marine environment which were well connected with the open sea.The majority of the reported faunashows the prevailing of tropical to sub-tropical climatic conditions. The faunal similarity index of the late Miocene elasmobranch of India is closer toward South Pacific Ocean and Indo-Pacific region suggesting the shifting of migration path from the Mediterranean region after permanently closing the Tethys Sea ways. Most of the collected species of the late Miocene sharks and batoids are also presently found today in the Indian Ocean.

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A LATE QUATERNARY FORAMINIFERAL RECORD OF DEEP-WATER VENTILATION CHANGESBELOW OMZ IN THE NORTHWEST ARABIAN SEA

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This study is primarily based on benthic foraminiferal census data from ODP hole 722B (latitude:16°37.3′ N; longitude:59°47.76′ E; water depth: 2028 m) in the northwest Arabian Sea, which is located on the Owen Ridge beneath the OMZ. A total of 133 species of benthic foraminifera were recorded at hole 722B. The most dominant benthic foraminiferal species recorded are *Bulimina aculeata, Bulimina alazanensis, Globocassidulina subglobosa, Uvigerina proboscidea, Ehrenbergina trigona, Epistominella exigua, Gavelinopsis lobatulus, Cibicides bradyi, Eggerella bradyi* and *Gyroidinoides nitidula.* The primary objective of the present study is to better explain the deep-water ventilation history under the combined effectof surface productivity owing to monsoonal upwelling and the northward flow of southern sourced deep-water into the northwest Arabian Sea. The distinctive faunal changes such as prominent occurrence of *B. alazanensis-G. subglobosa* assemblage, higher abundance of epifaunal to shallow infaunal taxa and reduced percentages of dysoxic taxa along with low organic matter influx at the seafloor during interglacial MIS 5 (including 5.5 and 5.1) and Holocene indicate better ventilated bottom water due to enhanced northward outflow of oxygen-rich NADW up to the northwest Arabian Sea. Whereas higher relative abundance of *Ga. glutinata* represents more productive surface water due to increased upwelling under the influence of strong SW monsoon. Thus, despite the strong SW monsoon circulation and increased surface productivity, the remineralization of organic matter under increased deep- water ventilation reduced the amount of available organic matter at the sea floor. The latter portion of Late Glacial Period (~55 to 15 ka BP) was represented mainly by the occurrence of *Bulimina aculeata* assemblage which corresponds with the higher abundance of deep infaunaland dysoxic taxa and increased organic matter influx at the sea floor. The above changes indicate a decline in the deep-water ventilation and a better trophic condition at the bottom possibly due to reduced outflow of NADW into the Arabian Sea. *Uvigerina proboscidea* assemblage occurs prominently during latter part of MIS 4 and cold stadial MIS 5.2 which correspond with minor decrease in the abundance of dysoxic taxa and higher abundance of shallow infaunal taxa. These faunal changes represent minor upsurge in the dissolved oxygen or almost unchanged ventilation in the deep-sea with moderately higher trophic levels.

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DINOFLAGELLATE CYST EVIDENCE FOR BIOSTRATIGRAPHY AND PALEOENVIRONMENTAL CHANGESACROSS THE CRETACEOUS-PALEOGENE (K-PG) BOUNDARY IN THE KRISHNA-GODAVARI BASIN

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The Cretaceous-Paleogene (K-Pg) mass extinction represents one of the most significant bioticevents in Earth's history, characterized by abrupt and profound changes in the biosphere and geosphere. This global event also impacted the Indian subcontinent. The present study focuseson a biostratigraphic investigation of organic-walled dinoflagellate cysts from BST Well Cutting Succession A (depths of 3140–2630 meters) in the Krishna-Godavari Basin, India. Therecorded dinoflagellate cyst assemblage is predominantly characterized by key marker species including *Disphaerogena carposphaeropsis*, *Disphaerogena lemniscata*, *Exochosphaeridium bifidum*, *Glaphyrocysta expansa*, *Carpatella cornuta*, *Damassadinium californicum*, *Palaeocystodinium benjaminii*, and *Dinogymnium* spp. The Last Appearance Datum (LAD) of these age-significant dinoflagellate cyst species has been utilized to construct a detailed biostratigraphic framework. The analyzed sequences are assigned to the late Maastrichtian to early Danian age based on dinoflagellate cyst biostratigraphy. Two distinct organic-walled dinoflagellate cyst biozones have been established: The *Disphaerogena carposphaeropsis* Assemblage Zone (AZ) and the *Carpatella cornuta* Interval Zone (IZ). The upper part of the *D. carposphaeropsis* AZ and the lower part of the *C. cornuta* IZ correspond to the Late Cretaceous to early Paleogene interval. The upper boundary of the *D. carposphaeropsis* zone marks the Cretaceous-Paleogene (K-Pg) boundary within the Krishna-Godavari Basin. The dinocyst biozones established in this study, are correlated with well-documented boundary sequences in the Tethys ocean region, and many taxa are shared between the two areas. The observed species richness indicates that organic-walled dinocysts were not significantly affected by the K-Pg mass extinction. The turnover of dinoflagellate cysts across the K-Pg boundary supports the hypothesis of rapid oceanic acidification during the K-Pg event. Furthermore, the persistence of dinoflagellate cysts across this boundary suggests that the formation of organic-walled resting cysts was a key factor in their survival through this extinction event.

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PETROLOGICAL AND STRATIGRAPHIC ANALYSES OF LIGNITE FROM MATANOMADH AND UMARSAR MINES, WESTERN KACHCHH: IMPLICATIONS FOR DEPOSITIONAL ENVIRONMENT AND FACIES EVOLUTION

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Petrological investigations were carried out on lignite samples retrieved from Matanomadh and Umarsar mines, western Kachchh to decipher past depositional environment and facies characteristics. Petrographic studies reveal dominance of huminite maceral (especially detrohuminite) along with subordinate amounts of liptinite and inertinite in the lignite samples. The mineral content in these lignites ranges from moderate to high. The retrieved lignite and rock samples were also used to establish lithostratigraphy for both mines. Interestingly, this study pointsto the existence of limno-telmatic swamps characterized by a low to moderate subsidence rate and sluggish ground water movement. Higher percentages of inertinite macerals in the studied lignites also indicate intermittent prominent dry spells. This study suggests fluctuating conditions at the time of mire development in Kachchh Basin. The petrography based models utilized in this study, provideda compelling evidence of formation of lignites in a coastal marshy setting with moderate to high tree density under a transgressive regime. The presence of higher amount of pyrite in the studied samples indicates a paralic facies (marine origin) under reducing (dysoxic) conditions. In addition, the difference observedin the vertical positions of coquina beds (fossiliferous limestone) in litho-columns(lithostratigraphy) at Matanomadh and Umarsar suggests a distal and proximal facies respectively. Further, the petrographical parameters are related to the sequence stratigraphic setting it is realized that the lignites were deposited under the low stand system with multiple small-scale transgressive and regressive phases.

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PALAEOECOLOGICAL, PALAEOENVIRONMENTAL, AGE, AND PALAEOBIOGEOGRAPHICAL IMPLICATIONS OFTHE MICROBIOTA FROM THE CRETACEOUS-PALAEOGENE BOUNDARY TRANSITION OF CENTRAL INDIA

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Microbiota associated with the Deccan volcano-sedimentary sequences, peninsular India is a topic of global interest as it through light on bio- and geo-events linked to Cretaceous-Palaeogene boundary. Recently, a remarkable microbiota consisting of charophytes, ostracods and foraminiferans have been recovered from the four localities (Jhilmili, Ghat Parasia, Shriwas well and Government well) of Upper Cretaceous-Lower Palaeocene intertrappean sites, Chhindwara District (Madhya Pradesh), Central India. Charophytes foundin the Jhilmili and Ghat Parasia suggest the prevailing of a freshwater/lacustrine environment at these sites. The ostracod assemblage recovered from Jhilmili, Ghat Parasia, Shriwas well and Government well includes a mixture of both passive (*Frambocythere, Gomphocythere*, *Darwinula* and *Limnocythere*) and active (*Paracypretta*, *Mongolianella*, *Cypridopsis* and *Zonocypris*) swimmers indicating existence of dynamic environment. The majority of the ostracod fauna reflects a lacustrine freshwater habitat with low energy conditions. Speculation about the advancing of a marine seaway in Central India in the Maastrichtian- Early Palaeocene along the Narmada and Tapti rift zones by seasonal offshore currents is fueled by the discovery of two brackish water ostracod species (*Buntonia whittakerensis* and *Neocyprideis raoi*) and planktic foraminiferas. At the Jhilmili, deposition occurred primarily in semi-arid to dry terrestrial environments. This was followed by a brief aquatic interval (60 ka) of freshwater lakes, which led to low coastal marine and estuarine conditions with early Danian Pla planktic foraminiferas and brackish water ostracods. Palaeobiogeographically, the Late Cretaceous charophyte assemblages from different continental masses (Americas, Europe, Asia and Africa), show strong relationships with those from the Jhilmili and Ghat Parasia, both generally and specifically, and support some palaeobiogeographic inferences. The presence of a rare charophyte genus *Chara* with Asian affinity in India supports dispersion events from Asia to India close to the Cretaceous–Palaeogene boundary. The Jhilmili charophytes claim that a few genera (*Peckichara, Platychara, Chara* and *Nemegtichara*), may have dispersed from Laurasia to India by following the volcanic island-arc system of Kohistan and Dras. It is argued that the three genera (*Eucypris, Cypridopsis* and *Gomphocythere*) of Indian ostracods, may have moved 'Out-of-India' to North China, Africa and Alaska. The presence of two brackish water ostracod (*Buntonia* and *Neocyprideis*) and planktic foraminiferas in Jhilmili suggests that shallow marine waters either from the Bay of Bengal or Arabian Sea entered in the continental interior regions of Central India in the Cretaceous–Palaeogene interval via the Narmada–Tapti rift or Pranhita–Godavari rift systems, respectively.

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DIATOM-BASED RELATIVE SEA LEVEL CHANGES FROM SEDIMENTARY DEPOSITS OF DISCUSSION LAKE, LARSEMANN HILLS, EAST ANTARCTICA

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Relative sea level (RSL) change refers to the vertical shift between the sea surface and land over time, influenced by changes in global ocean volume and land adjustment due toocean and ice loading. Reconstruction of RSL in Antarctica is vital for understanding regional ice sheet histories and the Earth's response to past ice changes through ongoing glacial isostatic adjustment (GIA). The RSL changes can be deciphered from two main archives: raised marine landforms (beaches, deltas, etc.), and isolation basins (lakes).Low elevated lakes respond to RSL changes in coastal oases viz., Larsemann Hills, Vestfold Hills and Rauer Group (East Antarctica). In particular, for Larsemann Hills, the lakes below 10m elevation record such signatures. Here, we used a 201cm long radiocarbon dated sediment core (DL3), retrieved from Discussion Lake (5m a.s.l), Larsemann Hills, which spans the last 6100 years. We analyze diatom assemblages to infer paleoenvironmental changes for the mid-to-late Holocene period. Our diatom assemblages reveal that only marine sea-ice species were recorded between 6100 and 2733 cal yr BP (mid-Holocene). Marine diatoms taxa indicates that the lake was under marine influence i.e., the RSL was higher than 5 m. The higher abundance of the brackish water diatom species, *Amphora veneta,* between 2733–2368cal yr. BP suggests a transition zone recording a shift from marine-to-freshwater conditions. During this period, the lake received freshwater input from the surrounding snowbank and precipitation which led to the freshening of the lakes. This transition indicates the fall of the RSL, as a result of isostatic uplift (caused by ice sheet thinning or retreat) which outpaced therise of the eustatic sea level since 2368 cal yr. BP. As a consequence, the lake became an isolated basin at 2368 cal yr BP, as evident from the presence of only freshwater diatoms.This study delineates RSL changes in the Larsemann Hills, showing a transition from marine to freshwater conditions, driven by GIA.

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BENTHIC FORAMINIFERAL SYSTEMATICS AND MORPHOGROUPS IN THE MIDDLE TO LATE JURASSICROCKS OF KACHCHH BASIN, INDIA: IMPLICATIONS FOR PALAEOECOLOGICAL CHANGES

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The studied section of the Habai region, Kachchh, India, contains foraminiferal assemblages with 86 species, of which the family Vaginulinidae is dominant, and 27 are reported for the first time from the Indian subcontinent. Benthic foraminiferal morphogroups,the Fisher index, and multivariate analysis of the Middle to Late Jurassic reveal their responses to palaeoecological fluctuations in the area. To determine the palaeoenvironmental relevance of the morphogroup relationships, seven sub-morphogroups were recognised based on their lifestyles and feeding strategies. The elongated uniserial, flattened, and biconvex planispiral forms are dominant and show a high percentage of subgroups J1, J2, and K, with a deduced epifaunal to deep infaunal habitat. The Fisher index and statistical approaches including clustering, PCA, PCoA, and CA reveal four benthic foraminiferal assemblages representing five palaeoecological units. During the Bathonian, *Lenticulina subalata* assemblages suggest astable environment during a transgressive phase. This was followed by an environment characterised by dysoxic conditions, which led to the vanishing of foraminifera and other fauna, resulting in a barren zone. The subsequent depositional settings of the Middle Callovian, *Epistomina ghoshi* and *Ammobaculites hagni* assemblages record transgression and progressively deeper outer shelf conditions with high food flux and adequate oxygen levels, respectively. The deposition shifted again to a regressive environment during the Late Callovian to Oxfordian as this unit is devoid of foraminifera in addition to megafauna, which may be related to the palaeoenvironmental changes and probably unsuitable for life. Overall, the palaeoenvironmental conditions of the studied area exhibit a periodic pattern between the middle and outer shelf zones related to changes in sea level.

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RESOLUTION OF THE LONG PENDING DEBATE ON THE TAXONOMIC STATUS OF THE LATE PALEOZOIC MORPHO GENUS *Callumispora* BHARADWAJ AND SRIVASTAVA 1969 AND *Punctatisporites* IBRAHIM1933 EMEND. POTONIÉ AND KREMP 1954

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Palynological studies in the pre-quaternary sequences of India reveal an explosive number of names of taxa due to the absence of their phylogenetic relationship. This has led to the development of various taxonomic schemes based on morphological features without adhering tothe Linnaean nomenclature which has led to taxonomic discrepancies and needs to be revisited. Therefore attempts are being made to supply some common denominator of systematic thoughtto bring about consistency, as accurate stratigraphic conclusions depend primarily on accurate identification and the lack of uniformity in identification leads to questionable stratigraphic ranges. In this work the taxonomic status of the morpho genus *Callumispora* Bharadwaj and Srivastava 1969 is reviewed to validate the long pending debate regarding its taxonomic status as congeneric to *Punctatisporites* Ibrahim 1933 emend. Potonié and Kremp 1954. As on record there are 25 species of both *Punctatisporites* (13) and *Callumispora* (12) instituted by Indian workers. In this study, holotypes were re-examined both under optical light microscope and Confocal laser Scanning Microscope (CLSM) and compared with their original diagnoses and descriptions. Where holotypes were not available, we could only base our study on paratypes, illustrations and diagnoses. Fresh samples were also collected from Damodar Basin and Wardha Basin and macerated and observed under optical light microscope, CLSM and Scanning Electron Microscope (SEM). They were also compared with *Punctatisporites* spp. from some basins from South America. The five main morphological features which formed the main criteria to considerboth the genera distinct from each other were re-evaluated viz., amb, size, haptotypic structure, exine thickness and exine structure. The critical re-analysis revealed that both *Punctatisporites* and *Callumsipora* possess circular to subcircular amb, their exine varies from laevigate to infrapunctate, their size ranges from 24 –140 µ, the length of the trilete ray ranges from ½ to ¾th the spore radius or more, the thickness of the exine also ranges from 1-6 µ. Based on these morphological similarities exhibited by both, it is evident that *Punctatisporites* and *Callumispora*are congeneric and *Callumispora* is junior synonym of *Punctatisporites* by taxonomic rule of priorit

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PALEOCEANOGRAPHIC VARIABILITY IN THE WEST PACIFIC WARM POOL SINCE 6.5 MA:EVIDENCE FROM STABLE ISOTOPE RECORDS

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This study reconstructs the paleoceanographic history of the West Pacific Warm Pool (WPWP) region and examines its sensitivity to both regional and global climatic influences. We analyze planktic foraminiferal stable isotope data from ODP Site 803D to investigate the history of the WPWP over the past ~6.5 million years. During the late Miocene biogenic bloom, between ~6.5 and 5 Ma, both surface and subsurface region of the WPWP experienced gradual coolingassociated with increased productivity due to an enriched global nutrient reservoir. The graduallydecreasing stable carbon isotope ($\delta^{13}C$) values of *Trilobatus sacculifer* from the latest Miocene (~6 Ma) to the present indicate a long-term decline in surface productivity, with a notable perturbation around ~3.4 Ma when productivity increased until ~2.8 Ma. In the early Pliocene, our site underwent a warming phase that persisted until ~3.4 Ma, characterized by a continuous decrease in stable oxygen isotope ($\delta^{18}O$) values of *T. sacculifer* and *Globorotalia menardii*. During this period $\delta^{18}O$ values of *T. sacculifer* and *G. menardii* showed the lowest values in the entire studied interval. This warming phase is attributed to the prolonged El Niño conditions. At ~3.4 Ma, productivity in both the mixed layer and thermocline reached its lowest point. Following this, the WPWP experienced gradual cooling, likely due to the cessation of permanentEl Niño conditions in the middle Pliocene, accompanied by a spike in surface and subsurface productivity around ~2.8 Ma, which is synchronous with the onset of Northern Hemisphere Glaciation (NHG). The ~2.4 Ma period marks a divergence in productivity trends: thermocline productivity increased while mixed layer productivity decreased. At ~2.2 Ma, the $\delta^{18}O$ values of mixed layer and thermocline species began to diverge, indicating surface warming and subsurface cooling. However, the difference in gradient ($\Delta\delta^{18}O$) stabilized after ~2.2 Ma, signifying the final formation of the modern WPWP. From ~2 Ma onwards, $\delta^{18}O$ values for mixed layer and thermocline species became parallel, indicating the stabilization of the WPWP. Additionally, the $\delta^{13}C$ values of mixed layer and thermocline species also aligned around ~1.2 Ma, reflecting a stable and mature WPWP.

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CHANGES IN THE UPPER-WATER COLUMN STRUCTURE OF THE EASTERN ARABIAN SEA DURING THE LAST13 KA

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We present planktic foraminiferal assemblages combined with stable oxygen isotope records of mixed-layer (δ18O *Globigerinoides ruber*) and the thermocline depth (δ18O *Pulleniatina obliquiloculata*) from a sediment core (SSD-60/GC-10: 14°9' N, 72°17' E) retrieved from the eastern Arabian Sea at a water depth of 2055 m. The age model of the sediment core (SSD-60/GC-10) is basedon four radiocarbon (^{14}C) AMS dates. Multiproxy records are used to document changes in surface productivity (mixed-layer eutrophic species Vs. mixed-layer oligotrophic species), stratification (ratio of *Globigerina bulloides* and *G. ruber*) and the mixed layer (% mixed-layerspecies and δ18O *G. ruber*) vs. thermocline depth (% thermocline species and δ18O *P. obliquiloculata*)in the eastern Arabian Sea during the last 13 ka. Our faunal and isotope records reveal high surface productivity, low stratification and shoaling of the thermocline during the cold YoungerDryas period, probably due to the strengthening of the winter (NE) monsoon winds induced vertical mixing. Further, the proxy records show reduced surface productivity, increased stratification and the deepening of the thermocline depth during the early Holocene (11.7 to 8.2ka). This could be due to the weakening of the winter (NE) monsoon winds. There has been a significant change in surface hydrography during the late Holocene (4.2 to 1 ka) when surfaceproductivity enhanced, and the upper thermocline shoaled. The surface water condition seems very stable during the middle Holocene (8.2 to 4.2 ka) with a gradual increase in surface productivity and shoaling of the thermocline.

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IMPACT OF ONSET OF DECCAN VOLCANISM ON FLORA: EVIDENCE FROM MICROFLORA OF INTERTRAPPEAN BEDS

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Late Cretaceous-early Paleocene Deccan volcanism, with its peak close to the K-Pg boundary, is considered as one of the causes of mass extinction. To understand the impact of Deccan volcanism on flora, we studied the floral association of chronostratigraphically constrained intertrappean beds at multiple levels from the Deccan volcanic province, including Chhindwara-Mandla-Jabalpur, Nand-Dongargaon basin, Malwa Plateau and Saurashtra peninsula. Palynoflora as well as megaflora from Maastrichtian chron 30N intertrappean shows the presence of diverse flora, including Maastrichtian marker palynoflora such as *Azolla cretacea*, *Farabeipollis minutus*, *Jiangsupollis striatus* and *J. intertrappea*, and the dominance of *Gabonisporis vigourouxii* and *Aquilapollenites bengalensis*. This palynofloral association continues in intertrappean sediments of Maastrichtian chron 29R but, with a slight decrease in the diversity. Early Danian is marked by sharp decline in mega and microfloral recovery. Overall, the results of our study show that the initiation of volcanic activity was not detrimental for the flora but, increase in the intensity of volcanism close to the Cretaceous-Paleogene (K-Pg) boundary in early the Danian (Sprain et al, 2019; Schoene et al, 2019) was devastating for the existing plant community, which caused the extinction of many taxa such as *Azolla cretacea*, *Crybelosporites intertrappea*, *Farabeipollis minutus*, *Jiangsupollis* spp. and *Proxapertites monosulcatus* at the K-Pg boundary.

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DYNAMICS OF INDIAN SUMMER MONSOON DURING MIOCENE INFERRED FROM STABLE ISOTOPICSIGNATURE OF FORAMINIFERA FOSSIL SHELLS

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The Miocene Epoch marks the most salient interval in the Cenozoic Era, characterized by several major climatic events. The middle Miocene transition witnessed rapid fluctuations in oceanographic and climatic systems. However, very limited work has been attempted in Miocene sediments of the Northern Indian Ocean to identify these changes. An important aspect of Miocene epoch is related to the initiation and intensification of Indian summer monsoon (ISM), believed to have occurred during Miocene. While most researchers agree that the Asian monsoon systems intensified at around 8 Ma, however this view has been contested by few researchers, who suggested that the intensification occurred during the early Miocene and the late Eocene. Therefore, in order to better understand the timing of ISM initiation and intensification we focused our attention to reconstruct the paleoceanography of the Northeast Indian Ocean through stable carbon and oxygen isotopic ratios of foraminifera. The $\delta^{18}O$ and $\delta^{13}C$ values on G*lobigerinoides quadrilobatus* (planktonic) and C*ibicidoides wuellerstorfi* (benthic foraminifera) indicates initiation of ISM at 12 Ma and its intensification at 10 Ma. Along with various other global and local successions of oceanographic and climatic importance were identified viz. (a) Mid Miocene climatic Optimum (17–15 Ma), (b) Monterey excursion (17–14 Ma), (c) East Antarctica Ice sheet formation (13.8 Ma), and (d) evidence of a cooling event (10.2–9.6 Ma).

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ENVIRONMENTAL IMPLICATIONS AND DIATOMS RESPONSES TO WATER QUALITYCHANGES IN LAKES OF GADCHIROLI DISTRICT, MAHARASHTRA

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The present study explores the impact of water quality changes in the few lakes (Gadchiroli Lake-GL, Shankarpur Lake-SL, Taka Lake-TL and Deulgaon Lake-DL) of Gadchiroli district of Maharashtra state, India, with a focus on diatoms that serve as crucial bio-indicators of aquatic health and identifies the relationship between these factors and diatom responses. The composition and diversity of diatom communities are closely linked to variations in water quality, making them an essential tool for assessing the ecological condition of lakes.

In GL, the diatoms species *Aulacoseira granulata* (AUGR) and *Aulacoseira ambigua* (AUAM) were present in high numbers. The pH, alkalinity, TP, Electrical conductivity (EC), TDS were 7.7, 123.3mg/l, 0.046 mg/l, 420.83µmhos/cm, 212.5 mg/l, respectively. The concentrations of Caand Si were 29.75 mg/l and 8.78 mg/l, respectively. In SL, *Pinnularia subcapitata* (PISU), *Aulacoseira granulata* (AUGR) *Nitzschia palea* and *Nitzschia* sp were most abundant in sediment samples. The pH, alkalinity, TP, Electrical conductivity (EC), TDS were 9.2, 52 mg/l,
0.04 mg/l, 117 µmhos/cm and 61 mg/l, respectively. The concentrations of Ca, K, Si and Mg in SL were 9.6 mg/l, 0.3 mg/l, 1.4 mg/l, and 3.9 mg/l, respectively. In TL, *Pleurosigma elongatum* (PLEL), *Diploneis smithii* (DISM), *Nitzschia palea* (NIPA) and *Pinnularia subcapitata* (PISU), were present in high concentration. The pH, alkalinity, TP, Electrical conductivity (EC), TDS, was 8.6, 44 mg/l, 0.035 mg/l, 43 µmhos/cm, 21 mg/l, respectively. The concentrations of Ca, K, Si and Mg in TL were 8 mg/l, 0.2 mg/l, 1.2 mg/l and 2.9 mg/l. In DL, *Pinnularia subcapitata* (PISU) and *Nitzschia palea* (NIPA) were dominant. The pH, alkalinity, TP, Electrical conductivity (EC), TDS were 8.2, 140 mg/l, 0.05 mg/l, 434 µmhos/cm and 214 mg/l, respectively. The concentrations of Ca, K, Si, Na and Mg in DL were 27.3 mg/l, 0.5 mg/l, 9.6 mg/l, 28.8 mg/l and 7.8 mg/l, respectively.The comparative study of all four lakes using indicative diatoms shows that, GL has moderate pollution with *A. granulata* dominance, a slightly acidic pH, moderate EC and high alkalinity. SL shows potential eutrophication with a high pH, though its lower pH and alkalinity suggest moderate pollution. TL is the least polluted, with low EC and alkalinity with moderate organic pollution as indicated by the dominance of *P. elongatum* and *D. smithii*. DL exhibits highest pollution level, with high EC and alkalinity, pointing to eutrophic conditions as indicated by the prevalence of *P. subcapitata*, *N. palea* and other species of *Nitzschia*. The insights gained from this research are valuable for guiding conservation efforts and informing policy decisions aimed at maintaining the ecological balance in the aquatic systems of this region.

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ASSESSING THE SYNCHRONY OF THE LITTLE ICE AGE WITH EQUATORIAL TROPICAL CLIMATE: A MULTI-PROXY STUDY FROM THE SOUTHWEST COAST OF INDIA

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A comprehensive study of the 70 cm Mundrothruthu (MT) core from the Asthamudi wetland in Kollam, Kerala, India, has revealed three distinct climatic phases during the Little Ice Age (LIA) through detailed multi-proxy investigations. The findings provide insights into the complexinterplay between local environmental changes and broader global climatic trends during this period. The first phase, spanning from 1507 to 1518 CE, is characterized by high levels of agricultural activity, as indicated by the abundant diversity of diatoms and significant terrestrial influx observed in the core. This period also shows evidence of enhanced freshwater runoff, suggesting that the region experienced warm and humid climatic conditions. Elevated total organic carbon (TOC%) and $\delta^{13}C$ values further support the presence of a high-temperature environment.The warm and humid climate during this phase was likely driven by intensive farming practices, which may have contributed to increased soil erosion and subsequent terrestrial input into the wetland ecosystem. The second phase, covering the years 1519 to 1548 CE, marks a significant shift in the environmental conditions of the region. This period is characterized by an increased marine incursion into the wetland, likely driven by enhanced tidal currents. The core shows a risein marine palynomorphs, marine diatoms along with a mixture of terrestrial and marine organic matter. Additionally, the $\delta^{13}C$ values become less negative, and there is an increase in mud content,suggesting that the region experienced changes in sea level or tidal dynamics. These changes mayhave been driven by broader climatic shifts or local geomorphological processes that altered the tidal regime. The final phase, extending from 1548 to 1804 CE, shows a further enhancement of marine taxa within the sediment core. This period is marked by lower TOC% and $\delta^{13}C$ values, indicate lowering of temperature. These findings suggest a weakening of monsoonal trend in the region, likely associated with reduced solar insolation and a southward shift of the Intertropical Convergence Zone (ITCZ). The cooling and shift in climatic conditions during this phase may reflect the broader global climatic patterns observed during the latter part of the LIA. Overall, thestudy highlights both synchronous and asynchronous climatic behavior on the southwest coast ofIndia during the LIA. These findings underscore the complexity of local climatic responses to global events during the LIA, demonstrating that regional factors such as tidal dynamics and land-use practices played a significant role in shaping the environmental history of the southwest coastof India during this period.

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SEDIMENTARY PROFILE FROM OXBOW LAKE AS AN ARCHIVE FOR PAST PRODUCTIVITY ANDCLIMATE VARIABILITY: A CASE STUDY FROM CORE MONSOON ZONE, INDIA

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The Indian Monsoon is a complex interplay of ocean-atmosphere dynamics influenced by solar radiation, ocean circulation, and wind strength. To investigate paleoclimate and paleovegetation changes over the past ~6000 cal yr BP, a sediment core from Anshupa Lake in Odisha, eastern India, was analyzed. This lake is primarily influenced by the Indian SummerMonsoon (ISM), which plays a crucial role in its water budget. An 11.70-meter-long core wasextracted and examined for lipid biomarkers (n-alkanes) and relevant indices including the Carbon Preference Index (CPI), Paq, Average Chain Length (ACL) and Terrigenous-Aquatic Ratio (TAR), along with compound-specific δD and $\delta^{13}C_{C29}$ values, stable carbon and nitrogenisotope ratios ($\delta^{13}C_{OM}$ and $\delta^{15}N$) of organic matter (OM), total organic carbon (TOC), total nitrogen (TN), and C/N ratio. The results indicate that the OM in the sediments is derived froma mix of autochthonous aquatic sources and allochthonous terrestrial plants, with deposition occurring under reducing conditions that promoted OM preservation. This study demonstrates the efficacy of the δD and $\delta^{13}C_{C29}$ isotope approaches for distinguishing changes in precipitation and vegetation patterns in the paleolimnological record. From ~6000 to 4100 calyr BP, the study area experienced a warm and humid climate with a strong ISM, evidenced bythe dominance of terrestrial higher plants and C3-type vegetation. Organic geochemical proxieshave highlighted the well-known 4.2 ka drying event, and several other significant dry periods.The gradual increase in $\delta^{13}C_{OM}$ and $\delta^{13}C_{C29}$ and Paq value, from 4100 to 2000 cal yr BP, shifted to cooler and less humid conditions, reflecting reduced solar radiation and a weaker ISM, with a mix of vegetation types. The last 2000 years evidenced a gradual decrease in temperature and precipitation with significant fluctuations, mirroring a continued weakening of the ISM, with a predominance of C4-type vegetation. These findings suggest that solar activity has significantly influenced ISM patterns over the last 6000 years, and further studieswill help to understand the detailed forcing drivers that intensify the ISM.

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SURFACE PRODUCTIVITY VARIABILITY IN THE JAPAN SEA AND ITS LINKAGES TO THE CHANGES IN TSUSHIMA WARM CURRENT AND EAST ASIAN MONSOON INTENSITY IN THE LAST 400 KA

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The Japan Sea (JS) is a semi-enclosed basin. A branch of the Kuroshio Current enters the JS as the Tsushima warm current (TWC). The surface productivity of JS is driven mainly by the dynamics of the TWC and the East Asian monsoon (EAM). Hence, to assess the surface productivity variability in the JS over the last 400 ka, and its linkages to the TWC and the EAMdynamics, microfossil data from multiple Integrated Ocean Drilling Program (IODP) sites located in the East China Sea (Site U1429) and the JS (Sites U1423, U1426, U1427) are analyzed. The microfossils considered for the analysis are TWC and surface productivity indicator nannofossils, planktic foraminifera and radiolaria. The analysis suggests that between400 and 160 ka TWC influx drove the JS productivity. Post 160 ka, both East Asian Summer Monsoon driven coastal water influx and East Asian Winter Monsoon driven vertical mixing controlled and increased the JS surface productivity. The statistical analysis on microfossil datasuggests that changes in sea-ice extent have influenced the warm current and monsoonal intensity, which controlled the Japan Sea surface productivity, organic flux, and carbonate preservation, over the last 400 ka. The sea-ice extent in the JS is controlling the level of TWCinflux and surface-water mixing, which have a significant impact on the JS surface productivity.

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LONG-TERM VARIABILITY IN THE MIXED LAYER AND THERMOCLINE IN THE EQUATORIAL EASTERNINDIAN OCEAN: INFLUENCE OF WIND AND OCEAN CIRCULATION

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The monsoon system represents one of the essential elements of global atmospheric oceanic circulation. The seasonality in the monsoon system changes the atmosphere and ocean circulation and precipitation effect, leading to the Sea surface temperature (SST), Sea surface salinity (SSS), productivity, and upper water column structure. Mixed layer and thermocline variability in equatorial India helps to understand wind patterns and heat distribution through the atmospheric and oceanic surface and sub-surface circulation. To understand long-term surface and sub-surface hydrographic variations along the eastern equatorial Indian Ocean, here we use the planktonic foraminifera assemblage records and their isotopic signature ($\delta^{18}O$ *G.ruber* and $\delta^{18}O$ *G.menaardii*) in core RC14037-PC taken from the EEIO (1° 00' N, 90° 00' E; 2600 m water depth). The core chronology was prepared using five AMS (accelerator mass spectrometry) radiocarbon (^{14}C) dates and seventeen tie points over the past ~248 ka. The $\delta^{18}O$ *G.ruber* record shows lower and higher values during the Inter-glacial periods (MIS 7, MIS 5, MIS3, MIS 1) and Glacial periods (MIS 6, MIS4, MIS2), respectively. The lower and higher $\delta^{18}O$ *G.ruber* values represent the warm/ or wet and cold/dry climate, respectively. Further, a strong trade wind-induced shallower (cooled) thermocline existed during MIS 5, MIS 3, and MIS 1, as evidenced by the large $\delta^{18}O$ *G.menaardii* - $\delta^{18}O$ *G.ruber* ($\Delta\delta^{18}O$*m-r)* value and abundance of thermocline species. Conversely, the deeper (warmer) thermocline was observed during the early and late MIS 7, MIS 6, and termination points T1 and T2.

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INVESTIGATION OF MAGNETIC CHARACTERISTICS AND MICROPALEONTOLOGY IN KARAI SEDIMENTS, ARIYALUR, TAMIL NADU

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The present study investigates the magnetic properties and paleontological aspects of the Karai sediments in Tamil Nadu, India. The study aims to analyze the magnetic features of these sediments and the paleoecology of foraminifera by examining sediment samples from the Karai region and identifying microfossils. Approximately 60 samples were collected fromKarai in the Ariyalur district of Tamil Nadu. The samples include mudstones gathered every 100 meters, siltstones collected every 200 meters, and ferric and phosphatic nodules sampled at 500-meter intervals along the Karai formation.

Magnetic susceptibility was measured in the field using a kappameter. The magnetic susceptibility values ranged from a maximum of 3.75 × 10^(-3) at location 27, associated with ferric nodules, to a minimum of 0.03 × 10^(-3) at location 11, associated with siltstone sediment. Laboratory measurements were conducted with an MS2B Bartington susceptibility meter. Frequency dependency results indicated a maximum susceptibility value of 28.6 × 10^(-3) m^3/kg at location 46.1, which is a mudstone sample, and a minimum of 0.1 × 10^(-3) m^3/kg at location 28, also a mudstone sample.

Out of the 60 surface sediment samples, 40 were selected for detailed paleontological analysis. This study reveals that the Karai sediments have developed over a long period, with their ecological environment ranging from shelf areas to deep-sea neritic marine settings. While magnetic characterization of the sediments was attempted, further systematic studies with additional samples and a comprehensive lithological analysis are needed to better understand the sedimentary history of the Karai sediments. The initial findings suggest that the sediments are weakly magnetic.

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VERTICAL DISTRIBUTION OF BENTHIC FORAMINIFERA SPECIES AND PALEOECOLOGY OF THE PUNNAKAYAL MANGROVE ECOSYSTEM, SOUTHEAST COAST OF INDIA

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Mangroves are a unique habitat and largely influenced by sea level changes and hydrodynamics conditions. The preservation of benthic foraminifera in mangrove sediments can be used as an excellent proxy for deducing past conditions. For the present study, one-meter-long sediment core was collected from Punnakayal mangrove forest, south coast of India and subjected to foraminiferal and textural analysis to infer the paleoecolgical characteristics. A total of 29 benthic foraminiferal species belonging to 17 genera, 9 super families, 12 families and 4 suborders were identified from the core samples. Our study recorded an assemblage dominated by calcareous perforate forms (13) followed by calcareous imperforate porcelaneous (11) and arenaceous (2) forms. Among the identified forms, *Ammonia dentata, Nonion elongatum, Ammonia beccarii* and *Ammonia tepida* was observed in the entire core. The significant down core variation was observed in benthic foraminiferal abundance and diversity. The agglutinated forms were found to be high in the bottom portion of the core and shows decreasing trends towards top portion. The upper layers of the core were dominated by stress tolerance benthic foraminifera such as *Ammonia beccarii* and *Ammonia tepida* indicating stressed environmental condition prevailing in the study region. The low diversity and differences in distribution of foraminifera compared to surface samples may be due to intense post depositional changes or anthropogenic disturbances. The mangrove ecology thus appears disturbed by various factors.

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THE MEDITERRANEAN–ATLANTIC GATEWAY EXCHANGE: PRELIMINARY RESULTS BASED ON MICROFOSSILDATA FROM THE INTERNATIONAL OCEAN DISCOVERY PROGRAM (IODP) EXPEDITION 401

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The modern Mediterranean Basin has its own thermohaline circulation system, producing a dense overflow that enters the Atlantic through the subsurface, while a compensatory low-salineAtlantic inflow enters the basin along the surface through the Strait of Gibraltar. This Mediterranean–Atlantic exchange was already active around 7.8 Myr ago due to the tectonic convergence of the African and Eurasian plates, which restricted the Mediterranean-Atlantic gateway. Progressive restriction during the late Miocene substantially reduced the Atlantic inflow,resulting in the deposition of massive evaporites in the basin during the Messinian Salinity Crisis(MSC). There is wide controversy about the location, age, and geometry of the gateways that closed and the onset and precise series of events that led to the MSC. Some authors suggest thata megaflood at the latest Messinian/beginning of the Pliocene reconnected the Atlantic with the partially desiccated Mediterranean through the Gibraltar Strait, ending the MSC. According to another hypothesis, the Atlantic–Mediterranean connection through the Strait of Gibraltar was probably active before and during the entire MSC. Investigating Miocene Mediterranean–Atlantic Gateway Exchange (IMMAGE) is a Land-2-Sea drilling proposal that targets drilling at multiple onshore and offshore locations, to get a completerecord of Atlantic–Mediterranean exchange from inception (~7.25 Ma) through the salt giant formation (5.9 to 5.3 Ma) to the Early Pliocene establishment of a modern-like gateway configuration. International Ocean Discovery Program (IODP) Expedition 401 is the offshore component of IMMAGE and was conducted in the coastal areas off the west Iberian margin (Northeast Atlantic), in the Gulf of Cádiz and in the Alborán Sea (Mediterranean Sea) from 10th December 2023 to 9th February 2024. The sedimentological and micropaleontological records obtained onboard the JOIDES Resolution during IODP Expedition 401 have been used to assess the Miocene–Pliocene Mediterranean–Atlantic paleoenvironmental evolution. The preliminary analysis of retrieved cores at Site U1611 (Alborán Sea) indicates that the water mass was stratifiedand anomalously saline in the terminal Messinian, and there is no evidence of any catastrophic flooding event in the succession recovered around the Miocene–Pliocene boundary.

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BENTHIC FORAMINIFERA AS A BIOINDICATOR FOR HEAVY METAL POLLUTION: A CASE STUDY FROM THEINDIAN SUNDERBANS

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The Sunderbans mangrove forest, one of the largest such forests in the world (140,000 hectares), lies on the delta of the Ganges and Brahmaputra rivers on the Bay of Bengal. The site is intersected by a complex network of tidal waterways, mudflats and small islands of salt-tolerant mangrove forests and presents an excellent example of ongoing ecological processes. In coastal and marginal marine environments, benthic foraminifera are being utilized more and more as environmental bio-indicators of pollution. The basic environmental features can be inferred fromtheir community structure, while certain species are sensitive to particular environmental factors.Test abnormalities may serve as a valuable bioindicator for tracking environmental effects in coastal areas, among other criteria. Thirteen surface sediment samples from Indian Sunderbans were collected for a study on benthicforaminifera. *Haplophragmoides wilberti* dominates the abundant, well-preserved benthic foraminiferal assemblages found in this region, along with other agglutinated species like *Miliammina fusca* and *Trochammina inflata*. Calcareous hyaline shells of *Cribroelphidium poeynum*, *Cribroelphidium hispidulum*, *Haynesina depressula*, *Haynesina germanica*, *Ammonia tepida*, *Ammonia parkinsoniana*, *Ammonia beccarrii*, *Cocoarota* sp. have been identified along with the only porcelaneous constituent *Quinqueloculina seminulum*. The relative abundance of species varied from one station to the other with 6 species having relative abundance of more than 5%. Multivariate analysis demonstrates that the presence of heavy metals has an apparent effect on the taxonomic makeup of foraminiferal communities as well as the emergence of anomalies in tests. In the present work, we observed that besides the marked negative population response to the presence of a significant concentration of heavy metal pollution of the surveyed area, the presence of abnormal tests emphasizes the adverse effects of these pollutants over the foraminiferal fauna. We can suggest that the more perturbed environmental condition which can results from higher heavy metal content may be accountable for the abnormalities found in the foraminiferal assay. The low percentage of heavy metals is strikingly similar to the low concentrations of those elements.

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FOSSIL FISH REMAINS FROM THE MAASTRICHTIAN DECCAN INTERTRAPPEAN BEDS OF MALWA PLATEAU,MADHYA PRADESH, CENTRAL INDIA

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The Northern Deccan volcanic province also known as the Malwa volcanic sub-province is less known for intertrappean vertebrate fossils than its counterparts, Western, Central-Southern, and Eastern Deccan volcanic sub-provinces. Fossilized remains of varied fishes represented by teeth, vertebrae, dental bones, scales, and spines were recovered from the Late Cretaceous intertrappean exposures at Gujri and Kakarda, Dhar District, Madhya Pradesh, Central India following screen washing technique. A fish assemblage comprising Pycnodontidae indet., *Lepisosteus indicus, Lepidotes* sp., *Phareodus* sp., Siluriformes indet, *Enchodus* sp., and Pristolepidae indet. has been identified from the collected material. The Pycnodontidae are represented by incisiform and molariform teeth, *Lepisosteus indicus* by isolated teeth and scales, *Lepidotes* sp. by few oral teeth while *Phareodus* sp. is represented by teeth, vertebrae, scales anddental bones. Indeterminate Siluriformes recorded from the present study are known by their pectoral and dorsal spines. Isolated teeth of *Enchodus* sp. and isolated scales of Pristolepidae indet. are also recognized in the studied material. The recovered fishes inhabit varied habitats, such as *Lepisosteus indicus*, *Phareodus* and Pristolepidae are found in freshwater rivers and lakes, whereas *Lepidotes*, *Enchodus*, Pycnodontidae and Siluriformes inhabit freshwater to euhaline lakes, rivers and sea. The absence of Chondrichthyes, *Igdabatis*, a typical shallow marine-brackish water ray fish, marine-brackish water ostracods and foraminifera in the studied sample and the predominance of non-marine ostracods, freshwater molluscs, amphibians, reptiles as an associated taxa in the microfossil assemblage of the study area indicates that the intertrappean beds of Gujri and Kakarda were deposited under freshwater environmental conditions.

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EOCENE TO OLIGOCENE PALEOCEANOGRAPHY OF THE SOUTHERN OCEAN: A REVIEW

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Recent climate models predict an ice-free polar region due to an unprecedented increase in the atmospheric greenhouse gases. To understand this shift, we examine the paleoceanography of the Southern Ocean from the Paleocene to Oligocene period (~56-23 Ma), from an ice-free period to a time with major ice-sheets formation. The Early Eocene (~53-49 Ma) was marked by extreme warmth and high atmospheric CO_2 levels, with Southern Ocean surface temperatures reaching 24-26°C, as shown by Mg/Ca and $\delta^{18}O$ proxies from foraminifera. This resulted in strong upper water column stratification and poorly oxygenated deep waters. Cooling began after 49 Ma, improving ocean ventilation and increasing productivity, as indicated by biogenic sedimentation and $\delta^{13}C$ values. This period saw the first signs of Antarctic cooling, as ice started accumulating on the continental highlands. This secular cooling trend was interrupted by a brief warming, the Middle Eocene Climatic Optimum (MECO) ~40 Ma, caused a ~4°C rise in in surface and deep-water temperatures, reducing Benthic and planktic foraminiferal production and export productivity. Following MECO, the Priabonian oxygen isotope maximum (PrOM) event (~37.3 Ma) indicated possible ice sheet expansion. The major climatic shift occurred at Eocene-Oligocene Transition (EOT; ~34 Ma) marked significant Antarctic glaciation, cooling both surface and deep waters by 3-5°C. Gateway openings like the Tasmanian and Drake Passages enhanced circulation, establishing the Antarctic Circumpolar Current (ACC), which isolated Antarctica and promoted global cooling. By the Oligocene, the Southern Ocean had transitioned to a cooler and more ventilated state. The ACC was fully established, reinforcing the thermal isolation of Antarctica and the maintenance of its ice sheets. The Southern Ocean's role as a significant driver of global heat transfer and CO_2 regulation was heightened during this period, with biological productivity contributing to atmospheric CO_2 drawdown. In conclusion, the Southern Ocean's paleoceanography from the Eocene to Oligocene reflects significant shifts in temperature, circulation, and biological activity. The key drivers of these changes were the climatic cooling events, oceanic gateway formations, and the onset of Antarctic glaciation.

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TAXONOMY OF *Neogloboquadrina pachyderma* (EHRENBERG) FROM THE SOUTH ATLANTIC OCEAN AND ITS APPLICATION IN PALEOCEANOGRAPHIC STUDIES

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Neogloboquadrina pachyderma inhabits in the polar waters, which makes its presence in the temperate/sub-polar to tropical waters a very useful tool for Paleoceanographic reconstruction. *N.pachyderma* evolved from *N.continuosa* in the late Miocene and has been assigned to many different genera, from originally assigned *Aristerospira* to *Neogloboquadrina* after many revisions from several authors. The other descendants of *N.continuosa* follow a different evolutionary trend than *N.pachyderma*. Depending upon the water mass characteristics and climatic conditions, *N.pachyderma* can show 2 types of coiling patterns, i,e. sinistral and dextral representing polar (cooler) and temperate (warmer) water mass, respectively. The ratio of two coiling types (Sinistral and Dextral) of *N.pachyderma* has been used to illustrate the glacial-interglacial periods. Various authors have identified the latitudinal distribution of these two coiled forms of *N.pachyderma* and concluded the Sea Surface Temperature (SST) range of 1-80C and 9-150C for sinstral and dextral forms, respectively. Based on the water mass characteristics, *N.pachyderma* can show numerous variations in its morphological features, like the aperture shape, chamber arrangement, chamber packing, surface ultra structure etc. The variations in the morphology of the *N.pachyderma* can provide evidences of changes in the paleoceanographic settings. As *N.pachyderma* sinks it continues to crystallize and records the geochemical and isotopic variation of the water column at different depths by recording their signatures in the additional calcite layers on its test. Recent genetic studies have shown that these two coiled forms of *N.pachyderma* are different species altogether, and a new name, *N.incompta*, was assigned to the dextral form of *N.pachyderma*. Although, *N.pachyderma* sinistral is considered to be confined in polar regions, they can still be found in temperate regions. These individuals if less than 3% are considered as aberrant forms of *N.pachyderma* dextral or *N.incompta*, as these aberrant *N.pachyderma* sinistral are genetically similar to the *N.pachyderma* dextral or *N.incompta*. With the help of genetic studies, 8 genotypes have also been established in recent years for *N.pachyderma* based on the latitudes and range of sea surface temperature that they inhabit.

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PALAEOBOTANICAL EVIDENCES FOR PERMIAN-TRIASSIC TRANSITION FROM TALCHERCOALFIELD, MAHANADI BASIN, ODISHA, INDIA

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The Talcher Coalfield is occupied in the south-eastern part of the Mahanadi Basin and it occurs as a detached basin surrounded by Precambrian rocks. This coalfield spreads over an area of 1800 sq. km. and bounded by latitudes 20º 53′ & 21º 12′ and longitudes 84º 20′ & 85º 23′. Total sixteen samples have collected from the borehole TTB-10, Talcher Coalfield, Mahanadi Basin, Odisha.The qualitative and quantitative palynological analysis reveals three distinct palynoassemblages. Palynoassemblage I is characterized by the dominance of striate bisaccate pollen *Striatopodocarpites* and sub dominance of monosaccate pollen mainly *Densipollenites* along with other palynotaxa such as *Crescentipollenites*, *Faunipollenites*, *Verticipollenites*, *Striatites*, *Rhizomaspora* and *Striasulcites*. The trilete spores are represented by *Microbaculispora* and *Microfoveolatispora*. This palynoassemblage suggest a Late Permian age. Palynoassemblage II exhibits mixed palynocomposition of Late Permian and Early Triassic age i.e. *Lundbladispora*, *Verrucosisporites*, *Microfoveolatispora*, *Microbaculispora*, *Playfordiaspora*, *Parasaccites*, *Densipollenites*, *Striatopodocarpites*, *Faunipollenites*, *Crescentipollenites*, *Verticipollenites* etc. This palynoassemblage designates the Permian-Triassic transition and is assigned to latest Permian age for borehole TTB-10. Palynoassemblage III is distinguished by the dominance of cavate cingulate spores namely *Lundbladispora* spp., *Densoisporites* spp., *Decisporites* and *Indotriradites*. The non-striate bisaccate pollens chiefly *Alisporites* spp., *Minutosaccus*, *Klausipollenites*, *Brachysaccus* and *Satsangisaccites*. The present palynoassemblage III is here assigned the Early Triassic age. A good assemblage of naked, permanent fossil spore tetrads is also recorded from the Palynoassemblage I. Based on morphological characters they are assignable to dispersed miospores genera *Lundbladispora*, *Densoisporites*, *Verrucosisporites* and *Callumispora*. The occurrence of these spore tetrads from the Early Triassic sediments suggests the prevalence of extreme hot condition during the deposition of the studied sequence.

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DYNAMICS OF OMZ-DENITRIFICATION IN THE SOUTHEASTERN ARABIAN SEAON MILLENNIAL TIME SCALE: BOLLING-ALLEROD TO HOLOCENE

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This study investigates the millennial-scale dynamics of oxygen minimum zone (OMZ) denitrification in the southeastern Arabian Sea, spanning from the Bølling-Allerød (BA) interstadial to the Holocene epoch. We analysed sediment cores to reconstruct past variations in OMZ intensity and denitrification processes, utilizing proxies such as stable isotopes of nitrogen and carbon ($\delta^{15}N$, $\delta^{13}C$) and total organic carbon and total nitrogen (TOC, TN) to unravel the complex interactions between monsoonal activity, marine productivity, and denitrification., Our results reveal significant fluctuations in OMZ strength, closely linked to regional climatic events and the Indian Summer Monsoon (ISM) intensity. The Bølling-Allerød period exhibited a relatively weaker OMZ, coinciding with increased monsoonal activity, which enhanced marine productivity and oxygenation. In contrast, the Younger Dryas (YD) cooling event triggered a strengthening of the OMZ, marked by elevated denitrification rates, likely due to reduced monsoonal strength and decreased ventilation. The transition into the Holocene saw a gradual intensification of the OMZ, aligning with a steady decline in ISM intensity. This study underscoresthe critical role of monsoonal dynamics in modulating OMZ denitrification and offers insights into the broader implications of climate variability on marine biogeochemical cycles.

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REPORT ON THE OCCURRENCES OF GONDWANA PALYNOFOSSILS IN AND AROUND DAMBUK, LOWER DIBANG VALLEY DISTRICT, ARUNACHAL PRADESH, INDIA

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The present palynological study has been carried out to confirm the presence of Gondwana rocks in the eastern side of Siang River, Siluk-Dambuk area, East Siang and Lower Dibang Valley, Arunachal Pradesh. By observing the similarity of lithological associations of established Gondwana sediments in other parts of Arunachal Himalayas and the study area, this attempt has been made to establish the age of these sediments. Geological mapping was carried out and the area is mainly comprised of sandstone, shale, carbonaceous shale, gray shale, purple shale with minor limestone bands and volcanics. The studied samples did not yield any macro fossil. Seven samples have been processed for palynological study and productive samples produced 18 palynofossil. They include the following typical Upper Permian palynotaxa -*Undulatisporites* sp, *Microbaculispora tentula, Alisporites oblongus, Monosaccate* sp, *Horriditriletes bulbosus, Parasaccites obscurus, Plicatipollenites gondwanensis, Parasccites radialis, Triletes* sp., *Microbaculispora* sp., *Verrucosisporites* sp.,*Brevitriletes unicus, Densipollenites indicus, Microbaculispora tentula, Tetraporina* sp. etc. The above fossil assemblage suggests presence of Gondwana sediment of Early Permian Age deposited dominantly under fluvial condition which was periodically influenced by marine incursions. These Gondwana sediments of Easternmost Arunachal Pradesh are exposed in a NW-SE trending linear and narrow belt in front of the Mishmi Hills.

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PROVENANCE, TECTONIC SETTING, WEATHERING AND PALEOCLIMATE EVOLUTION OF HOLOCENE SEDIMENTS OF PAUNI REGION, CENTRAL INDIA: A GEOCHEMICAL APPROACH

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The major, trace, and rare earth element (REE) composition of Holocene sediments of Pauni area of Bhandara district near the Wainganga River, Central India has been analysed to determine their geochemical characteristics, provenance, tectonic setting, weathering intensity, climate shifts, and to understand the regional sedimentary evolution. This study suggests that the Holocene sediments are of shale-type, with an intermediate composition provenance, indicating that the source rocks include granitic gneiss, andesite, muscovite schists, and Tirodigneiss from adjacent areas. The chondrite-normalized REE patterns of the sediments show anenrichment of light rare earth elements (LREEs), a slight depletion of HREEs, negative Eu and Lu anomalies. The negative Eu anomaly confirms that the source rocks are felsic, similar to those exhibited by the UCC and PAAS while the A-CN-K diagram suggests a felsic to intermediate source. The Lu negative anomaly indicates that the sediment have undergone multiple recycling episodes. The paleo-weathering conditions at the sediment's source region,based on the CIA (avg. 59.96), CIW (avg. 65.48), PIA (avg. 62.07), and ICV (avg. 1.65) indices, along with A-CN-K (Al_2O_3-$CaO+Na_2O+K_2O$) plots, suggest incipient to moderate chemical weathering. The discrimination diagrams based on geochemical data of the river sediments suggest passive margin depositional conditions, as the study area has not undergone any significant tectonic adjustments during the Holocene epoch. Paleoclimate conditions of thebasin, as suggested by the C-value plot and SiO_2 versus $Al_2O_3+K_2O+Na_2O$ diagram, indicate that the climate has evolved from semi-arid to semi-humid over time. The Rb/Sr (0.14–0.81) and Cu/Sr (0.16–1.0) ratios further support the hypothesis of a paleoclimatic shift from warmerto wetter conditions, which can be attributed to the intensification of the Indian Summer Monsoon (ISM) during the Holocene. Although the Indian monsoon generally strengthened from the early Holocene to the present, it exhibited sporadic climate variations.

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LATE QUATERNARY RECONSTRUCTION OF UPPER WATER COLUMN HYDROGRAPHIC VARIATIONS IN SOUTHWEST INDIAN OCEAN

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The Southern Ocean is crucial to the global climate system, assuming a pivotal role in governing the climate through its significant contributions. It facilitates heat transfer and salt among oceans worldwide and regulates atmospheric CO_2 levels. The Southern Ocean sector of the Indian Ocean is known for its unique ocean fronts and corresponding water masses, whose dynamics have been proposed to influence global climate variability across various timescales. The present study has been carried out on the marine sediment core samples (IODP Site U1475; latitude 41°25.61'S, longitude 25°15.64'E; water depth 2669 m) collected from southern Agulhas Plateau (AP), which is situated very close to the modern-day subtropical front (STF), in southwest Indian Ocean. Agulhas Plateau can be described as the region located amidst the fresh, cold, and nutrient-rich waters of the Sub-Antarctic Zone (SAZ) in the south and the warmer, nutrient- poor waters of the Agulhas Current in the north, which exhibits a high sensitivity to variation in both water conditions. The core spans ~350 kyr, was studied for the micropaleontological (abundances of ecologically sensitive planktic foraminifera) and geochemical analyses ($\delta^{18}O$ *G.bulloides*), to reconstruct the past hydrographic conditions, paleo-productivity variations, mixed and thermocline layer variations over the past glacial and inter-glacial cycles. Our records show an increase in the abundance of mixed layer species during glacial periods suggesting increased vertical mixing, also *G. bulloides* (%) indicates increased productivity during glacial periods, possibly influenced by the presence of the STF. Conversely, interglacial periods show an increase in thermocline species and a decline in mixed layer species, likely attributable to reduced vertical mixing caused by the southward shift of the STF. This shift enhances the dominance of warm ARC, leading to increased water column stratification during interglacial periods. $\delta^{18}O$ *G.bulloides* records show depleted values during interglacial and enriched values during glacial periods.

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MONSOON-DRIVEN STRATIFICATION AND CARBONATE PRESERVATION IN THE ANDAMAN SEA OVER THELAST 1.2 MILLION YEARS: INSIGHTS FROM PTEROPOD AND FORAMINIFERAL RECORDS

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This study examines the planktonic foraminifera and pteropods abundances in the Andaman Sea sediments over the last 1.2 million years, focusing on their relationship with glacial- interglacial cycles, oceanographic conditions, and Indian Summer Monsoon (ISM) variabilityutilizing deep-sea core NGHP-17 from a depth of 1344 meters. The region provides unique insights into how ISM-driven stratification and associated changes in ocean circulation and chemistry influence carbonate dissolution and preservation over long timescales. The data encompass a range of geochemical and environmental proxies, including planktonic foraminifera species distributions, total pteropod counts, *Limacina* Dissolution Index (LDX) and calcium carbonate percentage ($CaCO_3$%). The foraminiferal data provide insights into pastoceanographic conditions, indicating that glacial periods were marked by weak stratification and well-ventilated water column by a stronger upwelling, enhanced nutrient availability whichsupported higher abundances of fertile species and good preservation of pteropods. The prominent stratification events observed during interglacial periods during the MIS (Marine Isotope Stage) 9, 7, 5 and 1, featured intense stratification and reduced nutrient availability. The late Quaternary productivity in the Andaman Sea has been mainly influenced by salinity-driven stratification, shaped by northern hemisphere insolation and interactions between the summer and winter monsoons. The results further highlight a pattern of pteropod preservationduring glacial periods and reduced preservation during interglacial, with a pronounced peak during the Eemian interglacial, MIS 5e (130-115 kyrs). The identification of a 100,000-year cyclicity in pteropod preservation, aligned with orbital forcing, underscores the influence of global climatic drivers on regional ocean chemistry. Furthermore, the Mid-Pleistocene Transition (MPT) marks a pivotal shift in oceanographic conditions, leading to improved preservation of aragonite in post-MPT sediments. Overall, this study enhances our understanding of how monsoon-driven stratification and global climatic factors have shaped the paleoenvironmental evolution of the Andaman Sea, offering valuable perspectives on tropical marine ecosystem responses to long-term climatic changes.

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DECIPHERING THE OCEANOGRAPHIC CHANGES IN THE SOUTHEASTERN ARABIAN SEA DURING LATEPLEISTOCENE-EARLY HOLOCENE BASED ON PTEROPOD RECORDS

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The Arabian Sea hosts intense hypoxic conditions driven by the oxygen minimum zone (OMZ)at intermediate depths (150-1000 m) which is linked to the high surface production and decreased subsurface ventilation. Previous studies in this region have revealed millennial scale oscillations in the past OMZ extent, making it an ideal region for understanding complex relationship between OMZ variability, monsoon induced oceanic productivity, and ventilation in intermediate waters. The water in the OMZ is undersaturated with regard to aragonite due to excessive oxygen consumption and there is limited ventilation of thermocline waters in the Arabian Sea, hence the Aragonite Compensation Depth in the Arabian Sea is shallow (550 m). In this regard, sediment archives from the Southeastern Arabian sea (SEAS) provide a unique opportunity to investigate the response of OMZ intensity to monsoon variability on different time scales. Pteropods are holoplanktic microgastropods that are common members of the planktic microfaunal assemblage in Quaternary sediments of SEAS. They are aragonitic in compositionand are susceptible to dissolution; their preservation in sediment is highly dependent on the physico–chemical properties of the water column. As a result, fossil pteropod assemblages canrecord previous changes in surface and subsurface water mass carbonate chemistry. However, pteropods are quite abundant in deeper waters in the studied core and other cores from the SEAS, which could be due to ventilation of subsurface and intermediate water masses off the western coasts of India. Here we present the absolute and relative abundance of pteropods species (*Heliconoides inflatus, Limacina trochiformis, Creseis chierchiae and Creseis virgula)* with respect to planktic foraminifera from core SK 291-GC05 (10°24.85'N; 75°17.26'E; water depth 1000 m)to reconstruct changes in the paleoproductivity and water column oxygenation in the SEAS during the late Pleistocene and early Holocene.

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DIVERSITY AND ASSEMBLAGES OF DIATOMS AS POLLUTION INDICATORS FOR THE RAMAKKAL LAKE DHARMAPURI DISTRICT, TAMIL NADU, INDIA

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The quality of water is usually determined by its physico-chemical parameters and there is an intricate relationship between the aquatic diatoms and hydro biological parameters in a freshwater body. Hence the present study is focused on the investigation of physico-chemical characteristics on the effect of diatom composition of ten distinct Rammakkal Lake habitats in Dharmapuri, Tamil Nadu, India. In the present physico-chemical parameters result the maximum water pH (8.25), turbidity of 200 NTU, TDS 1207.5 mg/L, electrical conductivity of 1725 (µS/cm), alkalinity of 384 mg/l, C. hardness 288 mg/L, calcium of 115.2 mg/l, magnesium of 52.2 mg/l, sodium of 186 mg/l, Potassium of 20 mg/l, iron 2.8 mg/L, Ammonia 10.5 mg/L, Nitrate of 8 mg/l, chloride304 mg/L, Fluoride 0.3 mg/L, Sulphate 55 mg/l, Phosphate of 0.56 mg/l, Anion 1.11 mg/L and Cation 1.11 mg/L were recorded from Rammakkkal lake. The maximum individuals of 162 were observed in Station – X, Shannon diversity index (H') diatom diversity high index value of 3.406 was recorded in Station – II, the maximum Margalef index species richness value of 8.034 was recorded in Station – VI, the maximum Simpson index (D) species richness value of 0.9602 was recorded at Station – II, the maximum Pielou's species evenness value of 0.8375 was recorded in Station – II. In present rainfall in the monsoon season dilutes the municipal wastewater, domestic waste resulting in higher dissolved solids with high amount nutrients content; they are sensitive to many pollution conditions and show variability in diatoms species diversity and richness composition. This condition of the lake suggests for necessary monitoring, conservation strategies against increasing anthropogenic activities in the studied district, therefore suitable treatments are required before they are released to the river systems.

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IDENTIFICATION AND DISTRIBUTION OF PLEISTOCENE RADIOLARIA FROM CORE ABP-06, STATION-II (SECTION- 3),CENTRAL INDIAN OCEAN

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The study area, Akademic Boris Petrov (ABP) -06 of Station II, Section- 3 lies between Latitude 11°35.374'S and Longitude 75°10.109'E in Central Indian Ocean. The studied sectionis 1meter long and collected at a depth of 5,181 meters in the Central Indian Ocean. This sectionis composed of dark brown fine grained clayey material having radiolaria.
The sediment was first disaggregated in dilute hydrogen peroxide (H_2O_2) for 6-8 hours, followed by heating to just below the boiling point. One tea spoonful of Calgon (R) was addedto further disaggregate the samples and complete the treatment. The sample was then sieved through a 63μm mesh stainless sieve. After final wet sieving the residual material, it was driedand used for the preparation of slides with the help of Canada balsam. Fifteen samples were used and identified eighteen radiolaria. The distribution of all the identified taxa is noted in allthe samples. Based on assemblage and abundance, it is interpreted that the core belongs to Upper Quaternary age. The assemblage shows typical radiolaria species of tropical region like *Acrosphaera spinosa spinosa, Spongaster tetras tetras* and *Euchitonia furcata.* It is also observed that one cold water species- *Stylodictya validispna* and one upwelling species - *Tetrapyle octacantha* present.

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SYSTEMATIC PALEONTOLOGY AND DISTRIBUTION OF QUATERNARY RADIOLARIA FROM THE CORE ABP-06, CENTRAL INDIAN OCEAN

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A comprehensive study is carried out on the core ABP-06, Station II, Section 1 of Central Indian Ocean. 25 samples of 50 cm length were taken at a depth of 5,179m of Latitude 11° 35' 37.4"S and longitude 75° 10' 10.9"E. Lithologically, the studied core contains fine grained clayey material (siliceous ooze) with white lensoid patches and have radiolaria and sponge spicules in traces.The samples were disaggregated and boiled with dilute hydrogen peroxide for about 8-10 hours. Then sieved through 63µm mesh stainless sieve and thorough washing was done with running water to clean the test. The residual material was dried in an oven and used to prepare the strewn slides with the help of Canada balsam. 22 radiolarian species are identified from 25 samples. The distribution of each taxa and their systematics are described. It is observed that reworked species- *Spongaster pentas, Heliodiscus echiniscus* and *Acrosphaera spinosa echinoides*; upwelled taxa - *Tetrapyle octacantha* and cold water taxa - *Stylodictya validspina,* occurs very rare to rare. On the basis of assemblage, the core belongs to the Upper Quaternary age.

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DECODING THE MIDDLE JURASSIC PALEOCEANOGRAPHY: STABLE ISOTOPE INSIGHTS FROM OSTRACODESHELLS OF THE SPECIES *Galliaecytheridea remota* FROM THE SOUTHERN PART OF KACHCHH BASIN, INDIA

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The significance of carbonate ostracode shells and their use in stable isotope analysis has increased since the 1980s. The carapace of ostracode is known to accurately reflect the chemical composition of the water it inhabits since it directly absorbs ions (specifically Ca2+ and HCO3-) from the surrounding water. In this study the rock samples are collected from the southern part ofKachchh Basin, specifically Ler, Gangeshwar Mahadev, Fakirwari and Dhawalshahpir Mazar, for the extraction of ostracode fossils. The specimens of the species *Galliaecytheridea remota* were selected for the stable isotopic analysis due to their considerable abundance and excellent preservation. Well preserved, clean and milky white color valves (five to eight, including whole and broken valves) have been chosen from each sample for the analysis. The valves were then cleaned with deionized water, using a fine brush (000 size), to remove the adhering sediments and also checked under a light microscope for any kind overgrowth. The isotopic ratios of C and O were measured by extracting the CO2 from the samples by a reaction with 100% ortho- phosphoric acid at a temperature of 80°C. The procedure took around 20 minutes. The isotopic ratios are reported relative to the isotopic ratios of Pee Dee belemnites (PDB) and are expressed in per mil (‰). The analysis was carried out a dual inlet Isoprime-100 mass spectrometer, at IRMS facility, Department of Earth Sciences, Pondicherry University. The $\delta^{18}O$ value of the *Galliaecytheridea remota* ranges from -4.14 to -2.07 and $\delta^{13}C$ value ranges from -2.96 to 0.79. The $\delta^{18}O$ value (4.14 to -2.07) suggests that the shells are of calcitic composition and not dolomitic one. Also, the range of $\delta^{18}O$ suggests that the shells might have contains neomorphic calcite crystals, suggesting the initial phase of diagenesis and were precipitated from the sediment pore water that fills the pore space of top few meters of sediment, which carries important palaeoceanographic information. The paleotemperature of the pore water is determined using Anderson and Athur equation: T (°C) = 16 + 4.14 (δ 18Oc - δ 18Ow) + 0.13 (δ 18Oc - δ 18Ow) 2. The temperature ranges from 23.09°C to 28.59°C with an average temperature of 25.07°C. δ13C value of the shell ranges from-2.96 to a maximum of 0.79, which falls within the normal range observed for the marine carbonate.

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PALEOENVIRONMENT OF MIDDLE JURASSIC OSTRACODES FROM DHAWALSHAHPIR MAZAR SECTION, SOUTHERN PART OF KACHCHH BASIN, NW INDIA

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The present investigation deals with the paleoecology of ostracode fauna recorded from the Middle Jurassic sequence represented by the Jumara Formation exposed at Dhawalshahpir Mazar section, in the Charwar Range of the Mainland Kachchh. The studied section located at 9-10km from the Bhuj town, along the Bhuj-Mandvi Road and approximately 2km southwest from Fakirwari Dome. Members III and IV (Biswas, 1993) of Jumara Formation are exposed in the studied section and consists of alternate beds of shale, limestone and conglomerates. The recorded ostracode genera are *Acrocythere, Bairdoppilata, Cytherella, Cytherelloidea, Cytheropteron, Fastigatocythere* and its subgenera (*Batella, Fastigatocythere, Habocythere*,) *Galliaecytheridea, Glabellacythere, Majungaella, Mandawacythere, Oligocytheris, Paracypris, Progonocythere, Protobuntonia, Schuleridea, Trichordis.* Based on the distribution of various ostracode species belong to the above said genera two ostracode biozones have been established within the studied sequence of the rocks viz. *Fastigatocythere (Habocythere) jakhari* Assemblage Zone and *Majungaella perforata kachchhensis-Galliaecytheridea remota* concurrent Range Zone. Apart from the paleoecology of individual genera, valve- carapace ratio is considered to establish the depositional energy condition, depth analysis carried out with the help of CBCC (Cytheroidea, Bairdioidea+Cypridoidea, and Cytherellidae) ternary plot, introduced by Dingle (1980, 1981) and the dissolved oxygen concentration is determined by the abundance of filter feeding ostracodes (Platycopids), suggested by Whatley et al. (2003). The above analysis, suggest that the beds of *Fastigatocythere (Habocythere) jakhari* Assemblage Zone were deposited in shallow (up to 200m depth), warm marine environment under moderate energy regime with normal oxygen level and the beds of *Majungaella perforata kachchhensis-Galliaecytheridea remota* Concurrent Range Zone were deposited in shallow to deep marine (up to 500m), shelf environment under slower energy regime and well oxygenated condition during the transgressive cycle.

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INCREASING PRODUCTIVITY STRENGTHENED THE OXYGEN DEFICIENT ZONE IN THENORTHEASTERN ARABIAN SEA DURING THE LAST 3000 YEARS

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Northeastern Arabian Sea hosts a prominent oxygen deficient zone (ODZ). The intensity and extent of ODZ in this region varies temporally, as evidenced by the sedimentary records that reveal alternating phases of pronounced and reduced ODZ intensity. The strength of ODZ is closely linked with the variation in primary productivity. The past records can help us understand the factors affecting ODZ intensity and extent in the northeastern Arabian Sea. Thecharacteristics of the microfossils in the sediments are an efficient proxy to reconstruct the pastODZ intensity and primary productivity. We reconstructed the multi-decadal ODZ and productivity changes in this region during the last ~3000 year, by using both the sedimentary characteristics [organic carbon (C_{org}%), organic carbon to nitrogen ratio (C_{org}/N), calcium carbonate ($CaCO_3$%)] and foraminiferal morphogroups, in a core collected at a water depth of512 m within the modern intense ODZ. Benthic foraminifera were categorized in to nine morphogroups representing productivity and ODZ intensity. The consistent increase in C_{org}% with a synchronous increase in the infaunal and decrease in epifaunal benthic foraminifera suggests an increase in productivity coupled with decrease in the dissolved oxygen concentration during the last 3000 years. A synchronous decrease in C_{org}/N throughout the last3000 years suggests increasing marine organic carbon contribution since the Roman Warm Period to the Little Ice Age. The low relative abundance of tapered-cylindrical and flattened ovoid benthic foraminifera matched well with C_{org}%, prior to the Roman Warm Period, suggesting low productivity and well oxygenated waters. We also report a consistent decreasein $CaCO_3$% during the last 1500 years due to the dissolution under low dissolved oxygen and higher organic matter content in the sediments.

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PLEISTOCENE RADIOLARIA FROM LEG 119 SITE 738B SECTIONS (1H1-1H2), SOUTHERN OCEAN REGION; TAXONOMY AND DISTRIBUTION

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This paper presents diverse and abundant assemblages of cold water species of Southern Ocean. The 25 samples were used to carry out this study from Leg119 Site 738B. These samples were collected at a water depth of 2252.5 mbsf and lies between latitude 62º42.54'S and longitude 82º47.25'E. This area lies at the Southern slope of Kerguelen Plateau in the Southern Ocean Region. Lithologically, the studied core consists calcareous chalk and limestone along with siliceous ooze having microfossils like radiolaria, foraminifera and diatoms. Twenty species were identified and described along with their taxonomy. The radiolarian species occur from rare to few like *Antarctissa denticulata, Antarctissa cylindrica, Antarctissa strelkovi* and *Cycladophora davisiana* in the studied sections. The identified species show typical Antarctic assemblage like *Cycladophora davisiana, Cycladophora bicornis, and Spongotrochus glacialis;* Sub Antarctic- *Botryostrobus* sp, *Cenosphera cristata*, *Spongopyle* sp, cosmopolitan- *Prunopyle antarctica* and and bi-polar - *Peripyramis circumtexta* are noted and described.
On the basis of age marker of certain taxa, two radiolarian zones namely Omega and psi were established on the base's abundance, first and last common occurrence of radiolaria. On the basis of assemblage of radiolaria these sections belong to Pleistocene age.

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LATE CRETACEOUS AND EARLY TERTIARY PLANKTIC FORAMINIFERA FROM VRIDHACHALAM AREA, CAUVERY BASIN, SOUTH INDIA

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The late Cretaceous-early Tertiary section in the Vridhachaam area of Cauvery basin is represented lithostratigraphically by Parur, Patti, Mattur, Aladi and Pondicherry Formation in ascending order. This sequence is important because well-developed marine outcrops which have yielded richest and well preserved planktic foraminiferal fauna so far recorded from South India. A total of twenty one species of planktonic foraminifera belonging to nine genera *(Hedbergella Globotruncana and Rugoglobigerina, Parasubbotina, Subbotina, Igorina, Acarinina ,Morozovella, and Pseudohastigerina)* are identified in the present study. Of the nine genera recorded, two genera are from Maastrichitian and seven are Paleoecene – Eocene sequence.The late Maastrichtian species are *Hedbergella holmdelensis, Globotruncana arca*, and *Rugoglobigerina rugosa*. The species of the genus*Morozovella* are abundant in the assemblage. The angulo-conical *Morozovella*constitutes the dominant element and represented by eight species, *Morozovella occlusa, Morozovella aequa, Morozovella angulata, Morozovella preangulata, Morozovella acuta, Morozovella acutispira, Morozovella velascoensis* and *Morozovella conicotruncata.* The *Morozovella conicotruncata* and *M. velascoensis*are highly specialized angulo-conical forms with large, conical test, wide open umbilicus and prominent peripheral keel. The species of *Acarinina* is common and represented by *Acarinina strabocella*. The genus *Subbotina* is well represented with two species, *Subbotina patagonica*, and *S. hornibrooki* of late Paleocene – early Eocene age. Genus *Igorina* is represented by two species (*Igorina tadjikistanensis* and *Igorina albeari*) are very distinct and limited in occurrence. The genus *Parasubbotina* is represented by single species *Parasubbotina varianta* of Paleocene age. *Pseudohastigerina* is represented by a single species of early Eocene in age. These planktonic foraminiferal species spanning an interval from late Maastrichtian to early Eocene Zone. More detailed biostratigraphic work is in progress to identify individual zones and determine the completeness of the sections.

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FORAMINIFERAL AND SEDIMENTOLOGICAL INVESTIGATIONS OF BET ZONE OF GREAT RANN OF KACHCHH SEDIMENTS: IMPLICATIONS FOR MID-LATE HOLOCENE RELATIVE SEA-LEVEL FLUCTUATIONS

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The Bet zone is the second-highest geomorphic surface of Great Rann of Kachchh (GRK) basin, which remains free of annual marine inundation cycles. This roughly NW-SE trending geomorphic unit of GRK basin is believed to have formed due to great 1819 Allah Bund earthquake (M 7.8). To its south, E-W trending low lying supra tidal saline flat connects the Kori Creek and the Arabian Sea. It is generally agreed among geologists that this basin has evolved under complex climate-tectonic processes which remains to be understood well. In this study, we present foraminiferal and sedimentological dataset on our ~32 m long DS core raised near Dharamshala in the Bet zone of the GRK that covers last ~6.6 ka time frame. Foraminiferal assemblage is dominantly comprise of benthic foraminifera, while, planktonic forms show significant cyclic changes through the studied core. Based on the temporal variations in the foraminiferal assemblage, we identified seven zones represented by eight significant genera of which benthic forms primarily belong to *Ammonia, Quinquiloculina, Nonian, Elphidium, Cibicides, Textularia* while planktonic forms represented by *Globorotaloides* and *Globigerina* species. Bottom to upward sediment core record suggest higher marine water column existed at core site around 6 ka, 4.4 ka and 3.5 ka BP. The total foraminifera number (TFN) found to co-vary with the planktonic while the anti-correlated with few benthic forms that mimic rapid environmental shifts. The sediment grain size variations in the context of radiocarbon ages through the core section marks changes in sediment flux and depositional energy which is evident reflected on the foraminiferal content.

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NEW INSIGHTS INTO THE SURFACE-OCEAN DYNAMICS OF THE NORTHEASTERN ATLANTIC OCEAN ACROSS THE MARINE ISOTOPE STAGE 7

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The upper water-column dynamics and surface productivity variability in the Northeastern Atlantic Ocean across the MIS 7 interglacial complex is not well understood. Here, we present high- resolution planktic foraminiferal proxies combined with ANN based-SST and IRD records from IODP Site U1385, SW Iberian Margin for the intervals representing MIS 8 deglaciation, MIS 7 interglacial complex and MIS 6 glacial inception. The long-term SST pattern is modulated byinsolation and precession parameters across the MIS 7 interglacial complex and is superimposed by the millennial-scale variability (stadials at ~250, ~243, ~230, ~221, ~203, ~196 and ~192 ka). The regional SST records indicate high temperature gradient (~6 °C) between the sub-polar North Atlantic Ocean and the SW Iberian Margin during MIS 7d which enhanced the moisture transport from mid-to-high latitudes. Further, low obliquity with low insolation induced cooling at high latitudes and promoted the expansion of ice-sheets during MIS 7d. Comparison of our faunal proxies with the published marine and terrestrial records from SW Europe and western Mediterranean Sea suggested a weakening and southward shift of Azores High pressure system, similar to the present- day (-) NAO-like atmospheric configuration during the early phases of MIS 7e, MIS 7c and MIS 7a, resulting reduced surface productivity of SW Iberian Margin. During the late phases of MIS 7e, MIS 7c and MIS 7a, the Azores High pressure system strengthened and shifted northward causing the intensification of the trade winds, a scenario similar to present-day (+) NAO-like atmosphericconfiguration, which resulted in high surface productivity of SW Iberian Margin.

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VARIATION IN THE MIXED AND THERMOCLINE DEPTH AND UPPER THERMAL STRUCTURE NEAR THE COASTOF MOZAMBIQUE CHANNEL DURING THE LATE QUATERNARY

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The variation in the thermocline depth is mainly governed by physical processes such as wind intensity, vertical mixing, upwelling intensity, and orbital forcing in the tropics. Hence, difference in δ18O value of mixed *(G. ruber)* and thermocline *(N. dutertrei)* species was conducted in a marine sediment core 47-PC retrieved near the coast of Mozambique Channel (MC) from western tropical Indian Ocean which is denoted as Δδ18Or-d and is used to reconstruct the variation in the shallower and deeper mixed-layer/thermocline depth and vertical upper thermal gradient near the coast of MC. To investigate the glacial-interglacial dominant controlling factor for mixed/thermocline depth variability governed by surface and sub-surface water masses circulation and their plausible mechanism. The study covers the last ~196.6 kyr BP, with an average sedimentation rate of ~3.5 cm/kyr BP.

The variation in the isotopic record of δ18O of G. ruber and N. dutertrei displays an obvious glacial-interglacial cycle. The δ18O of *G. ruber* and *N. dutertrei* varies from ~ -0.29‰ to ~ 2.03‰ with an average of ~ 1.1‰ and from ~ 0.5‰ to ~ -2.5‰ with an average of ~ -0.5‰, respectively, over the last ~196.6 kyr, BP. The Δ δ18Or-d ranges from ~ 1.62‰ to ~ -1.68‰ (with an average of ~ -0.6‰), with the depleted and enriched value observed during interglacial periods (MIS 5, late MIS 3) and glacial period (MIS 6), respectively. On the contrary, the depleted value of δ18O N. dutertrei observed during MIS 6 while enriched value occurred in the MIS 5, MIS 3, and MIS 1. The dashed line indicates the average value of Δδ18Or-d, which is 0.75‰.

The present study shows that a large isotopic difference between mixed-layer species (G. ruber) and thermocline dwelling species *(N.dutertrei);* Δδ18Or-d occurred during interglacial/interstadial periods (MIS 5, late MIS 3), suggesting shallower thermocline due to southern sourced upwelled intermediate water masses (SAMW/AAIW) near the coast of MC in the western tropical Indian. The relatively smaller isotopic difference (Δδ18Or-d) during glacial periods (MIS 6, and MIS 4) suggests that a deeper thermocline layer is possibly due to the downwelling of warmer tropical surface water near the coast of MC. During MIS 1 and MIS 2, the phenomenon was reversed from other interglacial and glacial periods, respectively, due to ENSO and IOD-related mechanisms.

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SEQUENCE STRATIGRAPHIC TELL-TALE OF THE KURGIAKH TECTONICS IN A NUT-SHELL

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The intra Cambrian pan ITM 'Kurgiakh Tectonics' includes the most important events of the ¬ 635-444 ma Vendian – Ordovician Himachalian mega-sequence within its third 1st order ¬ 521-500 ma TST. The late Middle Cambrian Stage 7 ¬ 500 ma Acantha Zone MFS accretion of the then alien TH (inclusive of NC-IC) along MCT to the then Indian north margin of LH is interpreted as the main event. Another major event occurred of the secession of SC from LH at the late Early Cambrian Stage 4 Noetlingi Zone also along MCT. SC earlier to the said secession from LH made the distal margin of the Indian plate while LH the proximal part. The MCT had its initiation at the secession of SC from LH during the ¬ 521 – 512 ma span. The deformation, metamorphism and granitisation events are time-constrained during the ¬ 500 – 482 ma 1st order RST.

Among the prevailing two contrasting broad schools of Kurgiakh Tectonics, 1) TH being a part of the Indian plate and 2) being alien to it, Krishna conceptually favored the second school with modifications. He in the last 7-8 yrs integrated the multiple multidimensional evidence in TH, LH and the Indian margin to happenings all over India and imparted the said tectonics yet greater significance. Echos are also suggested in Arabia in the west and Australia in the east.

The pre ¬ 521 ma geological parameters of the alien TH were markedly similar to NC-IC and strongly dissimilar to the then Indian margin of SC- LH while those of SC strongly similar to LH. The main tectonic events are chronicled. The –TH-NC-IC already inched-in to LH during the ¬ 526-521 ma 2nd order RST. SC distanted-out of from LH in the ¬ 518-512 ma TST during the following 2nd order RST.

Regional uplift events in LH, TH and Marwar at the ¬ 512 ma Noetlingi Zone MFS, due south thrusting of the Dharagadh sheet over the Chilar Formation and granitisation during the ¬ 512-509 ma 2nd order RST are significant. Finally, TH-NC-IC accreted to LH at the ¬ 500 ma mega MFS. The ¬ 512 -509 ma Kalkarindji volcanic LIP may also be linked and related. The emergence of Kunzam-la, Parahio and neighborhood except for Zanskar is interpreted during the ¬ 506 – 502.5 ma 2nd order RST. Zanskar also uplifted by the ¬ 497 ma 2nd order SB. Bhutan submerged at/near the ¬ 497 ma. Angular unconformity, slope-reversal and origin of highs occurred during the ¬ 500 – 497 ma 2nd order TST.

A few other inter-basinal to supra-regional events are also linked in sequence stratigraphic perspective.

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DIVERSE PALEOGEOGRAPHIC TRANSFORMATIONS IN AND AROUND INDIA DURING THE HIGHLY EVENTFUL CRETACEOUS: HIGH RESOLUTION SEQUENCE STRATIGRAPHIC PERSPECTIVE

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The highly diversified Indian Cretaceous is dominated by extensional tectonics within the ¬ 259-61.6 ma Neotethyan mega-sequence and includes 12 2nd order sequences CI to CXII. At the start, India is inclusive of Madagascar. The Indian Ocean is already initiated at the ¬ 159 ma in late Middle Oxfordian in the east. There is good development of shallow marine Cretaceous on the then Indian margin particularly in Cauvery, Tethys Himalaya, Kachchh and Madagascar. The focus is on the marine fossiliferous precisely datable units. Events of different basins are interlinked, so also the manifestations of igneous events, slope reversals, ranges of shallow marine corridors and units with resultant over ¬ 3 myr high- resolution per sequence timeline. The paleogeographic events are precisely time constrained in the mega to 2nd order sequence framework. The main resultant of the integrated exercise is the genetic linkage between the imprecisely/loosely dated abiotic events to precisely dated fossiliferous sequence surfaces. Each of the tectonic events is linked to a precisely dated natural surface in a sedimentary column. There are three components; **1)** The ¬ 125 - 90 ma Aptian – mid Late Turonian ¬ 35 myr main part is a 1st order sequence on India – Madagascar separation linked to Marion plume volcanics. **2)** It is preceded by the later ¬ 20 myr part of the preceding 1st order ¬ 183-125 ma sequence of India – Australo-Antarctica separation linked to Kerguelen plume volcanics, and **3)** succeeded by the major ¬ 28 myr part of the following ¬ 90 - 61.6 ma 1st order sequence of India – Greater Seychelles and finally India – Asia impingement initiation. The dismemberment from ¬ 145 ma base Berriasian to the ¬ 107 ma early Middle Albian Dentatus Zone giga MFS leads in steps to the origin of AAP, GAP, CAP, PAP up to the final Srilanka/Enderby oceanic separation. The related magmatism has the ¬ 159 – 107 ma span. Events of the east sector are recognized also in the west sector in Kachchh and elsewhere.The spreading axis moved from east to west between India and Madagascar with origin of the 'composite continental sliver' during ¬ 107-90 ma. The igneous activity started at the ¬ 90 ma mid/late Late Turonian base of the 1st order sequence. India/Madagascar separation started at the ¬ 88 ma intra-Coniacian Theobaldinum Zone MFS 1st order MFS. The igneous activity lasted up to the ¬ 82 ma 2nd order MFS leading to the final Cauvery/Morondova oceanic separation at the Early Campanian Karapadense Zone ¬ 82 ma 2nd order MFS. The slope reversal tilting down due northeast corresponds to the origin of the distant Assam basin. Olaipadi and Kottarai Conglomerates and Corridor Seaways – The uplift related local marker conglomerates above the SBs are of pan Tethyan significance. The transient Gondic and Dravidian corridor seaways respectively ranged from ¬ 149-142 ma and ¬ 120-107 ma. Hindsite – Insite -- Foresite and Interbasinal Links - The Mascarenes basin, in hindsight, nearly stopped growing at the ¬ 67.5 ma 2nd order Quadra Zone MFS due to space constraints and the Reunion plume influenced the separation of Greater Seychelles thereafter from India.
The seq-stratigraphy thus refined and interlinked the supra-regional geodynamics.

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CHANGES IN THE PRODUCTIVITY AND HYPOXIC CONDITION SINCE THE LATE MARINE ISOTOPE STAGE 3,EASTERN ARABIAN SEA

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We analyzed the assemblage of benthic foraminifera, relative abundance of planktic foraminifer *Globigerina bulloides*, stable isotope ratios in benthic foraminifer *Uvigerina peregrina* from Core SK291/GC17 encompassing an age of ~40,000 to 3,500 calibrated years before present (cal yr BP). The core was retrieved from a water depth of 182 m, off the Goa coast, eastern Arabian Sea (EAS). A distinctly high abundance of *G. bulloides* suggests strong upwelling and high productivity driven by intense Indian summer monsoon (ISM) winds in the EAS during ~40,000-29,000 cal yr BP, which is coeval with the late Marine Isotope Stage 3 (MIS 3). During this interval, a hypoxic condition is evident from the low abundance of the oxic benthic foraminifera and the very low diversity of benthic foraminifera. Euhedral pyrite crystals and framboidal pyrite aggregates were observed during the MIS 3, suggesting iron-rich continental influx to the study core followed by pyritization in the anoxic benthic environment. During the Last Glacial Maximum (LGM), a lower sea level and weak ISM caused relatively mesotrophic (and well-oxygenated) conditions at Core SK291/GC17. The extreme hypoxic condition Core SK291/GC17 witnessed during the late MIS 3 was never experienced during the younger intervals.

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MID-HOLOCENE HIGH SEA-LEVEL STAND IN THE LITTLE RANN OF KACHCHH (LRK)BASIN, WESTERN INDIA: A MICROFOSSIL APPROACH

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The Little Rann of Kachchh (LRK) basin, located on the western continental margin of India, remains one of the least explored regions. It is believed that the LRK basin, which spans approximately ~5,000 square kilometers, represents the recently uplifted floor of a former gulf of the Arabian Sea. This triangular basin, oriented roughly in a NE-SW direction, receives sediment deposits primarily from the Banas, Rupen, and Saraswati (local) rivers, which originate from the Aravalli ranges. The region is also notable for its archaeological sites, situated on rocky islands that interrupt the otherwise monotonous, flat, and gradient-lesslandscape. Based on the geomorphological features and the distribution of archaeological sites within and around the LRK basin, geologists and archaeologists have hypothesized thatthis area might have once been connected and navigable during the Harappan period, until about 2,000 years ago. However, there is still no conclusive evidence or studies that definitively establish the marine nature of the basin or its extent during that time frame.

To investigate these aspects, we explored a well section approximately 29 feet deep near Oddu village in the LRK basin and conducted multi-proxy studies alongside chronological analysis. Our findings reveal that the LRK basin experienced marine transgressive floodingas early as ~7.5 ka, evidenced by the presence of foraminifera, diatoms, $\delta^{13}C$ values, and TOC/TN ratios, which abruptly transitioned from a previously fluvially dominated environment. During this period, the initially shallow marine environment developed a significant water column of about 4-6 meters, as indicated by the highest planktonicforaminifera counts and the presence of distinctive in-situ planktonic diatom species like *Thalassiosira*, *Biddulphia*, *Campylodiscus*, *Actinocyclus*, *Gyrosigma*, and *Nitzschia separanda* and silicoflagellates. These findings are further supported by organic proxies ($\delta^{13}C$ and TOC/TN). Chronologically, this event is dated between 7 and 6.6 ka BP, marking the first evidence of a mid-Holocene high sea-level stand in the LRK basin. Notably, the diatomspecies and silicoflagellates identified during this event are absent in other parts of the record, further confirming its significance at attesting about the prevailing high sea-level during thedeposition period.

Between 6.6 and 3.9 ka, the LRK basin experienced a reduction in marine water levels, as indicated by rapidly declining planktonic foraminifera and the absence of diatoms except during the high-stand event. By around 3.9 ka, the well record shows a significant decline inmarine signatures, with marine microfossils becoming scarce and the sediment organic matterindicating a shift towards terrestrial sources. The TOC/TN vs. $\delta^{13}C$ scatterplot suggests varied contributions from C3 and C4 vegetation types. The drying of the LRK basin from the northeastern margin likely occurred between 4 and 2 ka BP. However, more precise timing requires additional records and better chronological controls for comprehensive basin-wide paleoenvironmental reconstructions.

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MICROSOLENID CORALS FROM THE LATE BAJOCIAN (MIDDLE JURASSIC) MARKER BEDS OF JAISALMERFORMATION, JAISALMER BASIN

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Late Bajocian marker beds of the Jaisalmer Basin are characterised by fossiliferous biorudstone with reworked coral-heads of *Isastrea bernardiana*. Sequence stratigraphically, these marker beds represent transgressive systems tract, coeval to those of Leptosphinctes Pebbly Rudstone beds of the neighbouring Kachchh Basin, also with reworked coral-heads of*Isastrea bernardiana* representing TST, best exposed along the cliff of the Kala Dongar hill range. In the Kachchh Basin the marker beds can be traced all along onshore-offshore gradient. On the deeper side inthe Jhura Dome the beds have also yielded reworked coral heads of microsolenids. Similar to the Kachchh Basin, microsolenid corals have been recorded and described here from the coeval sediments of the neighbouring Jaisalmer Basin. Microsolenids are pennular corals with fenestrate septa. The pennular microarchitecture along with the fenestrate septa have been compared with the present day *Leptoseris fragilis*, which is a suspension feeder and lives in deeper water. On the contrary *Isastrea* is characterised by compact septa with lateral ornamentation characteristic of warm, shallow, high energy, well-lit and clear marine water condition, an environmental setting suitable to most reef corals. The record of microsolenids along with *Isastrea* suggests: 1. Deeper water open sea condition also existed in the Jaisalmer shelf basin prior to the peak of Upper Bajocian transgressive episode. 2. Mixing of corals of two niches due to the transgressive event.

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MIOCENE VERTEBRATES OF KUTCH, GUJARAT, INDIA: AN IMPLICATION INDIAN-ASIAN POST COLLISION FAUNAL DIVERSIFICATION AND PALEOBIOGEOGRAPHY

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Globally, Miocene time is significant for its intense tectonism as a continuation of collision tectonic of Indian and Asian plate taken placed during the Eocene time. This event and subsequent tectonism is considered to be associated with the migration of vertebrate fauna, changes in climate, geodynamic shifting of Indian-Asian-African plate and changes in resultant paleogeographic set up such as the upheaval of the mighty Himalaya, formation of Landbridge between Africa and Eurasia, migration and diversification of fauna, etc. Such events are directly or indirectly affecting in the diversity of flora and fauna in Indian subcontinent and also in global extent. The present paper tries to discuss the paleobiogeographic and paleoenvironmental significance of Miocene vertebrates from Kutch. Miocene deposits of Kutch are divisible into three formations namely Early Miocene Khari Nadi Formation, Middle Miocene Chhasra Formation and Late Miocene Sandhan Formation. These deposits are known also for its diverse assemblage of vertebrates including fishes, reptiles, lizards, amphibian and mammals. The early Miocene Khari Nadi Formation of Kutch yielded fossil fishes (Chondrichthyes and Osteichthyes), reptiles (tomistomid crocodiles) and mammals (*Deinotherium* sp., Gomphotheriidae indet. and *Brachypotherium* sp.). Certain chondrichthyan and osteichthyan fishes, reptiles (Lizard, Snake and Crocodiles) and mammals, etc. were reported from the middle Miocene Chhasra Formation of Palasava locality. Piscean (chondrichthyan and osteichthyan) remains such as *Carcharhinus brevipinna, C. falciformis, C.* cf. *leucas, C.* aff. *perezi*, *Carcharhinus* sp., *Negaprion* sp., *Aetobatus* sp., *Myliobatis* sp., *Dasyatis probsti, D. rugosa*, *Himantura menoni*, *Pastinachus* sp., and *Taeniurops* sp., teleost of the families Bagridae, Channidae, Characidae and Cyprinidae, and mammals such as *Sanitherium, Sivameryx, Brachypotherium, Zygolophodon, Gomphotherium*, and *Deinotherium* are known from Palasava sites. The late Miocene Sandhan Formation of Tapar locality also yield certain mega-mammals (Deinotherium, Gomphotherium, Listrodon, Zygolophodonts, etc) and micromammals assemblages, reptiles, amphibians, lizards, etc. and elasmobranch such as *Myliobatis, Aetobatis, Dasyatis, Pastinachus, Himantura* and *Pristis,* etc. The presence of elasmobranch in association with certain foraminifers and invertebrate from the Khari Nadi Formation suggest the existence of lagoonal, near shore to outer shelf environment. The middle Miocene vertebrate from the Chhasra Formation suggests a coastal, marginal marine, near-shore littoral to neritic environment of deposition with the influence of freshwater riverine system and the presence of warm, humid/ wet, tropical to sub-tropical environmental conditions. Based on Piscean and terrestrial faunal records, the late Miocene The

deposits of Sandhan Formation of Tapar sites suggested a fluvial depositional setup near coast under tropical to subtropical humid climate. Early Miocene elasmobranchs from Kutch shows close affinities with those from Mediterranean Sea suggesting a well connection of Tethyan seaway passages till the early Aquitanian and the presence of the remnant waterbody connecting the Mediterranean Sea and Indo-Pacific. Similarly, in the Indian Ocean region Miocene fauna of Kutch shows close similarity with those of Baripada Beds, Orissa, Bhuban Formation of Mizoram, Gogha Coast, Piram Island and Madagascar. A short-lived reopening of the marine pathway between Indian and Mediterranean Sea is suggested by the good similarity index of Middle Miocene elasmobranch comparing with their counterparts in the Mediterranean Sea. However, a much higher faunal affinity with those of Eastern Pacific indicates a gradual shift in migration path through the Pacific Ocean to Indo-Pacific region after the permanent Landbridge was formed. A closer affinity of late Miocene terrestrial mammalian fauna of Kutch with those of Africa, Europe and Indo-Pakistan may be due to Miocene dispersal across the ‘Gomphotherium Landbridge’.

Abstract no: ICMS 2024/ DU/79 **Mode of Presentation: POSTER**

FORAMINIFERA STUDY FROM LOWER MIOCENE SEDIMENTS OF TERA VILLAGE, WESTERNKACHCHH, GUJARAT, INDIA: CONSEQUENCES FOR DETERMINING THE PALAEOENVIRONMENT

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A pericratonic rift basin in India is the western Kachchh. Spanning 200 million years of geological history from the Jurassic Period to the present, the fossil-rich assemblage of the Kachchh Basin reflects this geological past. In the present study 20 species of benthic foraminifera belonging 03 classes are studied i.e., Globothalamea, Tubothalamea and Nodosariata and 04 orders i.e. Rotaliida, Textulariida, Nodosariida and Miliolida have been recognized from Limestone and Silty-claystone of Tera section belonging to Lower Miocene. The benthic foraminifera species distribution from the Tera section is provided by this taxonomicstudy. On the basis of this distribution of the investigated foraminifera, an interpretation of the depositional palaeoenvironment is attempted.

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PLIOCENE PALEOCEANOGRAPHY OF EQUATORIAL INDIAN OCEAN FROM ODP HOLE 716A: PLANKTIC FORAMINIFERAL STUDIES

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The Indian Ocean is unique because its surface circulation reverses annually due to wind stress caused by monsoonal winds, which result from the differential heating of the continents and oceans. During the Northern Hemisphere summer, referred to here as summer, the intense South-West (SW) monsoon triggers upwelling, leading to a significant increase in surface water productivity as nutrients rise to the surface. This process reduces the thickness of the ocean's mixed layer and shoals the thermocline. However, during the North-East (NE) monsoon, upwelling does not occur, resulting in a thickened and well-defined mixed layer. Planktic Foraminifera, which live in the upper ocean water column within the mixed layer and thermocline, exhibit variations in their abundance according to these processes.

This study examines core samples from the early to late Pliocene from ODP hole 716A, located in the Maldives Ridge of the Equatorial Indian Ocean at a water depth of 554.8 meters. This site contains undisturbed carbonate oozes composed of foraminifera and calcareous nannofossils. A planktic foraminiferal census was conducted by splitting the sample into a minimum aliquot of 300 individuals. All specimens were then mounted onto micropaleontological slides, and their relative abundances were calculated. Different species groups were created, including Mixed Layer Dwellers (MLD), Thermocline Dweller Species (TDS), Oligotrophic Indicator Species, and Upwelling and Productivity Indicator Species. This study presents a comparative analysis of the relative abundance of MLD versus TDS and Oligotrophic Indicator Species versus Upwelling and Productivity Indicator Species.

The results indicate a strengthening of the Mixed Layer and Oligotrophic conditions, with a concomitant decline in upwelling and productivity, which can be attributed to an increased strength of the NE monsoon and a weaker Indonesian Throughflow (ITF).

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PALYNOLOGICAL ANALYSIS OF QUATERNARY SEDIMENTS IN PARTS OF DIBRU-SAIKHOWA NATIONAL PARK, TINSUKIA DISTRICT, ASSAM, NE INDIA

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The Quaternary sediments present along the banks of the Dibru river, GuijanGhat, Nearby Dibru Saikhowa National Park, Tinsukia, Assam contains multiple palynofossils. The present study is aimed to identify and characterize the different palynofossils from the Quaternary sediments. The study also aims to compare the palynological association with the sediments of the Himalayan and Naga Hill. Total 22 samples were collected using spade, shovel tool from river bank. Standard protocol of maceration by Erdtman and Acetolysis by Faegri and Iverson 1989 was followed for extraction of Microfossil and further the samples were studied under the Light
Microscope for Identification. For the characterization of different pollens multiple features such as Shape, Size, surface ornamentation was identified. The different palynofossils identified in the samples are *Davillia*, Monolete, Triporate, Trachiedal pits, *Meliola*, Parenchymatous tissue, *Glomus* sp, Amaranthaceae, Algae Filament, Microcharcoal, Poaceae, *Cookeina sp*, *Polygonum*, *Acacia catechu*, Trilete, Lemiaceae, Hyphae, Asteraceae Tubuliflorae, *Thalictrum(*Ranunculaceae), Pinus,*Prospodium* sp., Bryophytic spore, Pteridophytic spore, Algal spore, Rosaceae, Caprifoliaceae(Lonicera type), *Justicia*, Caryophyllaceae, *Cyperaceae*, Cuticles , Quercus type . Such an association of palynofossils in the quaternary sediments are comparable to the published data on palynofossils of Himalayan and Naga areas.
Such a comparative analysis will provide insight into paleoenvironmental and paleovegetational conditions of the areas under study and will enhance understanding for future ecological research.

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APPLICATION OF BENTHIC FORAMINIFERA IN EVALUATING THE ENVIRONMENT AROUND NEW MOUTH OPENING OF CHILIKA LAGOON

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Chilika (19˚28' to 19˚54' N; 85˚54'N to 85˚38' E) covering the borders of Khordha, Ganjam and Puri district is not only the biggest coastal water body in East Coast of India but also Asia's largest tropical brackish water lagoon. The depth of the Chilika Lagoon varies from 0.3m in the dry season to 1.8m to 4.2m in the rainy season. Based on the physical and chemical parameters, the lagoon is divided into four sectors i.e. the Southern, Central and Northern Sectorsand the Outer Channel. The Outer Channel connects the lagoon with the Bay of Bengal at Arakhakuda (old mouth) and at Gabakunda (newly formed mouth). Brackish sea water comes into the Outer Channel through the old and new mouths and thus forms a typical estuarine to lagoon environment. Sediment samples were taken from ten locations from the outer channel of lagoon's new mouth opening area for benthic foraminiferal study, sediment and water quality following all standard operating procedures. Study suggested sand dominates as the substrate towards the new mouth area and silty to clayey sand towards the southern part of the Outer Channel. Loeblich & Tappan method followed for identification of foraminiferal taxa upto genuslevel under stereo zoom binocular microscope and also with help of scanning electron microscope (SEM) imaging. Total 13 genera of benthic foraminifera having 36 species were documented at the sampling stations and species having highest abundance present in more than4 sampling stations have been documented. The abundant benthic foraminiferal species in all the sampling station are *Ammonia beccarii* and *Ammonia tepida,* whose variations indicate abundant labile carbon sources in the brackish water. Population of *Quinqueloculina seminulum* used in biomonitoring assessment and palaeoenvironmental reconstruction increases towards the sampling locations near to the mouth opening which is a zone of intermixing of sea water with the lagoon.

Abstract no: ICMS 2024/ DU/83 **Mode of Presentation: ORAL**

LATE NEOGENE –QUATERNARY PLANKTONIC FORAMINIFERAL BIOSTRATIGRAPHY OF THE ODP SITE 846B, EASTERN EQUATORIALPACIFIC

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The planktonic foraminifera have been the most preferred groups of microfossils extensively used for biostratigraphic subdivisions of the deep sea sequences from across the world. The rapid rate of evolution in planktic foraminifera have resulted due to their habitat in the upper ocean water column which is in direct contact with the atmosphere and subtle change in the atmospheric condition transmit enough stress to their evolving population made them excellent biostratigraphic markers for the Cenozoic.

The ODP site 846B is strategically located at a water depth of 3307 meters on the southern limb of the Carnegie Ridge on the crust formed at the Galapagos Spreading Centre which marks the terminal point of Humboldt Current at 3˚S latitude where the eastern edge ofSouth Equatorial Current (SEC) is located. On the basis of the detailed qualitative analysis of planktic foraminifera from ODP Hole 846B, we have subdivided the Late Neogene-Quaternary Section into six planktic foraminiferal zones. 21 Late Neogene planktic foraminiferal events have been identified at ODP Hole 846B out of which 16 foraminiferal events are identified in Late Neogene while 05 foraminiferal events are marked in the Quaternary. The Last Occurrence (LO) of *Globigerinoides fistulosus*, once utilized to denote the Pliocene-Pleistocene boundary and found to be synchronous across a broad latitudinal range, has become invalidated due to the redefinition of the boundary at the Gelasian Base.

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PLANKTONIC FORAMINIFERA FLUXES AND THEIR RESPONSE TO THE MONSOON AND SURFACEHYDROGRAPHY CONDITIONS OF THE BAY OF BENGAL DURING LAST ~ 34 KYRS

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This study describes seasonal changes in the fluxes of planktonic foraminifera in response to changes in environmental conditions during the monsoon and surface hydrography changes in the Bay of Bengal. Relative abundance records of planktic foraminifera and their correlation are noted from the sedimentary core (SK 336 GC 2), retrieved from the western side of the OMZ, located off the coast of Visakhapatnam in the Bay of Bengal. Around ten planktonic foraminifera were recognized, of which six species (*Globigerinoides ruber*, *Globigerina bulloides*, *Neogloboquadrina dutertrei*, *Globorotalia menardii* and *Trilobatus sacculifer*)dominated the assemblage (~70%) from the study area. During the last glacial period, the Younger Dryas (YD) and Heinrich Events, are associated with a weaker Indian Summer Monsoon (ISM), also the last deglaciation (~19–11 cal ka), there was a brief but intense phaseof monsoon activity at the Bølling-Allerød (B/A), contrasting with the weaker monsoon periods during Heinrich Event 1 (H1) and the Dark Age Cold Period. The combined record ofproductivity and salinity tracking proxies for the last glacial period on record (~34–11.7 ka) have shown considerable changes in monsoon evolution on a millennial scale. However, the proxy records show a stronger ISM values prevailing during the Holocene epoch than during the glacial period.

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PALEOCLIMATIC INSIGHTS ON OXYGEN MINIMUM ZONE (OMZ) VARIABILITY IN THEEASTERN ARABIAN SEA

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The Arabian Sea is one of the world's most productive regions with surface primary productivity driven by seasonally reversing Indian southwest (SW; Summer) and northeast (NE; Winter) monsoonal winds. High primary productivity in conjunction with sluggish ventilation facilitates the formation of intense hypoxia at intermediate levels (Naqvi, 1987; Wyrtki, 1971). Mid-depth oxygen depletion in the Arabian Sea also exerts a significant control on the chemical composition of the atmosphere through production of N_2 and N_2O. Thus, making it an important biogeochemical region in the world tropical ocean (Naqvi et al., 2005, 2010). Unlike other OMZ's, the ASOMZ is shifted eastward relative to the high productive upwelling region probably due to increased advection and vertical mixing in the western region (McCreary et al., 2013; Acharya and Panigrahi, 2016). Recent observational and model studies have shown expansion and deepening of ASOMZ in response to monsoonal wind intensification (Lachkar et al., 2018) resulting in habitat contraction and considerable changes in marine biogeochemistry. To better understand the OMZ dynamics under the current climate change regime, two questions are relevant: 1) how does the magnitude and temporal changes in oceanic dissolved oxygen modulate OMZ variability on longer time scales and 2) what were the local and remote factors driving OMZ changes in the past.

We compared existing datasets with pteropod records of Naidu et al., 2014 to better understand the vertical extent of OMZ with respect to productivity changes and oxygenation history. We also compared results from previously published paleoceanographic records in the Arabian Sea to identify the driving factors for changes in OMZ intensity and dynamics.

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PALEOPRODUCTIVITY RECONSTRUCTIONS IN THE SOUTHEASTERN ARABIAN SEA SINCE THE LAST 9 KYR

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The southeastern Arabian sea is characterised by a seasonal reversal of surface coastal currents in response to prevailing monsoon winds. During the southwest monsoon, the West Indian Coastal Current transports the high salinity water mass from Arabian sea to the Bay of Bengal. Further south, weak upwelling occurs along the southwest coast of India (south of 10°N) during this season resulting in the presence of moderately cold, nutrient-rich surface water in the region. During the winter season, both the westward flowing North Equatorial Current between equator and 10°N and southward flowing East Indian Coastal Current (EICC) brings warm and low salinity water into Arabian sea from the Bay of Bengal. Advection of nutrients by this intrusion triggers enhanced levels of chlorophyll near the southern part of the western shelf of India.

In this study we documented the planktic foraminiferal proxy data (abundances of eutrophic and oligotrophic species/group and *G. bulloides* / *G. ruber* ratio, abundance percent of individual species) of approximately 120 samples at the core site SK -06 **(9° 20′N** (Latitude), **75° 33′E** (Longitude), water depth 890 m**)** located in southeastern Arabian sea to reconstruct the paleoproductivity since the last 9 kyr at the sub-centennial to millennial scale. Relative abundance percent of *G. bulloides*, mixed layer eutrophic species (*G.bulloides, G glutinata* and *G. falconensis*) and mixed layer oligotrophic species (*G. ruber, T. sacculifer, T. quadrilobatus, T. trilobus*) are used as potential proxy to record changes in mixed layer environment . Temporal variation of relative abundance percentage of MLES (mixed layer eutrophic species) and *G. bulloides* remains relatively unchanged during the last 5.8 Kyr reflecting that there is no major change in surface productivity. Although the *G.bulloides* trend shows a moderate increase in productivity between 3 and 1.5 kyr.

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DISTINCT WATER COLUMN PROPERTIES INFLUENCE THE ECOLOGY OF PLANKTIC FORAMINIFERA IN THE SOUTHEASTERN ARABIAN SEA

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The abundance of planktic foraminifera depends on various parameters like food and light availability as well as water-column properties. However, the influence of these parameters on their abundance vary from region to region. With this in consideration, 91 surface sediment samples collected from a wide range of depth from ~25 to 3000 m were taken to document the ecological preferences of planktic foraminifera from the south-eastern Arabian Sea. The top 0-1 cm of both multi-core and spade-core samples were analysed and 31 planktic species belonging to 17 genera were identified. The most dominant species was *Globigerina bulloides*. Further, 15 major and moderately abundant species (≥4% abundance) were correlated with various surface water parameters. It was observed that the abundance of the planktic foraminifera in this region was significantly influenced by the mixed layer salinity-temperature, along with chlorophyll-a, and the thermocline salinity-temperature. Species like *G. bulloides*, *Globorotalia ungulata* and *Neogloboquadrina incompta* prefers shallow nutrient rich waters while *Globigerinoides ruber*, *Pulleniatina obliquiloculata*, *Globoquadrina 89onglomerate*, *Globigerinella calida*, *Globorotaloides hexagonus*, *Globoturborotalita tenellus* and *Globigerinita glutinata* represent shallow mixed layer depth. Representative thermocline species were *N. dutertrei, G. menardii* and *G. siphonifera.* These ecological preferences of planktic foraminifera can eventually be applied in sub-surface samples to understand changes in past water column structure from this region.

Abstract no: ICMS 2024/ DU/88 **Mode of Presentation: ORAL**

FIRST REPORT ON THE OCCURRENCE OF MICROBIAL REMAINS IN URANIFEROUS AS WELL AS NON- URANIFEROUS LIMESTONE OF THE NEOPROTEROZOIC SHAHABAD FORMATION BHIMA GROUP AND DEFORMED BASEMENT GNEISS, KARNATAKA, INDIA

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The present study records an assemblage of syngenetic as well as endolithic microbialremains from the Neoproterozoic Shahabad Limestone of the Bhima Group in south India. Microbial remains are observed in limestone and cherty litho-units of the limestone in Kanchankayi and Hulkal block. Some of the microbial remains, also observed in the deformed basement gneiss in Hulkal block, Bhima Basin, are replaced by sulphide and uranium minerals. Discovery of microfossils assemblage is a new addition to the previously reported *Sinosabellidites huainanensis, Protoarenicola baiguashanensis* and *Pararenicola huaiyuanensis* fossils recorded in the Hulkal Formation. The discovery of microbial assemblage traces the antiquity of microfossils in the Sahabad Limestone, a stratigraphically older lithounit of the Bhima Group. Present study further discusses role of microbes' interaction and concentration of the radioactive mineral, as well as, the exceptional type of microbial preservation.

Abstract no: ICMS 2024/ DU/89 **Mode of Presentation: POSTER**

IMPACT OF PRODUCTIVITY AND SALINITY CHANGES IN THE NORTH-EASTERN BAY OF BENGAL DURINGTHE LAST 18KYR

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The Bay of Bengal (BoB) is a semi enclosed basin in the north-eastern Indian Ocean, significantly impacted by freshwater input from rivers originating from the Himalayas and Indo-Burman ranges. As a result, salinity (or density) stratification exists in the upper water column during seasons of heavy rainfall. During the Indian summer monsoon (ISM), the northern BoB experiences higher riverine inputs compared to the southern bay, resulting in a north-south surface salinity gradient in the BoB. These characteristics oceanographic settings have a large impact in the distribution of planktic foraminifera assemblages. The present study focuses on the relative abundance of planktic foraminifera from the core MGS29/GC-01 (14º18’06” N, 92º18’47” E), collected from the north-eastern Indian Ocean. The radiocarbon age was determined using four selected depth intervals of the core and the calibrated age of the last depth interval corresponds to ~18 kyr BP.The freshwater influx and monsoonal winds develop a strong near surface stratification which limits mixing to shallow depths. The seasonal fluxes of planktic foraminiferal species also vary with changing oceanographic conditions. The tolerance to temperature, salinity and nutrient availability varies with different species of planktic foraminifera resulting in different assemblages in different parts of Bay of Bengal. The core has yielded rich assemblages of planktonic foraminifera, whose downcore abundance variations are reflecting the past changes in water column structure . The most dominant species are *Globigerinoides ruber, Globigerinita glutinata, Neogloboquadrina dutertrei, Globigerina bulloides, Globigerinella siphonifera*. The dominant assemblages of *Neogloboquadrina dutertrei* and *Globigerinella siphonifera* suggest low saline conditions due to enhanced monsoon precipitation and river runoff. High productivity is indicated by the relatively high abundance of *Globigerina bulloides*, *Globigerinita glutinata*, and *Globigerina falconensis*, marking weak stratification driven by weak monsoon conditions.

Abstract no: ICMS 2024/ DU/90 **Mode of Presentation: POSTER**

MONSOON EVOLUTION OVER THE LAST 23 KYR: INSIGHTS FROM FORAMINIFERAL RECORDS IN THE BAYOF BENGAL

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This study presents a detailed analysis of planktonic foraminiferal assemblages from marine sediment core SK343-GC-02, collected from the continental margin off the Palar River in the Bay of Bengal. The age model of the core was based on five Accelerator Mass Spectrometer ^{14}C dating and provides a record of past 23 kyr. The sediments yielded rich assemblages of planktic foraminifera along with well-preserved pteropods and ostracods. The important and abundant key species present are *Globigerinoides ruber, Globigerina bulloides, Neogloboquadrina dutertrei, Globigerinoides sacculifer, Globigerinita glutinata, Globigerinella siphonifera* and *Globorotalia menardii. G. ruber* shows a pronounced peak during the mid to late Holocene (0–6 ka), indicative of warm, oligotrophic surface waters whereas marked decline during the LGM (18–24 ka), reflecting low productivity and cooler conditions. During the Holocene Climatic Optimum (around 9 to 5 kyr BP), stronger monsoonslikely resulted in greater nutrient upwelling, indicated by the abundance of fertile species. *G. glutinata* exhibits fluctuating abundance with a notable peak in the early to mid-Holocene (6- 12 ka), suggesting enhanced nutrient availability, may be related to increased monsoonal precipitation and river runoff. *T. sacculifer* and *G. bulloides* show sporadic and prominent peaks, respectively, aligning with periods of intensified monsoon-driven upwelling and nutrient availability during the early to mid-Holocene. *G. bulloides* also shows high abundance during the LGM, indicating strong upwelling conditions and enhanced productivity caused bywind driven mixing and nutrient availability. Higher abundances of *G. dutertrei* are often associated with periods of stronger monsoon winds and show maximum abundances between 12 ka and 18 ka. Apart from planktic foraminiferal assemblage, important abundant key speciesof pteropods such as *L. inflata* show high abundance during the Holocene (0-12 ka), indicatinghigh productivity and stronger monsoon. Its significant variability during early MIS 2 (15-24 ka) suggests fluctuating monsoon conditions. *L. trochiformis* and *C. conica* exhibit more pronounced fluctuations over time, with peaks during glacial and interglacial transitions, reflecting changes in monsoon strength and environmental conditions. This study provides valuable insights into past monsoon variability and its influence on oceanic conditions.

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ENVIRONMENTAL IMPACT ASSESSMENT USING DIATOMS AND WATER QUALITY PARAMETERS IN THAMIRABARANI RIVER, TIRUNELVELI DISTRICT, TAMIL NADU, INDIA

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Diatoms are one of the most significant organisms beneficial for biomonitoring investigations. The diatom and water samples were collected from three different seasons i.e. pre-monsoon, monsoon and post-monsoon from the ten different locations in the Thamirabarani River.The diatom samples were enumerated and the morphometrics valve was documented by light microscopy. In the present study a total of Hundred and Ten (110) diatom taxa belonging to 28 genera were identified. The most commonly abundantly were recorded diatom genera such as *Achnanthes*, *Aulacoseira*, *Cocconeis*, *Cymbella*, *Diadesmis*, *Discostella*, *Encyonema*, *Eunotia*, *Fragilaria*, *Gomphonema*, *Navicula*, *Oricymba*, *Pinnularia*, *Planothidium*, *Staurosirella*, *Tryblionella* and *Ulnaria* in the study area. The dominant presence of diatom taxa such as *Cymbella tumida*, *Discostella stelligera*, *Eunotia asterionelloides*, *Gomphonema gandhii*, *Navicula heimansioides*, *Planothidium frequentissimum* and *Staurosirella pinnata* were recorded in the locations of Papanasam, Athallanallur and Mukkudal that are indicating the good water quality due to good flowing of water. However, the dominant diatom taxa were recorded at the locations of Kallidaikurichi, Ambasamuthiram and Thirupudaimaruthur such as *Cocconeis placentula*, *Gomphonema gracile*, *Gomphonema parvulum*, *Navicula cryptocephala* and *Nitzschia palea* that indicating the moderate water quality due to anthropogenic activity. Conversely, the diatom taxa such as *Aulacoseira ambigua*, *Aulacoseira granulata*, *Diadesmis confervacea*, *Gomphonema affine*, *Gomphonema augur*, *Gomphonema lagenula*, *Navicula cryptocephala*, *Navicula cryptotenella*, *Navicula notha*, *Navicula rostellata*, *Nitzschia amphibia*, *Nitzschia clausii* and *Ulnaria ulna* were recorded dominantly at the locations of Sivanthipuram, Sunpapermill, Gopalasamudram and Kokkirakulam that indicating the bad water quality due to domestic wastages, industrial effluents, urban sewage disposal and anthropogenic activity. The water parameters analysis results were interpreted as statistical methods of water quality index. In the study area, physico-chemical characteristics of river water recommended thatThamirabarani River is polluted by cause of diverse effluents. The Tamiraparani River significantly deteriorated due to the discharge of urban waste and municipal dumping. Water quality was deteriorating due to severe river water pollution caused by urban development nearthe Tamiraparani River.

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UPPER JURASSIC OSTRACODES FROM MAINLAND KACHCHH, GUJARAT, INDIA

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The Mesozoic Kachchh basin, geographically located in the north-western part of India, Mainland Kachchh, Gujarat. Stratigraphically, the basin is classified by Biswas (1971) into four formations (i.e) Jhurio (Jhura), Jumara, Jhuran and Bhuj. The Jurassic rocks are exclusive for paleontological studies as they comprehend well-preserved mega- as well as micro-fossils. The present study emphasizes the age and Taxon-range Zone based on Ostracode fossils from the members of Jhuran formation exposed in Kachchh Mainland. Lithologically, the Formation mainly comprised of sandstones, limestones, siltstones, ferruginous nodules and shales (Biswas, 2016) and is well exposed along Bhuj-Jadura road, around ~9km south of Bhuj Town. We carried a detailed fieldwork and collected rock samples from two sections belonging to one location; These samples yielded a well-preserved assemblage of ostracod fauna represented by 19 species belonging to 14 genera, recorded from the Members of Jhuran Formation, for the first time. Two species - *Majungaella perforata* Grekoff and *Pirilebris tenuisulcata* Mette et Geiger - are assigned to already known taxa, 17 species are left in open nomenclature. Based on the distribution of the fauna, one ostracode biozone *Macrodentina* sp., Taxon-range Zone has been proposed for the beds of upper Lower and Middle Members of Jhuran Formation and tentatively Middle-Upper Kimmeridgian age is assigned for the zone.

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TRACING POSSIBLE CLIMATE CHANGE INDUCED METHANE EMISSIONS FROM HYDRATE BEARING SEDIMENTS OFF CONTINENTAL MARGIN OF INDIA: BENTHIC FORAMINIFERA PROXIES

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Gas-hydrate occurrences along the Chilean margin have been widely documented. However, the relationship between variations in benthic foraminifera species and warming-induced hazards like submarine landslides in the Chilean margin has not been thoroughly studied. Thisresearch aims to investigate the probabilities of dissociation of gas hydrates and the release ofmethane to the ocean and the atmosphere. The study focuses into the complex dynamics of methane dissociation from gas hydrates in a potential setting on the Chile margin, relying on the analysis of benthic foraminifera abundance, their stable isotope signatures, and pyritization patterns. Through the examination of benthic foraminifera specimens collected from sediment samples, significant shifts in species abundance are identified, particularly highlighting *Uvigerina peregrina*, *Nonionella auris, Globobulimina pacifica* and *Fursenkoina bradyi* as prominent indicators. These shifts, notably during the Last Glacial Maximum (LGM) and subsequent deglaciation, suggest a correlation with environmental changes, possibly reflectingmethane presence, potentially originating from hydrate dissociation. Stable isotope analysis of *Uvigerina peregrina* corroborates the hypothesis of methane influence, as low $\delta^{13}C$ values imply the incorporation of methane-derived carbon. Also, heavier $\delta^{18}O$ values observed duringglacial and deglacial periods provide additional evidence of methane seepage activity in the region. Furthermore, the examination of pyritization patterns among selective species providesadditional insights into methane release events. Higher pyritization levels, particularly observed in species such as *Globobulimina pacifica* and *Fursenkoina bradyi*, correspond to periods of increased methane venting. The study emphasizes stable isotopes of benthic foraminifera for understanding past methane dynamics, highlighting the sensitivity to changes of benthic foraminifera and the need for species-specific responses in methane seepage studies.

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POLAR-TROPICS CONNECTIONS: PERSPECTIVE ON INDIAN MONSOON

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The polar and high-latitude regions, including the Arctic Ocean and Southern Ocean, have been postulated to play an important role in governing Earth's climate by forming major deep and intermediate water masses and air-sea interactions. Recent short-term studies have also indicated a significant influence of polar climate variability on monsoon via "atmospheric bridges" and "oceanic tunnels". However, the short-term variability of monsoon is predominantly governed by ocean-atmosphere interactions over the northern Indian Ocean (e.g., IOD, SST) and the equatorial Pacific Ocean (e.g., ENSO). Hence, delineating the influence of polar climate variability on monsoon on shorter timescales is obscured by these processes. Therefore, this complex interaction between the monsoon and the polar regions remains to be fully explored. Studies focusing on longer timescales (multi-centennial to multi-millennial) are relatively unaffected by shorter timescale processes and can help to understand polar-monsoon connections. Our study from an Arctic fjord spanning the last millennium found that a warmer Arctic climate strengthens the summer monsoon via atmospheric pathways. Another of our studies based on IODP sediments from the Indian Ocean (IODP Expedition 355) and its comparison with Arctic Ocean sediment (ODP Leg 151) showed that lower Arctic sea ice extent was related to stronger summer monsoon. We have also noted a close connection between the monsoon and southern hemisphere temperatures. Our study involving proxy and model data suggests that the SST of the mid-latitude Southern Ocean has governed the monsoon on millennial timescales, with colder SSTs leading to stronger summer monsoons via oceanic and atmospheric pathways. The tropical oceans currently control most of the inter-annual variance in Indian monsoon intensity. But, this could change in the near future as the polar amplification intensifies its relative dominance on Indian monsoon variability, even on a shorter scale.

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MICROFOSSILS OF K-PG PERIOD: INSIGHTS FROM THE SOUTHERNCAUVERY BASIN

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The Cretaceous-Paleogene (K-Pg) period, marked by a mass extinction event around 66 million years ago, is one of the most significant transitions in Earth's history. The Southern Cauvery Basin in India, particularly the regions of Pondicherry, Ariyalur, and Vridhachalam, holds a rich record of microfossils from this period. These regions have yielded a wealth of microfossils especially foraminifera, with extensive studies by researchers like Sastry et al. (1968) and Venkatachalapathy & Ayyasami (1990), who provided detailed taxonomic and biostratigraphic data for the Ariyalur and Vridhachalam areas from the Cretaceous and Paleogene periods. Similarly, Samanta (1967) contributed significantly to our understanding ofthe Pondicherry area's microfossil assemblages. These microfossils provide critical insights into the environmental changes and biotic responses associated with the K-Pg event. Microfossils are abundant in the sedimentary sequences of the Southern Cauvery Basin. Foraminifera are the most extensively studied group in this region. Their diverse assemblages serve as key biostratigraphic markers, allowing precise dating of the sedimentary layers. The shifts in foraminiferal populations across the K-Pg boundary reflect significant changes in marine environments, such as variations in sea level, temperature, and salinity, driven by the global climatic upheaval of the period. Ostracods, though less studied, are also present in the K-Pg strata of the Basin. These are valuable for reconstructing past environmental conditions, particularly in marginal marine settings. Preliminary studies in areas like Ariyalur and Vridhachalam indicate a diverse ostracod fauna, suggesting varied depositional environments during the K-Pg transition.However, despite the extensive research on other microfossils, ostracods have not received significant attention in the Cauvery Basin. More detailed research is needed to fully explore their biostratigraphic and paleoenvironmental potential. The microfossil record in the Southern Cauvery Basin is not just a window into the past but also a valuable tool for understanding the dynamics of extinction and recovery. Continued research in this region, especially focusing on the underexplored ostracods, will furtherenhance our knowledge of the K-Pg transition and its global implications.

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STABLE ISOTOPE ANALYSIS OF OSTRACODE SPECIES *Galliaecytheridea remota* SHELLS FROM MIDDLE JURASSIC BEDS OF SOUTHERN KACHCHH BASIN, WESTERN INDIA: PALAEOCEANOGRAPHIC IMPLICATIONS

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Ostracodes (fossil record is known since basal Ordovician) occur in every aquatic habitat. Their mode of life is mainly benthic and subordinately planktonic, mostly vegetal and animal detritivore. The mineralized portion of the ostracode shell is mainly carbonate and composed of low Mg calcite, however in some cases, composed of amorphous calcium carbonate; and is known to accurately reflect the chemical composition of the water it inhabits since it directly absorbs ions from the surrounding water. Ostracodes undergo a series of eight to nine moults before reaching adulthood, with each moult being followed by a short period of calcification. For present study, shells of taxa *Galliaecytheridea remota* were analysed which were recovered from the Jurassic beds of Ler, Gangeshwar Mahadev, Fakirwari and Dhawalshahpir Mazar domes, Mainland Kachchh.

For the analysis, 5-8 (including whole and broken valve) well preserved, clean and milky white color shells have been chosen from each sample and cleaned with deionized water using a fine brush, to remove the adhering sediments and also checked under a light microscope for any kind of recrystallisation and overgrowth. The isotopic ratios (relative to the isotopic ratios of PDB and are expressed in per mil, ‰) of C and O were measured by extracting the CO_2 from the samples by a reaction with 100% ortho-phosphoric acid at a temperature of 80°C. The analysis was carried out a dual inlet Isoprime-100 mass spectrometer at IRMS facility, Department of Earth Sciences, Pondicherry University. The $\delta^{18}O$ value of the *Galliaecytheridea remota* shells ranges from -4.14 to -2.07 and $\delta^{13}C$ value ranges from -2.96 to 0.79. The $\delta^{18}O$ value (4.14 to -2.07) suggests that they are of calcitic composition and not dolomitic one, and that they might have contained neomorphic calcite crystals, which suggests the initial phase of diagenesis. The $\delta^{18}O$ and $\delta^{13}C$ value, in such cases represents sediment pore water, from which the neomorphic calcite precipitated. The paleotemperature of the pore water, determined using Anderson and Athur equation: $T°C = 16.0 - 4.14(\delta^{18}O_c - \delta^{18}O_w) + 0.13(\delta^{18}O_c - \delta^{18}O_w)^2$, is ranges from 23.09°C to 28.59°C with an average temperature of 25.07°C. $\delta^{13}C$ value of the shell ranges from -2.96 to a maximum of 0.79, which falls within the normal range observed for the marine carbonate.

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EXPLORING AGRICULTURE DURING BARA CULTURE (1700-1400 B.C.) INSARASWATI BASIN: AN ARCHAEOLOGICAL AND ARCHAEOBOTANICAL INSIGHTS

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Indian archaeology and archaeobotany provide valuable insights into the region's ancient cultures,agricultural practices, and environmental history. Palaeoclimate plays a crucial role in human civilization and their sustenance and thereby has a pivot role in archaeobotany, which is the studyof plant remains from archaeological sites. Understanding ancient climate conditions helps archaeobotanists interpret how past environments influenced human societies and their use of plants. The present study has been carried from the Jognakhera site which is situated 4 km northwest of Kurukshetra University, Haryana. This ancient site is a settlement on the palaeochannel of the Vedic Sarasvati River with profound archaeological significance. This regionis rich in archaeological findings and related to ancient civilizations, including the Harappan or Indus Valley Civilization. The Ghaggar and Hakra River basins were the primary Bara cultural center. From this cultural center, it extended to the Yamuna-Ganga doab in Western Uttar Pradesh,Sarasvati and Drisvati in Haryana. This culture has been reported at places viz; Mahorana, Kotla-Nihang-Khan, Ropar, Bara, Sanghol, Balu, Mirzapur, Jognakhera, Bhagwanpura, Daulatpur, Mitathal, Alamgirpur, Bargaon, Hulas Khera, etc. The site has yielded a variety of pottery, including both fine and coarse ware. Harappan pottery typically features sophisticated designs andis indicative of the advanced craftsmanship of the civilization. Archaeobotanical studies reveal information about ancient diets and agriculture. Seeds and plant impressions help to reconstruct past environments and subsistence strategies along with their climatic perturbations. It allows to understand how ancient communities adapted to changing climates. From the results of the presentstudy it was inferred that A\agriculture was the foundation of the Bara culture's economy, as it wasfor other prehistoric societies on the Indian subcontinent. Using the Ghaggar-Hakra River system's water resources, they were engaged in irrigation-based agriculture, growing crops including *Oryza sativa* (rice), *Triticum sp.* (wheat), *Hordeum vulgare* (barley); legumes *Macrotyloma sp.* (Horsegram), *Vigna sp* (Mung/ Urd) and Fruits and Wild taxa includes *Ziziphus nummularia* (Ber), *Lathyrus sativus* (Sweet Pea), *Vicia sp.* (Common Vetch), etc. It's interesting to note that carbonized rice kernels and a large combination of rice husks used as a degraissant in pottery are evidence of the cultivation of rice, the native crop of the Ganga Valley. The climate during the period shows a moderate warm and humid climate.

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STUDY OF OSTRACODA FAUNA FOR AGE DETERMINATION FROM NIMAR SANDSTONE FORMATION OF BAGH GROUP, JHABUA AND ALIRAJPUR DISTRICTS, MADHYA PRADESH, INDIA

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The present research is carried out to determine the age of Nimar Sandstone Formation of Bagh Group on the basis of ostracods fauna. For this study samples from Pipaldehla, Sajwani(Gola Chhoti), Dhekal Badi, Tkadi Moti, Ranapur, Para, Rajla, Udaigarh (Kanas), Umrali, Ban, Bavadi, Kanakakra, Gerughati localities from Jhabua and Alirajpur districts of Madhya Pradesh were collected. Out of these localities, except for a few, the majority of them have yielded ostracods and foraminifers. Authors analysed samples taken from Sajwani (Gola Chhoti) N 22°69' E 74°59'for ostracod study and reported forty-four species of ostracods from this locality. Nineteen species are new which belong to following genera: *Cytherelloidea*, *Bairdoppilata*, *Neonesidea*, *Bythocypris*, *Rostrocytheridea*, *Parakrithe*, *Neocythere*, *Neocytherideis*, *Makatinella*, *Soudanella*, *Cytheropteron*, *Eocytheropteron*, *Semicytherura*, *Monoceratina*, and *Microceratina*. The following twenty-three species have been previously described: *Cytherelloidea oudiapurensis* Jain, *Cytherelloidea raoi* Jain, *Cytherelloidea thuatiensis* Jain, *Paijenborchella jeerabadensis* Chaudhary and Nagori, *Amphicytherura* aff. *A. yakhiniensis* Rosenfeld, *Perissocytheridea batei* (Jain), *Ovocytheridea baghensis* Chaydhary and Nagori, *Rostrocytheridea baghensis* (Jain), *Rostrocytheridea* sp. cf. *R. cerasmoderma* Ballent and Whatley, *Rostrocytheridea divergens* Chaudhary and Nagori, *Rostrocytheridea jaisalmerensis* Singh, *Parakrithe oudiapurensis* (Jain), *Neocytherideis reymenti* Jain, *Haughtonileberis derooi* (Jain), *Haughtonileberis thuatiensis* (Jain), *Makatinella punctata* Chaudhary, *Makatinella thuatiensis* (Jain), *Cytheropteron hanumanpuraensis* Chaudhary and Nagori, *Eocytheropteron bilthanaensis* Chaudhary and Nagori, *Bythoceratina tewarii* (Jain), *Microceratina ratitalaiensis* (Chaudhary and Nagori), *Paracypris acutocaudata* Rosenfeld, *Paracypris jaini* Singh. Two species *viz. Cytheropteron* sp., and *Eocytheropteron* sp. are leftin open nomenclature. The age of the upper calcareous part of the Nimar Sandstone Formation of the Bagh Groupis discussed in the present paper and this study reveals a Lower/Early Turonian age for the calcareous top of Nimar Sandstone based on ostracods, algae, and other faunas

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BENTHIC FORAMINIFERAL ASSEMBLAGES AND THEIR RESPONSE TO THE PALEOENVIRONMENTAL CHANGES ACROSS THE UPPER CRETACEOUS/LOWER TERTIARY (K/T) TRANSITION OF CAUVERY BASIN, SOUTHERN INDIA

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Benthic foraminiferal investigation of the Upper Cretaceous–Lower Tertiary succession (Campanian to early Eocene) of the Cauvery basin, revealed a high abundance of calcareous benthic foraminifera. In total, 180 species belonging to 48 genera of benthic foraminifera were identified in the studied succession. The assemblage suggests that they have distinctive paleoenvironmental preferences. This enables us to assess the ecological preferences of these Upper Cretaceous–and Lower Tertiary taxa and establish them as ecological-marker (eco-marker)species for paleoenvironmental interpretation. Three main distinct depth controlled benthic foraminiferal assemblages have been recognized. Each containing taxa with a common depth preference, one similar to the 'Tethys Carbonate Fauna' (TCF) a shallow-water, inner to middle shelf assemblage (< 30--50 m water depth) of Berggren, (1974); Midway-type" faunal assemblageis a middle to outer shelf assemblage (50--200 m water depth) which was defined by Berggren, (1974) and Berggren & Aubert (1975); and the other developed in a deep-water basin environment containing 'Velasco-type fauna'.The 'Tethys Carbonate Fauna' (TCF) a shallow-water, inner to middle shelf assemblage (< 30--50 m water depth) of Berggren, (1974) is characterized by various *Cibicidids, rotaliids*, andlarger benthic foraminifera such as *Nummulites,* and *Discocyclina* along with calcareous algae are recorded from Thondaimanattum and Saidarpet of Pondicherry area suggest deposition occurred at shallow water (upper neritic < 50m) environment. Midway-type" faunal Assemblage is a middle to outer shelf assemblage (50--200 m water depth) is characterized by various textulariids, nodosariids, polymorphinids, and anomalinids are recorded from the Paleocene - early Eocene sediments of Pondicherry area. The MF is commonly occurring in neritic marl/shale deposits. Thepaleobathymetric ranges of some "Velasco-type" fauna were restricted to middle neritic-abyssal. The onset of the Late Paleocene transgression allowed the presence of deep-water taxa *Anomalinoides rubiginosa* has a wide paleobathymetric range, middle neritic to bathyal. *A. capitatus* primarily occurs in bathyal but also ranges to abyssal depths, *A. semicribratus* indicativeof middle bathyal to abyssal. Upper bathyal benthic foraminiferal assemblages are characterized *by Anomalinoides acuta, Tifarina wilcoxensis, Cibicidoides, and Nuttallides truempyi, Osangularia velascoensis* deep-water species found with an upper depth limit of 500-700 m. A dominant lower bathyal-abyssal form are various *Lenticulina* species common in the study area suggesting upper to middle bathyal depths (200-1000m). Various *gyroidinoids* and *buliminids* indicate the middle bathyal depositional environment, with paleobathymetry varying between 500-600 m and 1000 m.The Late Maastrichtian assemblages are dominated by calcareous foraminifera infaunal morphogroups, suggesting a moderately eutrophic environment. Paleocene assemblages are characterized by abundant epifaunal or mixed epifaunal/infaunal morphogroups, suggests mesotrophic conditions and the food supply to the benthos was less abundant than in the Upper most Cretaceous time. The investigated assemblages are dominated by morphogroups characteristic of both neritic to bathyal/deep-sea conditions and bathyal to abyssal environment

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AN OVERVIEW OF THE POLLEN-BASED HYDROCLIMATIC CHANGES SINCE THE LAST GLACIAL MAXIMUM FROM THE CORE MONSOON ZONE OF INDIA

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The Indian Summer Monsoon (ISM) is one of the major components of the Asian Monsoon System that exhibits a complex ocean-atmospheric-coupled mechanism of the tropics, which is indispensable in inter-hemispheric heat transfer on Earth. The ISM causes ~80% of the total rainfall over India and nearby regions, thereby influencing the agricultural productivity and socio-economic growth of one of the most densely populated regions of the globe. The ISM variability over the core monsoon zone (CMZ) is considered as the measure of the intensity of the annual ISM rainfall. The present review aims to investigate the response of the ISM over the Indian subcontinent, primarily in the CMZ, and the peripheral regions and its association withthe regional records since the Last Glacial Maximum (LGM). The response of vegetation to the ISM rainfall variability, as manifested by the palynological records, forms the basis of the study in the central Indian CMZ. Besides, we have also aimed to address the teleconnections of theISM variability in the CMZ, with that of the natural forcings and climate variables with reference to the global climate dynamics. The present review shows that the CMZ witnessed a weak ISM during the LGM, similar to other regional records; however, the central CMZ witnessed a cool and dry climate, while the peripheral CMZ shows the influence of winter precipitation linkedwith the enhanced Siberian High. The Younger Dryas (YD) was observed to be weak. The onsetof the Holocene witnessed a strong ISM due to high solar insolation over the entire CMZ;however, some of the studies reveal a delayed intensification of the ISM in the central CMZ region. The present study reveals that the CMZ has been more responsive towards the stronger ISM phases (Holocene Climate Optimum: HCO; Minoan Warm Period: MWP; Roman Warm Period: RWP; Medieval Climate Anomaly: MCA and Current Warm Period: CWP) than theweaker ISM periods (Dark Age Cold Period: DACP and Little Ice Age: LIA).

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MICROFAUNAL ANALYSIS AND TEXTURAL CHARACTERISTICS OF SEDIMENTS FROM MUNAMBAM TO FORT KOCHI BEACH, ERNAKULAM: ASPECIAL EMPHASISE TO ENVIRONMENTAL IMPLICATIONS

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The current study analyse eighty sediment samples that were retrieved from the Cochin shoreline between Munambam and Fort Kochi beach. It examines the distribution and shell chemistry of foraminifera, sediment properties, and the consequences for the shifts in environmental patterns. *Ammonia beccarii* is the only foraminifera species present in the sediment sample from the area underinvestigation. Numerous broken molluscan shells were identified. Carefully estimated the amounts of calcium carbonate, sand, silt, and clay were used to analyze the textural properties. Together with the *Ammonia beccarii* count, the broken molluscan shell is responsible for the calcium carbonate proportion. Anomalies in the chemical composition of the foraminifera shells are observed in certain samples. Thulium (Tm), an infrequently occurring rare earth element in the foraminifera test, was linkedto Cherai beach tracked by EDS analysis of *Ammonia beccarii*. Stone revetments erected to prevent coastal erosion have been found to weather, add silt to the beach, and have an impact on the surroundingecology.

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BIOSTRATIGRAPHY AND ENVIRONMENTAL CHANGES DURING THE MIDDLE MIOCENE: A NANNOFOSSIL APPROACH FROM THE SURMA GROUP OF NAGA HILLS

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Calcareous Nannofossils acts as the crucial biostratigraphical tool in establishing and understanding the geological time scales and the history of the Earth's climate and oceans. These microscopic marine organisms, which are primarily small, calcium carbonate plates (coccoliths) from coccolithophores, have been valuable in dating and correlating marine sequences. In this study silty shale samples are used for reconstruction of the biostratigraphy and palaeoenvironment. This is the first record of Nannofossils is from Surma group of Naga Hills. In the present study, 10 Calcareous Nannofossil assemblage have been recognized comprising 10 species viz. *Coccolithus pelagicus, Calcidiscus leptoporous, Cyclicargolithus floridanus, Coccolithus miopelagicus, Helicosphaera carteri, Helicosphaera euphratis, Reticulofenestra haqii, Reticulofenestra minuta, Reticulofenestra perplexa, Reticulofenestra pseudoumbilicus.* This study is significant in determination of age and palaeoenvironment as the region lacks faunal data more so of Nannofossil record. By integrating Calcareous Nannofossil occurrences, we constrain the studied succession to Calcareous Nannofossil Zone CNM7 of Backman et al. (2012), which corresponds to the early part of the middle Miocene. The presence of *Helicosphaera* suggests a hemipelagic depositional setting for Bhubhan Formation of Surma Group of Naga Hills.

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MICROFOSSIL ASSEMBLAGE FROM CORE SEDIMENTS OF MANSAR LAKE OF JAMMU ANDTHEIR PALAEOECOLOGICAL SIGNIFICANCE

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Mansar Lake is a freshwater body, semi-oval in shape situated 60 km east of Jammu at 665 meters above mean sea level. Stratigraphically it comes under the Mansar Formation in the Lower Siwalik Subgroup of Jammu region (J & K), India. It falls under toposheet No.43P/2 and lies between the longitude ($75^0$08'16''E to $75^0$08'52''E) and the latitude ($32^0$41'28''N to $32^0$42'09'' N). In the present study, we collected core sediment samples from Mansar Lake which exhibits varying proportions of sand, silt, and mud-clay layers. The collected samples were then macerated and screen-washed using different sets of sieves (60, 80, and 120 mesh). The obtained residue material was dried in the sunlight and sorted by size. The picking of microfossils was carried out under a stereo-zoom binocular microscope. By using the above maceration technique, we recovered a good number of microfossil specimens from the 4-meter-long core sediment of Mansar Lake, which includes three species of ostracods (*Darwinula stevensoni., candona* sp. *candona compressa/Candona neglecta),* and three species of gastropods (*Melanoides tuberculata, Polypylis* sp., *physa).* Palaeoecologically, these species commonly live in ponds, rivers, streams, canals, reservoirs, wetlands, and freshwater lacustrine environments.

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A PRONOUNCED IMPACT OF THE 8.2 KA EVENT IN THE BAY OF BENGAL

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The 8.2 ka event is a prominent climate anomaly characterized by a sudden and significant global cooling. This event is believed to have been triggered by the release of large amounts offreshwater into the North Atlantic Ocean. It disrupted the Atlantic Meridional Overturning Circulation (AMOC) causing a short cooling episode, likely transmitted globally via atmospheric teleconnections. The global impact of this event is highly debated, mainly because of its short-lived nature. The signatures of this event are hard to find in usually centennially resolved marine records. We report a strong influence of 8.2 ka event on the monsoon in the Indian subcontinent, based on a decadal resolution marine sedimentary record recovered from the southwest Bay of Bengal. The abrupt decrease in coarse fraction (>63 μm), calcium carbonate ($CaCO_3$), organic carbon (C_{org}), and Nitrogen (N) at 8.5 ka, points towards a collapsein productivity. The decrease in the C_{org}/N ratio at 8.5 ka, also suggests an abrupt weakening of the monsoon that continued till 8.0 ka. The total planktic foraminifera number (TPN/g sediment) abruptly decreased between 8.5 to 8.0 ka responding well to the event. We report that this event affected the climate for 500 years in the Indian subcontinent and nearby oceans.The pronounced weakening of the monsoon in the Bay of Bengal, likely driven by the changesin the sea surface temperature and atmospheric circulation pattern, underscore the intricate andfar-reaching nature of the climate teleconnections. This study contributes to a deeper understanding of the global ripple effects of abrupt climate events and its capacity to reshape regional environmental conditions.

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TRACE METAL POLLUTION ASSESSMENT USING BENTHIC FORAMINIFERA IN CHILIKA LAKE, INDIA'S LARGEST BRACKISH WATER LAGOON

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Lagoon sediments serve as key indicators of environmental conditions in coastal areas. These areas are significantly intervened by anthropogenic contaminants, especially trace metals, which pose serious threats to the benthic community, disrupting their habitats and ecological balance. Recently, there has been a rise in pollution in Chilika Lagoon, primarily from untreated sewage discharges and aquaculture. These contaminants get into the lagoon and have a detrimental effect on its ecology, resulting in a sharp decline in biodiversity including reduction in the numbers of fish, prawns, and crabs. Among benthic organisms, foraminifers are a group of single-celled protists of benthic communities that are highly susceptible to environmental stress and found in the surface sediments of Chilika Lagoon. These benthic foraminifera can be used as a pollution indicator. In this study, the surface sediments from 38 locations were analyzed using Q-ICPMS for the concentration of trace elements. According to PCA analysis, the distribution of foraminifera in this brackish water lagoon is influenced more by the amount of silt and the presence of trace metal pollution than by salinity. Notably, the species *Ammonia tepida* is a trace metal indicator species that has been linked to high concentrations of trace metals such as lead (Pb), cadmium (Cd), zinc (Zn), chromium (Cr), copper (Cu), nickel (Ni), and arsenic (As). The strong positive correlation between *Charophytes* and *A. tepida*% indicates freshwater intrusion is the primary driver of pollution rather than marine influence. Additionally, the positive relationship between *A. tepida*% and silt suggests that the Mahanadi River system is a major source of pollutants, bringing in trace metals from urban runoff and other anthropogenic sources. These findings highlight the vulnerability of the Chilika lagoon to environmental stressors and underscore the importance of foraminifera as bioindicators for monitoring ecosystem health in polluted coastal areas. Additionally, *Ammonia maruhasii*, a distinct benthic species, has been suggested to have a substantial positive correlation with *A. tepida%*, making it a potential trace metal indicator for this region of the Chilika Lagoon.

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IMPACTS OF GLOBAL CLIMATE EVENTS ON INDIAN MONSOON DYNAMICS AND PRIMARY PRODUCTIVITY IN THE EASTERN ARABIAN SEA DURING THE LATE QUATERNARY

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The Arabian Sea plays a crucial role in global climate dynamics, primarily due to its extensive sedimentary deposits and the presence of the most pronounced and thickest oxygen minimum zone (OMZ) in the modern ocean. The southwest monsoon (SWM) significantly enhances surface water productivity in the Arabian Sea, coupled with poor ventilation of intermediate waters, it results in intense denitrification within the OMZ. Despite the importance of this process, there is still limited record of vertical expansion of the OMZ in the deep sea sediment of the Arabian Sea. As a result, investigating the fine-scale evolutionary changes within this region is essential for addressing the ongoing challenges of developing a robust and cohesive model for predicting future rapid climate change. This study focuses on examining a well-dated 2.68-meter long sediment core from the eastern Arabian Sea, by analyzing environmental magnetic, grain size distribution, stable isotope measurements of carbon and nitrogen, total organic carbon (TOC), total nitrogen content, trace elements (TE) and rare earth elements (REEs). The aim of this study was to understand the variations in sediment supply driven by both monsoonal and non-monsoonal factors, along with associated changes in primary productivity and possible vertical expansion of OMZ during the late Quaternary in eastern Arabian Sea. Through careful chronological analysis of the investigated parameters in relation to significant global events, we identified the response of the Arabian Sea to major climatic events occurring around 42.8–28 ka, 17 ka, 14.5 ka, 11.7 ka, 9.7 ka, 8.2 ka, 4.6–3.9 ka, and 2–0.6 ka. These global events played a crucial role in regulating oxygen levels within the Arabian Sea's water column. Additionally, a comparison with sedimentary records from off Chennai in the Bay of Bengal suggests that the anti-phasing between the southwest (SW) and northeast (NE) monsoons is a post-25 ka phenomenon, whereas prior to 25 ka, the SW and NE monsoons exhibited synchronous variations. We hypothesize that this shift to anti-phasing was driven by the Earth's axial precession cycle, shedding light on the cyclic nature of monsoonal variability.

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PALYNOLOGICAL COMPARATIVE STUDY OF THE NEOGENE ROCKS EXPOSED IN PARTS OFSIWALIK BELT, ARUNACHAL PRADESH AND BELT OF SCHUPPEN, NAGA PATKAI HILLS

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The Neogene period, defined by its unique climatic and geological conditions, is associated with a rich record of palynomorphs and palynodebris within the sedimentary rocks, exposed inthe Siwalik Belt in Arunachal Pradesh (consisting of Kimin, Subansiri and Dafla Formation) and the Naga Schuppen Belt (consisting of Tipam group), with their own paleoenvironmental and paleoclimatic conditions. This study presents a comparative palynological analysis of these two regions, with distinct geographical and geological settings in order to infer about climatic and vegetational variation during the Neogene period, after systematic sampling of sedimentary rock sequences from both belts. Detailed palynological analyses results in a distinct assemblage of pollen types corresponding to their paleoenvironmental and paleoclimatic conditions of each Belt. The Siwalik Belt of marine environment associated with sediments derived from the Arunachal Himalaya is represented by a palynological record indicative of warm, humid environment while the Naga Schuppen Belt of fluvial environment associated with recycled sediments has palynological association indicative of cooler climatic conditions. Tectonic activity-driven change in elevation, and changing monsoonal patterns associated with environmental variation affected the distribution of vegetation patterns in these regions during the Neogene. It can enhance the knowledge of paleoecology, biogeography and climatic evolutionof northeastern India.

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TRACING PALAEO-HYDROLOGICAL CHANGES IN THE WESTERN ARABIAN SEA SINCE 32 KA TO 4 KA USING PTEROPODS AND STABLE ISOTOPIC DATA

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The present study offers high resolution insights into palaeoclimatic records using from the upperslope of the Oman margin in the Western Arabian Sea (WAS). It is a first attempt to decode the palaeo-hydrography of the region between 32 Ky to 4 Ky before present, using multi proxy approach. Past palaeoclimatic studies from the Oman Margin has predominantly focused on long-term, low-resolution data specifically addressing aspects such as monsoon dynamics, upwelling, productivity, and sea surface temperatures, primarily using planktonic foraminifera. However, noattempt has been made to compare or relate these processes with the timing or intensity of the samein the Eastern Arabian Sea (EAS). Additionally, there remains a noticeable lack of any palaeoclimatic reconstruction using pteropods which being aragonitic are more sensitive tochanges in intensity Oxygen Minimum Zones (OMZ) and glaciation-deglaciation driven salinity fluctuations and possible degassing. While some studies with planktonic foraminifera have delvedinto detecting the and its correlation with productivity, limited attention has been given to describing pteropod assemblages or comprehensively understanding shifts in hydrodynamic conditions. Through analysis of pteropod assemblages, as well as oxygen and carbon isotopic signatures, the study offers crucial insights into how the ocean responded to atmospheric warmingduring the Late Glacial Warming and the subsequent Holocene Sea level rise due to melting icesheets.

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THE VINDHYAN SUPERGROUP: A CHRONICLE OF TWO CENTURIES OF RESEARCH

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The geological terrain of the Vindhyan ranges of the Proterozoic age is an abode of the sacredHindu Goddesses the *Vindhyavasini* and *Maihar Devis*. Despite a long religious antiquity, therecorded history of the geological investigations on the *Vindhyachal* hill ranges is merely two centuries old. Incidentally, the first scientific observations on these rocks were palaeontological in nature. Captain Dangerfield reported his observations to Major General John Malcolm, who published them in 1823 in the *Memoirs of Central India including Malwaand adjoining provinces.* Vindhyan Proterozoic succession is an important geological entity on the regional and global level as evidence for a large part of Earth's history related to the evolution of the lithosphere, hydrosphere, and biosphere are entombed in the Vindhyan rocks.This keynote traces and chronicles the development in the field of Vindhyan geology over thepast century, particularly in the post-Auden era. The article enumerates unsolved problems related to stratigraphy, palaeobiology, age, basin configuration, and evolutionary lessons drawn based on fossil occurrence.

Pioneering studies help build the basic data framework for understanding the lithostratigraphic succession, constituting the Vindhyan Supergroup (VSG). The Vindhyan basin was once considered a large single basin. The consensus is now emerging to establish it as two independent basins (Son Valley and Chambal Valley) with distinct lithostratigraphy. The classical division of the rocks divided the VSG into the Semri, Kaimur, Rewa, and Bhander. Initially, the Semri was designated as the Lower Vindhyan; and the Kaimur, Rewa, and Bhander were grouped as the Upper Vindhyan with a significant hiatus between the two divisions. The time lag between the deposition of the Lower Vindhyan and Upper Vindhyan successions is a great enigma. Porcellanite and volcaniclastics are well known in the Semri Group. Some recent studies have also recorded their presence in Kaimur and Rewa Groups. Their emplacement and palaeogeography of the basin are other questions to be addressed. Thelithostratigraphy and age of such a vast expense of rocks are complex and debatable. Are there a few younger age litho-units between the lower and upper Vindhyan? The depositional environment of the VSG was once considered a shallow marine environment restricted withinthe peritidal regime for a long time. However, new studies show that some of the litho-units of the Upper Vindhyan are not as shallow as considered but are deposited distally offshore to the deeper part of the shelf. Palaeobiological remains are, although well documented from theVSG, affinity, and age connotation of some of them are baffling and a great challenge to explain. Eukaryotic forms, represented by acritarchs, are considered to have evolved during the Proterozoic. Acritarchs recorded from the Semri Group are important evidence and need further investigation to trace the first eukaryotic common ancestor (FECA). The occurrence ofrare

large prokaryotic forms, such as *Grypania spiralis* and *Katnia singhi,* at certain stratigraphic levels still needs a suitable explanation. Reported dubiofossils and pseudofossils have posed a big problem, and inferences drawn on their basis have created a lot of confusion in lithostratigraphy, palaeobiology, and geochronology.

Research opportunities: Several new research opportunities are available in the Vindhyan Supergroup to be investigated. Modeling of the basin requires deep seismic studies penetrating the complete crust to understand the structural features and reconstruction of the subsidence history of the basin. Precious diamonds are retrieved from the kimberlite pipes intruded into the Vindhyan rocks and sedimentary successions of the Kaimur and Rewa Groups around the Panna district in Madhya Pradesh. Besides the kimberlite pipe in the Pannaarea, searching for the primary source of the diamond is the need of the hour. The carbonate rocks occurring at different stratigraphic levels of the VSG are the most significant source for the country's cement industry. Premier agencies of the country, like ONGC and OIL, considerthe VSG as the frontier basins exploring the hydrocarbon prospects in the Ganga Valley.

Several deep wells drilled on the VSG and in the Ganga valley await detailed investigations.Identifying and conserving geo-heritage sites is a new dimension of study in geology. VSG also supplied sandstone slabs extensively used in famous forts, i.e., Chunar and Kalinjar, historical Mogul, and modern British eras buildings in central India. The Ashok Chakra (Ashoka wheel), the national emblem and the pride of the Bharat, is also built of the Vindhyan sandstones. Some of the recent buildings of National importance also received thebuilding materials and stone from the VSG.

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BOTTOM WATER CHARACTERISTICS OF THE CENTRAL SOUTH PACIFIC DURING THE MID-PLEISTOCENE TRANSITION

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The mid-Pleistocene transition (MPT, 1.2- 0.78 Ma) has witnessed a gradual switch in climateperiodicity from 41 to 100 kyr without substantial changes in the Milankovitch forcing. Changes in ice-sheet dynamics, declining atmospheric CO_2, and changes in deep oceancirculations are some proposed mechanisms that might trigger long-term ice ages. Hence, to assess the role of the Southern Ocean bottom water and its characteristics during the MPT, thisstudy analyzed benthic foraminifera and other related proxies on the sediment cores recoveredfrom International Ocean Discovery Program Site U1540 located at the Central South Pacific (CSP). Our data indicates that CSP bottom water periodically switched between oxic and suboxic conditions during the MPT. During the onset of the MPT, bottom water was suboxic with sluggish current strength that continued up to Marine Isotopic Stage (MIS) 25 except forMIS 31. During the mid-phase of the MPT between MIS 25 and 23, a disruption in the thermohaline circulation (THC) was reported globally that also affected the CSP. The oxic species abundance shows a substantial decline during this period indicating a suboxic and sluggish bottom water at the CSP. After MIS 23, the bottom water became oxic, particularly during the interglacial periods, and is characterized by stronger bottom water currents. The oxygenation conditions persisted beyond the MPT at CSP suggesting a strong bottom water current. The intensity of the bottom water circulation at the CSP follows the Antarctic Circumpolar Current strength during the MPT, except for MIS 22.

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INTERRELATION DISTRIBUTION, ECOLOGY AND TAXONOMY OF RECENT BENTHIC FORAMINIFERA FROMPALAR AND UPPANAR ESTUARINE SEDIMENTS, TAMIL NADU

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The present work discusses the foraminiferal fauna and to evaluate the ecological relationship of benthic foraminiferal assemblages with physicochemical characteristics that govern the living population of the Palar and Uppanar estuaries of Tamil nadu, India. Sediment samples and bottom water samples during Pre-Monsoonand Post-Monsoon were collected from 25 stations in Palar estuary and 30 stations in Uppanar estuary. In Palar estuary a total of 40 foraminiferal species belonging to 15 genera was observed during the Pre-monsoon period, whereas in the Post-monsoon period 53 species belonging to 24 genera was observed. In Uppanar estuary a total of 59 foraminiferal species belonging to 23 genera was observed during the Pre-monsoon period whereas in the Post-monsoon period 47 species belonging to 19 genera was observed. The foraminifera population (living, total, living- total ratio) identified in the pre-and post-monsoon sediments in the Palar and Uppanar Estuaries were inferred in association with the conforming substrate characteristics (sand-silt-clay ratio, CaCO3 and Organic Matter content) and bottom water parameters (Temperature, Salinity, D/O, pH) to resolve the ecology of foraminifera in these estuaries. Temporally, the increase in salinity and dissolved oxygen content of the bottom water and the higher organic matter and calcium carbonate content of the bottom sediments are found to be the reason for the foraminiferal population as a whole. Shannon, Simpson, and Pielou's indices for Pre-Monsoon and Post Monsoon seasons in Palar and Uppanar estuaries indicate limited diversity is due to the environment being severely stressed during the Pre-monsoon and Post Monsoon seasons. This might be due to a number of factors, including 1) the closing of the estuarine mouth, which restricted sea water circulation in the estuary, and 2) the fast regional change of biological characteristics. In addition, anthropological activities such as fish and crab farming and dredging of estuary bottoms for edible shells contributed to ecological instability. v Total (dead + live) foraminifera were considered for cluster analysis because the living taxa are sparse and absent in many stations in both Palar and Uppanar estuaries. The Palar estuary had 53 benthic species, although many of them were sporadic. *Ammonia beccarii* and *Ammonia parkinsoniana* were the two most prevalent species, accounting for more than 80 percent of the foraminiferal abundance. The faunal assemblage was dominated by the most tolerant species, *A. beccariiand A. parkinsoniana*, which thrived and reproduced in a stressed environment. The substrate has an impact on faunal distribution and relative abundance. The lack of connection between the estuaryand the open sea directly impacts environmental factors and, as a result, foraminiferal abundance and geographical distribution. The Uppanar estuary had a total of 64 benthic species, many of which were occasional. *A. parkinsoniana* and *A. beccarii* were the most abundant species, accounting for more than 65 percent of the foraminiferal abundance. Almost all sample locations were dominated by *Ammonia parkinsoniana* and *A. beccarii* species. Salinity changes had a small influence on the distribution of total assemblages when compared with the Pre- Monsoon and Post Monsoon periods. The faunal distribution and relative abundance are positively correlated with the substrate. The number and diversity of benthic foraminifers are severely impacted, and the estuary is dominated by stress-tolerant Ammonia species. Due to rising hypoxic conditions across the estuary, the estuary is unsuitable for symbiotic foraminifera habitat. The stressed ecological signatures can be attributed to industrial wastes (anthropogenic pressures) that are drained into this estuary, among other biotic variables.

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WEAKENING OF THE INDIAN SUMMER MONSOON AT 8.2 KYR BP: VEGETATION DYNAMICS AND HYDRO-CLIMATIC CHANGES IN THE CORE MONSOON ZONE OF INDIA

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The 8.2 ka event is the most significant global climate anomaly of the Holocene Epoch, but a lack of records from the central Indian Core Monsoon Zone (CMZ) currently limits our understanding of the spatio-temporal extent of the climate response. We present a 1.2-m-long lake sediments pollen record from the central Indian CMZ, which provides a history of the Indian Summer Monsoon rainfall (ISMR) over the last 8.2 kyr (the "8.2 ka event). The study revealed that between ca. 8217 and 7601 cal yr BP, tree savanna vegetation occupied the landscape under a cool and dry climate, probably indicating a reduction in the ISMR. This phaseof harsh climate coincides with the global "8.2 ka cooling event" of the North Atlantic. Betweenca. 7601 and 4977 cal yr BP, tree savanna vegetation was replaced by open forest vegetation under a warm and relatively less humid climate with moderate monsoon rainfall. Between ca. 4977 and 3775 cal yr BP, open mixed tropical deciduous forest transformed the open vegetation under a warm and relatively more humid climate with increased monsoon rainfall. This phase of amelioration in climate is correlatable with the Holocene Climate Optimum. The open mixed tropical deciduous forest continued to grow with some increase in the arboreal taxa between ca. 3775 and 918 cal yr BP under a warm and relatively more humid climate with further increase in monsoon rainfall, correlatable with the Roman Warm Period. Subsequently, between ca. 918 and 145 cal yr BP, dense mixed tropical deciduous forest came into existence and replaced the open mixed tropical deciduous forest under a warm and relatively more humid climate with intensified monsoon rainfall, matches with the Medieval Climate Anomaly. Finally, between ca. 145 cal yr BP to the Present, mixed tropical deciduous forest transformed the dense mixed tropical deciduous forest under a warm and relatively less humid climate with increased monsoon rainfall. This phase of increased monsoon rainfall corresponds with the Current Warm Period

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FOSSIL OF FISH TEETH FROM THE UPPER SIWALIK SUBGROUP, KATHUA DISTRICT OF JAMMU ANDKASHMIR

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This study presents the discovery of a promising new locality for fossils of fish teeth from theTatrot Formation, Kathua district of Jammu and Kashmir. The Upper Siwalik Subgroup, whichis well-known for fossil richness, has provided a wealth of information about the paleoenvironment and evolutionary history of the region. However, the distribution of microvertebrate-rich sites remains relatively limited. The discovery of this new site is significant, it underscores the need for continued exploration to fully uncover the potential of the Upper Siwalik Subgroup for microvertebrate research. The newly identified site, characterised by its fine-grained sediments and proximity to ancient river channels, offers a promising opportunity to expand our understanding of the region's aquatic ecosystems. Preliminary investigations at the site have yielded a diverse assemblage of microvertebrate fossils, including fish teeth. The finding of fish teeth holds great importance because it offers valuable insights into the aquatic habitats present in the area from the Pliocene epoch. By analysing, the morphological characteristics and taxonomic affinities of these fish teeth, researchers can reconstruct paleoenvironments, identify evolutionary trends, and correlate withother geological and paleontological data. The discovery of this new microvertebrate fossil sitecontributes to the growing body of knowledge on the Siwalik paleoecosystem. It offers opportunities for further research on the diversity, distribution, and evolutionary history of aquatic organisms in the region, providing valuable insights into the ancient ecosystems of theHimalayan foothills.

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DECODING PAST ENVIRONMENTS OF BAKHIRA WETLAND USING PALYNOFACIES: A CASE STUDY FROM ARAMSAR SITE IN SANT KABIR NAGAR, INDIA

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The vast Indo-Gangetic plains are characterized by an expansive alluvial landscape formed by the Indus, Ganga, and Brahmaputra rivers, along with their numerous tributaries. The geological upliftof the Himalayas, particularly the Tibetan Plateau, played a crucial role in shaping the Indo- Gangetic Plain, creating a variety of fluvial landforms and significantly influencing India's currentmonsoon system. Bakhira Wetland, one of the largest natural floodplain wetlands, located in SantKabir Nagar, Uttar Pradesh, India, is a significant Ramsar site that plays a crucial role in regionalbiodiversity and hydrology spanning an area of 29 km². The wetland serves as an essential habitatfor a wide range of floral and faunal attribute. Since the past, the wetland evolution, influenced byclimate change, hydrological variations, and anthropogenic activities, can be effectively studied through palynofacies analysis. The present study aims to decode the past environments of Bakhira Wetland using palynofacies, providing insights into the past climate, vegetation dynamics, and hydrological changes that have shaped this ecologically vital region. Palynofacies refers to the study of organic matter in sedimentary rocks, focusing on the distribution, composition, and preservation of palynomorphs (such as pollen, spores, and other organic particles) and associatedorganic matter. The analysis of palynofacies (phytoclasts, palynomorphs, and Amorphous organicmatter (AOM)) involves examining the types and abundance of these organic particles to infer thedepositional environment. Based on the analysis of the palynofacies data analyzed from the Bakhira wetland it is inferred that the high percentage of degraded brown organic matter (OM) indicate a terrestrial or nearshore environment with a significant influx of terrestrial plant materialwith periods of low water levels or increased oxidation within a wetland or floodplain environment. Similarly, Structured organic matter including identifiable plant fragments, such as wood, cuticles, and other plant tissues that retain their original structure, suggest deposition in a low-energy environment, transport of organic matter with minimal transport and degradation in anoxic or waterlogged conditions. Also helping to infer rapid burial and reduced exposure to oxygen, and reconstruct the vegetative cover and local hydrology during deposition. The record of opaque phytoclasts indicate higher-energy environments subjected to significant transport and mechanical breakdown which can occur in river channels or high runoff and suggest a dynamic environment with fluctuating energy conditions. In this study high percent of fungal hyphae thrivein environments with suggest ample moisture, so a high concentration in palynofacies often indicates humid conditions during depositional time. These fungal remains are common in wetlands, marshes, and tropical regions with high rainfall are typical environments. Along with these palynofacies, the other components present are spore/pollen, fern spores, Thecamoebians, crustacean remains, zoomorphs, fish scales, scolecodonts, etc. in variable percentage affecting theenvironmental setting of the Bakhira wetland. Thus, the decoding of palynofacies-based paleoenvironmental reconstruction of Bakhira Wetland will provides a comprehensive view of the wetland's past development, climate dynamics, and ecological changes through time.

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PALAEOENVIRONMENTAL SETTINGS OF ARTINSKIAN SEDIMENTS IN THE SATTUPALLI AREA OF THE CHINTALAPUDI SUB-BASIN, GODAVARI VALLEY COALFIELD, SOUTH INDIA

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A palaeoenvironmental investigation was conducted on borehole SSP-385 (72.35 m deep), drilled in the Sattupalli area of the Chintalapudi sub-basin, through palynofacies analysis. Five distinct forms of organic matter have been identified spore-pollen (SP), structured phytoclasts (ST), opaque phytoclast (CH), degraded organic matter (DOM), and amorphous Organic Matter (AOM). Based on the occurrence of the various forms of the organic matter three distinct palynofacies assemblages (PA-I—PA-III) have been identified. PA-I has been identified based on the dominant occurrence of SP and ST (40.61-98.06%, avg. 77.87%), and PA-II is recognized by the dominance of the DOM and AOM (avg. 72.61%, 47.15-100%). While the dominant presence of the CH (CH: avg. 67.76%, 46.46-99.80%) characterizes PA-III. The concurrent occurrence of the sedimentary units and the dispersed organic matter in three distinct environments has been interpreted for the identified palynofacies assemblages. The concurrence of sedimentary facies and organic matter distribution suggests that PA-II was deposited in low-energy environments conducive to swamp formation. The association of fine-grained sediments with organic matter components indicates persistently elevated water levels during its deposition, leading to the interpretation of PA-II as representing lakeshore or flooded palaeomire environments within anoxic, low-energy settings. In contrast, the presence of equidimensional opaque phytoclasts points to deposition under moderate to high-energy conditions, leading to the interpretation of PA-III as representing oxidized swamp settings.

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RECORD OF PALEOCLIMATIC FLUCTUATIONS IN THE TROPICAL INDIAN OCEAN SINCE THE NEOGENE

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The Neogene and Quaternary periods have undergone many variability in different climatic and oceanographic systems. These changes in the past climate can be deciphered from the marine paleoclimatic archives. The climatic events are preserved as definitive imprints withinthe buried sediments on the seafloor of major world oceans and seas. One of the most widely used proxies, from the marine sediment archive, to understand variations in the paleoclimate is through interpreting stable oxygen isotope ratios of planktic foraminifera. As the ocean and atmosphere are coupled, changes in the atmosphere induce geochemical changes in the water column, which are embedded within the foraminifera tests. Understanding the climatic changesin the past enables us to better understand the future climatic trends. Very limited work has been attempted in the sediments of the western equatorial Indian Ocean to identify these climatic changes on a long-term geological timescale. Therefore, with the aim of constrainingthe major climatic events since ~20 Ma in the equatorial Indian Ocean region and to reveal whether it behaves like other tropical ocean basins for efficient correlation studies, we analysedsediment samples procured through International Ocean Discovery Program (IODP), Expedition-359, in the Maldives Inner Sea. Planktic foraminifera, *G. ruber* and *T. quadrilobatus*, were picked from the sediments, in the size range of (250-355) μm, to yield a detailed oxygen isotopic ($\delta^{18}O$) record using Isotope Ratio Mass Spectrometer (IRMS). Our $\delta^{18}O$ record gives several insights into the fluctuating cooling and warming climatic trends, coincident with major global climatic events. The warmest period of Miocene epoch called the Miocene Climatic Optimum (MCO) can be observed from ~17-15 Ma from an overall excursion towards more negative values of $\delta^{18}O$, followed by Middle Miocene Climate Transition (MMCT), from ~15-12.5 Ma, which was also a period of East Antarctica Ice sheet formation (EAIS) and expansion. Further, we also suggest the initiation of South Asian Monsoon (SAM) between ~13-12 Ma. A cooling trend can be seen between ~2.8-1.8 Ma, associated with Northern Hemisphere Glaciation (NHG). Overall, the equatorial Indian Oceanmajorly behaves like other tropical oceans and can be used to study significant global climatic events.

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RECONSTRUCTING THE EASTERN ARABIAN SEA OXYGEN MINIMUM ZONE: INSIGHTS FROM THE DEGLACIATION TO HOLOCENE

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The expansion of climate-driven Oxygen Minimum Zones (OMZs) is a growing concern due to their impact on ocean ventilation and marine ecosystems, necessitating detailed study. To understand the covariation between past oxygenation changes in OMZs and carbonate preservation, we analyzed the shell weights of planktic foraminifera species (*Globigerinoides ruber*) along with calcium carbonate ($CaCO_3$(wt.%)) content and uranium (U) concentrations- an oxygenation proxy from the OMZ depth of the Eastern Arabian Sea (EAS) over the past ~15.5 kyrs on sediment core SK-376/GC-02, retrieved from a depth of 614 m within the present OMZ. Our study reveals the shell weight was higher during deglaciation while it declined throughout the Holocene. However, there have been significant changes in $CaCO_3$(wt.%) throughout deglaciation to the Holocene. The simultaneous decrease of $CaCO_3$(wt.%) and shell weight during the late Holocene suggests potential carbonate dissolution. While the U concentration shows an increasing trend overall, the Heinrich Stadial (HS-1) (~17.5-14.5 kyr), and Younger Dryas (YD) (~12.8-11.2 kyr) show lower U content, suggesting a weaker OMZ, while the Bølling-Allerød (B-A) period (~14.5-12.8 kyr) showed a moderately high U value, suggesting a significant strengthening of OMZ. The U content showed an increasing trend throughout the Holocene suggesting a transition towards an intensifying OMZ which could be the potential reason for the decreasing shell weights throughout the Holocene. These findings highlight the impact of climatic events on carbonate preservation and oxygenation, providing valuable insights into the palaeoceanographic evolution of the EAS.

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RODENT FOSSILS FROM THE SIWALIKS OF MOHAND, SAHARANPUR DISTRICT, AND BIOSTRATIGRAPHIC IMPLICATION

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Six fossiliferous localities (ML1, ML2, ML3, ML4. ML5 and ML6) have been explored in the Siwalik region of Mohand. Saharanpur district of Uttar Pradesh (India). Each locality has yielded many microfossils comprising charophytes, gastropods, bivalves, fishes, and insectivores, but the micromammal is very limited except for the locality MLI. A few rodent fossils represented by isolated teeth have been recovered from the locality ML1 in the area. Here, we describe the taxonomy of these rodents and discuss the age of the fossil locality based on rodent biochronology, which is an important tool in making the correlation of strata and dating isolated new fossil localities. The rodent fossils are identified as *Golunda* sp. and *Mus* sp. The *Golunda* sp. from Mohand differs from *G. dulamensis* and one living species *G. ellioti* and others African species *G. gurai, G. jaegeri, G. aouraghei*. It has shared the molar characteristics of *G. tatroticus* and *G. kelleri* but difficult to differentiate either *G. tatroticus* or *G. kelleri* as it is broken posteriorly. Based on the previous magnetostratigraphic data in the region, the fossil locality correlates to 5.23-4.36 Ma, approximately equivalent to the Tatrot Formation of Upper Siwalik. If the specimen is *G. kelleri*, then it represents FAD (First Appearance Datum) range extension roughly by ca. 1.5 Myr in the Siwaliks, or if it is G. tatroticus then it will be the oldest record of *Golunda* than those earlier reports from Siwaliks and Africa. The presence of *Golunda* sp. and Mus sp. similar to *M. elegan* and *M. flynni* in the area also supports the Early Pliocene age of Upper Siwalik rather than the Late Miocene of Middle Siwalik. The occurrence of our *Golunda* sp. in the older deposits also supports the hypothesis for the migration of *Golunda* from Asia to Africa and favors the origin in South Asia.

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ORBITAL SCALE SYNCHRONIZATION OF THE KUROSHIO CURRENT AND GULF STREAM

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Kuroshio Current (KC) and Gulf Stream (GS) are the main western boundary currents in the North-Pacific and North-Atlantic Ocean, respectively. Both KC and GS transport heat from thetropics to high latitudes, playing a crucial role in determining the weather fronts, storm surges and Northern Hemisphere climatic phenomena. This study applied cross-spectral methods andGaussian bandpass filters to KC and GS strength proxies, reconstructed North-Atlantic and North-West Pacific paleo-SST, and Antarctic composite CO2 and CH4 over the last 400 ka to understand the synchronization of KC and GS and implications of the greenhouse forcing. Thesimultaneous strengthening/weakening of KC and GS is observed over the last 400 ka. The cross-spectral analysis reveals that KC and GS are tightly coupled and show high coherence inthe 100 kyr band with a minimal phase difference suggesting their synchronization. Such coupling is evident between North-Pacific and North-Atlantic Ocean paleo Sea Surface Temperature (SST) records. This study hypothesized that greenhouse/ice-sheet forcing was crucial in KC and GS synchronization, and the synchronization mechanism is similar to the modern condition. Both KC and GS had a close relationship with Westerly Jet which links EastAsian Summer Monsoon precipitation with North-Atlantic Ocean SST anomalies.

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DECODING HOLOCENE MONSOON VARIABILITY: EVIDENCES FROM ICE CORES AND LAKE SEDIMENTS FROM TIBET AND HIMALAYAS

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Intense debate persists about timing of Asian summer monsoon weakening/intensification over Tibet and Himalaya, underscores the importance of high-resolution data for understanding past monsoon dynamics in a warming world. Here, we present the $\delta^{18}O$, δD, d-excess, dust proxy and the cloud chemistry inferred from ice cores, speleothems, and lake sediments to elucidate the complex relationships between these climate systems. The mid-Holocene period, roughly from 6500 to 4600 years ago (cal BP), was characterized by one of the most significant climate shifts of the last 11,000 yr, indicating a possible synchronization between northern Tibet and the north- western Himalaya. This alteration in atmospheric circulation has had far-reaching impacts on the cryosphere, vegetation patterns, dust deposition, and cryosphere chemistry throughout the Holocene.

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PALEOCLIMATE AND PALEOENVIRONMENT RECONSTRUCTION IN THE BAY OF BENGAL, OFF THE CUDDALORE-NAGAPATTINAM STRETCH, USING FORAMINIFERA AS A PROXY

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Climate is one of the important factors controlling significant changes in civilizations. The gap in written records of climate variations prior to ~100-150 Years B.P. draws attention to indirect techniques, the proxies - sensitive to changes in the physicochemical characteristicsof the ambient environment with a good preservation potential. In the marine environment, foraminifera, an extremely sensitive and ubiquitous microorganism, is extensively used for inferring past climatic records and various seawater parameters. In the Indian Subcontinent,the Indian Summer Monsoon (ISM) is a major driving factor in climatic fluctuations. The Bay of Bengal, a repository of vast marine life resources, is a very sensitive water body andthe regulator of ISM and Tropical Cyclones in the majority of Southeast Asia. The dated and taxonomically identified foraminiferal samples as well as grab sediment samples shall be helpful in achieving the following objectives:

- Determination of past Sea Surface Temperatures (SSTs),
- Determination of paleo-monsoonal circulations and paleo-productivity trends,
- Bio-indicators of sea pollution.

The proposed research shall require sediment core collection from the Bay of Bengal, off the Cuddalore-Nagapattinam stretch, followed by disaggregation of sediments, concentration of tests, and picking of foraminifers. The study proposes isotopic dating of samples, detailed taxonomical study (classification), δ18O analysis (using Isotope Ratio Mass Spectrometer-IRMS) and major ions' analysis (using Inductively Coupled Plasma Atomic Emission Spectroscopy: ICP-AES). We intend on inferring productivity and hydrographic conditions based on the distribution pattern of foraminiferal species with depth. Foraminiferal assemblages and the percentage of deformed or abnormal tests (morphological abnormalities) shall be studied for pollution bio- indicators. Together with the Arabian Sea, the Bay of Bengal controls the precipitation patternfor most parts of the peninsular India; the lack in extensive records urges for a detailed reconstruction of past climate and monsoonal fluctuations in this sector, regarded as the "sinkof the Indian Summer Monsoon," serving as a key to model the future climatic changes.

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GONDWANATHERIAN MAMMALS FROM THE LATE CRETACEOUS OF INDIA: DIVERSITY AND PALAEOBIOGEOGRAPHIC IMPLICATIONS

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Gondwanatheria is a clade of extinct, highly derived, less diversified non-tribosphenic mammals restricted to the Gondwanan landmasses, whose distinctiveness is marked by the earliest development of hypsodont dentitions among mammals. These mammals have been documented from the rocks ranging in age from Late Cretaceous to Middle Eocene from all Gondwanan continents except Australia and New Zealand. The known fossil record of gondwanatherian mammals from India is poor and restricted to the Maastrichtian epoch only. Till date only three forms: *Bharattherium bonapartei*, Sudamercidae indet. and Gondwanatheria indet. have been described from the four sites associated with the Upper Cretaceous Deccan-volcano sediments exposed at Naskal and Bacharam in Telangana, Kisalpuri in Madhya Pradesh and Gokak in Karnataka. The phylogenetic analysis of the Indian Late Cretaceous gondwanatherian mammal, *Bharattherium*, shows close relationship with the Late Cretaceous Madagascan gondwanatherian*Lavanify* and to some extent with the South American form, *Sudamerica*. The broad geographic distribution of sudamericid mammals in the Maastrichtian of India, together with the inferred sister-group relationship with Madagascan forms, supports the cosmopolitan distribution of the group and further suggests some Late Cretaceous physical connections among the Gondwana landmasses. Alternatively, it can't be ruled out that the ancestral stock of gondwanatherian mammals had a pan-Gondwanan distribution prior to the fragmentation of Gondwana landmass and its presence in India is a result of vicariant event.

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INFLUENCE OF ANTARCTIC BOTTOM WATER IN THE WESTERN EQUATORIAL INDIAN OCEAN AT ODP SITE 709: STUDY FROM BENTHIC FORAMINIFERA

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The Earth's climate has seen significant fluctuations throughout the Cenozoic era, ranging from periods of widespread warmth with no ice to extreme colder conditions with the formation of permanent ice sheets in the poles. This increase or decrease of polar ice volumes can be inferred from studying the relative abundance and Oxygen isotope ($\delta^{18}O$) values of benthic foraminifera. In this study, population abundance of *Nuttallides umbonifera* and $\delta^{18}O$ values of *Cibicides* spp. from ODP site 709, have been used to better understand the timing of Antarctic Bottom Water (AABW) influence in the western equatorial Indian Ocean from 17 Ma to the Recent. A rise in $\delta^{18}O$ values after 14 Ma from 1.2 to 2.6 ‰ indicates the increasein ice volume in Antarctic region. Consequently, the population abundance of *N. umbonifera* also rises from 2 to 8 % after 14 Ma reflecting an increase in AABW influence at our site. Again after 7.5 Ma the $\delta^{18}O$ values show a small rise from 2.6 to 2.9 ‰ and abundance of *N.umbonifera* increases from 1 % to 15 % reflecting an increase in major AABW productiondue to glaciation. After 3.3 Ma both $\delta^{18}O$ values and *N.umbonifera* increased from 2.5 to 3.4 ‰ and 2 % to 23 % respectively at our site reflecting a major increase in Antarctic ice volumes. The population abundance of *N.umbonifera* along with Oxygen isotopic study can be used as a major proxy for glacial-interglacial cycles. During glacial periods the species is more often abundant due to the presence of nutrient-rich environment. Changes in the population abundance of *N.umbonifera* can also be linked to the dynamics of ice sheets, particularly the expansion and contraction of Antarctic ice sheets, which influence global sea levels and thermohaline circulation.

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RESOLVING STRATIGRAPHIC RIDDLE IN MESOPROTEROZOIC BASINS AT THE EASTERN MARGIN OF THE INDIAN CRATON

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Delimited by two regional-scale crustal discontinuities (viz. Pranhita–Godavari rift on south–southwest and Mahanadi rift on north–northeast) and the NNE–SSW trending mobile belt (viz. Eastern Ghats Mobile Belt (EGMB) on east–southeast),the Bastar craton of central India hosts a number of Meso- to Neoproterozoic basins of widely varying spatio-temporal framework. These include Chhattisgarh and adjoining basins, viz. Khariar, Ampani, Sabari (Sukma) and Indravati. Amongst these the Chhattisgarh basin is the largest one and remained in the center of debate regarding its stratigraphy and tectonics. In the early nineties of last century workers from the Geological Survey of India classified the Chhattisgarh Supergroup into three unconformity-bound Groups, namely, Singhora, Chandarpur and Raipur, in order of superposition. The idea was contested by workers from the Indian Statistical Institute (ISI), Kolkata. Denying the independent stratigraphic status for the Singhora Group and considering the Singhora and Chandarpur Group one and the same, ISI workers revised the stratigraphy as composed of Chandarpur and Raipur Group with addition of a new Group 'the Kahrsiya Group', as the youngest one in the Chhattisgarh lithopackage. From U-Pb detrital zircon geochronology, sediment geochemistry and collation of available data the present study re-establishes the independent stratigraphic status of the Singhora Group and proposes a four-tier lithostratigraphy for the Chhattisgarh Supergroup, namely, Singhora Group, Chadarpur Group, Raipur Group and Kharsiya Group. Despite inherent limitations in the detrital zircon geochronology as an age-connotative methodology, it can bea very useful tool for resolving stratigraphic status for fossil-less Precambrian sedimentary successions.

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REVISION OF THE AGE OF THE OLDEST PALYNOZONE OF TALCHIR FORMATION BASED ON GUIDE PALYNOMORPHS PRESENT IN RADIOMETRICALLY DATED PALYNOZONATIONS IN COEVAL PAN GONDWANA BASINS

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Palynostratigraphy of the Indian Gondwana sequence hitherto constrained the depositional age of the entire Talchir Formation to the Asselian. However, correlation of the oldest palynozone, *Potoniesporites neglectus* Zone with the recently updated radiometrically constrained palynozones across Gondwana significantly enhanced the revision of the age ofthis zone constraining it to the late Carboniferous. This corroborates with the age constraintsprovided by the Geological Survey of India. However, as the upper Paleozoic sequences inIndia have no independent radiometric dates, currently Indian palynozones are correlatedwith palynozones across Gondwana radiometrically constrained in the context of the globaltimescale. In this work we present the results of two boreholes from Wardha and Rajmahalbasins, wherein the basalmost assemblages from the Talchir Formation have been constrainedto the late Carboniferous by correlation with radiometrically constrained similar assemblages,while the overlying assemblages are constrained to the Cisuralian by correlation with palyno assemblages constrained by Permian fauna *Eurydesma*, absent in the olderassemblages. Thus correlation with radiometrcially constrained assemblages provides finerage constraints as most of the Carboniferous and Permian palynomorphs and plantmacrofossils are endemic to Gondwana, preventing their correlation with the International Time Scale which is calibrated based on fossils absent in Gondwanan biotas such as fusilinids, conodonts etc.

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DECODING THE SOUTHERN OCEAN'S PAST: SEA SURFACE TEMPERATURE AND SEA ICE EXTENTANALYSIS AROUND THE KERGUELEN PLATEAU

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The Southern Ocean is pivotal in global climate regulation, yet paleoceanographic and sea ice records from the Indian sector of this region remain sparse. The complexities of paleoceanography in this area are heightened by the presence of islands and plateaus, which disrupt the flow of the Antarctic Circumpolar Current.

Our study focuses on reconstructing past sea ice extent (SIE) and frontal positions, alongside their interactions with ocean circulation over the glacial interglacial cycles. This research offersan in-depth analysis of Sea Surface Temperature (SST) and SIE, utilizing diatom census data to provide key insights into the oceanographic history near the Kerguelen Plateau. Situated eastof the Kerguelen Plateau at 44˚40’ S, 80˚23’E, within the Indian Sector of the Southern Ocean,our sediment core analysis reveals SST variations between 5˚ and 12˚C. A notable warming phase occurs between 16 – 13 kyrs, contrasted with glacial periods where temperatures dropping to around 4˚C. Currently, the site temperature is recorded at 10.80˚C. The core analysis also indicates intermittent sea ice presence during Marine Isotope Stage 2 (MIS 2), with diatom abundance ranging from 60-80 x 10^6 valves/g of sediments. A comparative analysis with adjacent regions suggests that the Antarctic Polar Front migrated to the core siteduring 20 – 17 kyrs.

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LATE HOLOCENE ENVIRONMENTAL CHANGES AND HUMAN IMPACT IN THE VEMBANAD WETLAND: A PALAEOLIMNOLOGICAL STUDY FROM A RAMSAR SITE IN KERALA, INDIA

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A comprehensive multi-proxy analysis, including diatoms, palynofacies, and grain size distribution, was conducted on a 100 cm sediment core extracted from Arookutty within the Vembanad wetland, Kerala, India. This study aimed to reconstruct palaeolimnological changes during the late Holocene, focusing on distinguishing between natural and anthropogenic influences within this Ramsar-listed wetland. The analysis revealed four distinct depositional phases spanning from 513 BCE to 421 CE, which correlate with the Roman Warm Period (RWP). The earliest phase, from 513 BCE to 449 BCE, is characterized by a diverse assemblage of freshwater and marine planktic diatoms, which are accompanied by silicoflagellates and an abundance of terrestrial organic matter. The low presence of dinocysts during this period suggests a dynamic aquatic environment, potentially influenced by fluctuating salinity levels and varying contributions from both freshwater and marine sources. The subsequent phase, from 446 BCE to 353 BCE, is marked by a significant increase in sand content within the sediment, indicative of enhanced runoff and substantial terrestrial influx. This period also shows a continued presence of both freshwater and marine planktic diatoms, suggesting the persistence of a dynamic aquatic system. The elevated sand content, alongside palynofacies evidence, points to increased human activity in the region, possibly linked to agricultural practices or settlement expansion. The third phase, spanning 353 BCE to 27 CE, continues to exhibit high sand content, further supporting the presence of strong anthropogenic influences during this period. A notable rise in silicoflagellates during this phase suggests that rising sea levels and intensified monsoonal precipitation played a significant role in shaping the environmental conditions. This phase highlights the complex interplay between natural climatic variations and human-induced changes in the landscape. The final phase, from 27 CE to 421 CE, initially shows a shift towards finer sediments, with a decrease in sand content and an increase in mud, which is indicative of a weakening southwest monsoon. This shift is likely linked to variations in solar cycles, which could have influenced the regional climate. However, from 299 CE to 421 CE, the sand content rises once again, accompanied by a significant influx of terrestrial material and an increase in dinocysts. During this period, silicoflagellates completely disappear from the record, suggesting a decline in marine influence. Despite the overall dominance of the RWP, this coastal region experienced an extended period of reduced monsoonal activity, highlighting the variability in climatic conditions during this time.

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EVOLUTION OF UPPER WATER COLUMN STRUCTURE IN THE EQUATORIAL EASTERN INDIANOCEAN DURING THE LATE DEGLACIAL-MIDDLE HOLOCENE: POSSIBLE LINK WITH IOD-LIKE MEAN STATE, ITF VARIABILITY AND INDIAN MONSOON

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The equatorial eastern Indian Ocean (EEIO), as part of the Indo-Pacific Warm Pool (IPWP), influences regional and global climate patterns over various time scales. Understanding the historical variability of the IPWP, including interactions between theIndonesian throughflow (ITF), the Indian Ocean Dipole (IOD), the Indo-Australian Monsoon,and other climatic factors, is crucial. The IOD mode is thought to be driven by seasonal shiftsin the Australian-Indonesian monsoonal (AIM) winds, specifically the south-easterly (SE) and north-westerly (NW) monsoonal winds. However, the relationship between the IOD, ITF, andthe Indian monsoon on a sub-centennial to millennial-scale remains underexplored. This study presents a sub-centennial scale record of upper water-column structure andproductivity changes in the EEIO during 4.7-13 ka, based on the planktic foraminiferal assemblage and stable oxygen isotope records in two deep-sea sediment cores collected from offshore Sumatra (8.40° S, 98.00° E; 3440m water depth) and the southern tip of India (6.37° N, 77.8°E; 2638m water depth). We reconstructed past surface hydrography and productivity by analysing temporal variations in the abundance of ecologically sensitive, symbiont-barren,and symbiont-bearing planktic foraminifera, as well as oxygen isotope records from *Globigerinoides ruber* (surface species) and *Pulleniatina obliquiloculata* (thermocline species). To assess the IOD-like mean state, our TEIO proxy data were compared with published Indian summer monsoon (ISM) records from the western Arabian Sea (WAS). Our findings reveal periods of weakly stratified surface waters, reduced freshening, thermocline shoaling, and enhanced upwelling at 12-9.2 ka, 8.0-7.3 ka, 6.4-5.6 ka, and 5.2-4.7ka, likely driven by intensified SE monsoonal winds in the TEIO, which were in phase with increased upwelling in the WAS, indicating a positive IOD-like mean state. In contrast, strongly stratified surface waters, increased freshening, and deeper thermocline depths at 13- 12 ka, 9.2-8.0 ka, 7.3-6.4 ka, and 5.6-5.2 ka, likely due to intensified NW monsoonal winds, correspond to periods of weakened ISM winds, suggesting a negative IOD-like mean state. This study illustrates how Holocene variations in the IOD-like mean state, ITF variability andISM intensity were influenced by alternating periods of thermocline shoaling and deepening inthe EEIO, driven by changes in upwelling and salinity stratification.

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HOLOCENE VEGETATION-DYNAMICS AND SEA-LEVEL FLUCTUATIONS IN NORTHERN KERALA: - INSIGHTS FROM TERRESTRIAL MULTIPROXY RECORDS

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This study aims to reconstruct the past vegetation dynamics and sea level fluctuations between 8200 and 2400 cal yr BP along the Southwest coast of India. Based on the sedimentological, palynological, and micropaleontological data of a 3.34 m sediment core from Dharmadom wetland in northern Kerala, 5 distinct climatic zones were delineated. Zone 1 (8200 to 6600 cal yr BP) marks a sharp shift from a humid to an arid climate with increased marine palynomorphs such as dinoflagellate cysts and back mangroves with low arboreal and non-arboreal pollen, coinciding with the globally recorded 8.2 ka aridity event. This period also shows a gradual intensification of the monsoon after 7800 cal yr BP, evidenced by a high influx of coarser particles and terrestrial pollen along with the marine palynomorphs such as mangrove pollen, dinoflagellate cysts, and foraminiferal linings. Zone 2 (6600 to 5400 cal yr BP) is marked by decreased terrestrial pollen input and reduced riverine transport of coarser sediments, suggesting a weakened monsoon condition followed by an increase in moisture index and detrital sediments as well as terrestrial pollen input post 6000 cal yr BP, indicating a gradual rise in monsoonal strength. Zone 3 (5400 to 4350 cal yr BP) observed an increased abundance of arboreal and non-arboreal pollen, revealing strengthened monsoon conditions interspersed by short intervals of weakening of monsoon. Zones 2 and 3 also correspond with a sea level fall, evidenced by low mangrove pollen abundance. Zone 4 (4350 to 2700 cal yr BP) reflects a period of decreasing monsoonal activity and fluctuating sea level marked by dominance of back mangroves pollen along with a decrease in terrestrial pollen and sand content. A notable dip in the monsoon strength around 4200 cal yr BP aligns with the globally recorded 4.2 ka aridity event. Finally, Zone 5 (2700 to 2400 cal yr BP) shows a highly fluctuating climate and sea levels. Our findings suggest that the study site was once a paleo-estuary, experiencing multiple episodes of sea-level change before transitioning into a wetland as the coastline receded approximately 0.5 km.

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EVALUATION OF DIATOMS RESPONSE TO WATER QUALITY CHANGE IN TROPICAL LAKES OFCHANDRAPUR DISTRICT, INDIA USING PRINCIPAL COMPONENT ANALYSIS (PCA)

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Lakes are proved to be excellent archives for characterizing their trophic statusand various sources of nutrients around them using various proxies such as diatoms, phytoliths, sediment chemistry etc. Diatoms play a very vital role in assessing the environmental parameters owing to their sensitivity changes in water quality. The Chandrapur District of the Maharashtra state, India consists of several industries like paper mill, cement factories, thermal power plants, coal and limestone mines etc., which affects water quality differently in respective localities. Therefore, the present work has undertaken the study of environmental and water quality assessment ofsome of the selected lakes (Amalnala, Anuradha, Bamni, Jogapur, Junona, and Naleshwar lakes) of the Chandrapur district. The results of the physicochemical study of these lakes were compared with the more prevalent diatom species to prepare the diatom inferred water quality database. The nitrogen and phosphorous are the limitingnutrients for the growth of diatoms along with the availability of the silica. The total phosphorous (TP) content in Anuradha (*Achnanthidium minutissimum, Eunotia bilunaris, Discostella stelligera, Cyclotella meneghiniana, Aulacoseira granulata)* and Amalnala lake (*Gomphonema angustatum, Ulneria ulna, Achnanthidium minutissimum*) indicate eutrophic status. Similarly, TP concentrations in Bamni (*Gomphonema angustatum, Achnanthidium minutissimum, Ulneria ulna, Cyclotella meneghiniana),* Jogapur (*Achnanthidium minutissimum, Diadesmis* sp., *Cyclotella meneghiniana*), Junona (*Gomphonema angustatum, Achnanthidium minutissimum, Ulneria ulna, Cyclotella meneghiniana, Aulacoseira granulata*) and Naleshwar Lake (*Aulacoseira granulata, Achnanthidium minutissimum*) indicate moderately eutrophic conditions. All the lakes under study show highly alkaline nature (pH >10) except the Naleshwar Lake (pH 7.2). Extremely high EC was noted in Anuradha Lake, while moderate EC was observed in Amalnala and Bamni Lakes and low EC in Jogapur andJunonan Lakes. The extremely high level of EC could be attributable to the higher concentrations of organic matter and dissolved salts/charged chemicals. The Principal Component Analysis (PCA) revealed the dominance of *Aulacoseira granulata, Achnanthidium minutissimum, Eunotia bilunaris* and *Discostella stelligera* indicating The Amalnala Lake and Bamni Lake have been mainly dominated by the distribution of *Gomphonema angustatum* and *Ulneria ulna* while *Discostella stelligera* and *Cyclotella meneghiniana* were dominated in Jogapur Lake indicating its water quality.

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ASSESSING PALEOMONSOONAL VARIABILITY FOR THE LAST 80KYR THROUGH PLANKTIC FORAMINIFERAL EVIDENCES IN THE ANDAMAN SEAREGION

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The wide distribution of planktic foraminiferal assemblages in deep sea sediment cores help in to understand the plaeoclimatic and paleoceanographic conditions as their distribution largely controlled by the temperature, salinity, nutrients and trophic conditions. The test of foraminifers nicely preserves the long term paleomonsoon intricacies. The Andaman Sea is shallow sea connected to the Bay of Bengal through three channels, viz., the Great Passage in thesouth, the Ten-degree channel in the center, and the Preparis channel in the north. The distinctivefeature of the Andaman Sea water masses is the seasonal variations in river water discharging, which dilutes the surface ocean water. In the present study, a detailed census count data is done for planktic foraminifera from the core SK 234-60 raised from the Andaman Sea. Around 35 species of planktic foraminifers are reported from the studied site. They are clubbed into Mixed Layer Dwelling (MLD) species, Thermocline dweller species (TDS), Upwelling Indicator species (UIS), productivity etc. In the last 80kyr, nearly 7 contrasting events of low and high % UIS at 2-6 kyr, 11kyr, 20kyr, 33kyr, and 8kyr, 50kyr, 54kyr, 75 kyr respectively. The productive indicator *N. dutertrei* species higher population abundance suggest strengthening of the Indian monsoon in the region as the amount of freshwater debouching into the Andaman sea made itlow in salinity in recent times.

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OSTRACOD BIOSTRATIGRAPHY AND PALAEOENVIRONMENT OF THE SUBATHU GROUP OF JAMMU REGION, NW HIMALAYA: INFERENCES ON THE PALAEOBIOGEOGRAPHY AND INDO-EURASIA COLLISION

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Ostracods which are also known as seed shrimp are important in determining the relative dating and correlation (biostratigraphy) as well as palaeoenvironmental and palaeoclimatic proxies as it is found in all aquatic environment. They are found from the early Ordovician to the present. Subathu Formation in the Northwest Himalaya received much attention for its molluscan and formaniferal fauna as compared to ostracods although they are important microfossil group. Ostracods possess most complete fossil record among the arthropods. Their rapid evolutionary rates and broad geographic distribution make ostracods valuable for biostratigraphy. By investigating the ostracods assemblages in the sediments shows the researchers to rebuild the ancient ecosystems and the changes in the environmental conditions. It helps in the biozonation of the marine strata and provides the valuable information about the palaeoenvironmental conditions. A preliminary work records 5 species from the middle Subathu Formation of Jammu region in the present study viz. *Bythocypris biswasi (Bhandari), Bythocypris sp., Bythocypris westi Singh and Tewari, Cushmanidea tewarii Khosla, Cytherella jaisalmerensis Bhandari* of Eocene age. These species and other further ongoing findings will help to decipher the biostratigraphy, depositional paleoenvironment which in turn will have inferences on the tectonic implication on the Indo-Eurasia collision.

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VINDHYAN - GANGA BASIN - LESSER HIMALAYA CONNECTION: TERMINAL NEOPROTEROZOIC - EARLY CAMBRIAN PALEOGEOGRAPHY AND PROVEN HYDROCARBON POTENTIAL OF THE GREAT VINDHYAN BASIN OF INDIA

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The historical micropaleontological discovery of the 'Cambro-Ordovician conodonts' from the Lower Tal phosphorites of Mussoorie Syncline by the author (Azmi et al., 1981) proved to be an important breakthrough in the Lesser Himalayan stratigraphy as it was soon realized that the assemblage belongs to the multiphyletic earliest Cambrian small skeletal/shelly fossils (SSFs) related to the global 'Cambrian Explosion' event and are useful in the Precambrian - Cambrian Boundary delineation. Another important consequence of the discovery was that it pushed the entire Lesser Himalayan succession below the Tal Formation into the Precambrian, thus founding the correlation of hitherto 'Permo-Carboniferous glacial 'Blaini Boulder Bed' with the global Terminal Neoproterozoic glaciation of *Marinoan* age (~650 - 530 Ma), often known as the period of *'Snowball Earth'* whose imprints are nearly present on all the continents. Evidently, these new developments brought the Lesser Himalayan Krol Belt succession closer to the Vindhyan Basin succession attesting the strong belief of Auden (1937) who had even coined the term *'Peninsular Himalaya'* for most of the *'Lower Himalaya'* as prolongation of the Indian Peninsular shield. A Very initial attempt in the Vindhyan was positive with the discovery of the Lower Cambrian SSFs from the upper part of the Lower Vindhyan Rohtasgarh Limestone of the Son Valley (Azmi, 1998). Subsequently, in quick succession, abundant SSFs were recovered from a number of sections of 'Rohtasgarh Limestone and Shale' spread over almost the entire length in the southern limb of the eastern Son Valley Syncline, especially the Jankikund Section of Chitrakoot of the northern limb, which proved to be of global significance where profusely algal laminated phosphatic Tirohan Dolomite (= Rohtasgarh Limestone) had yielded the Precambrian - Cambrian Boundary SSF assemblage of a far greater diversity with amazing preservation of phosphatized fossil embryos. These results thus laid a firm chronostratigraphic foundation for correlating the Vindhyan Supergroup and the Lesser Himalayan Blaini-Krol-Tal succession (Mussoorie Group) of the Krol Belt. Noteworthy is that both Vindhyan and Krol Belt platformal sequences were deposited over a highly deformed basement of low grade metamorphics of 1600-1800 Ma with a hiatus of > 1 Billion-Year (possibly related to the 'Boring Billion' period of the Earth's history). Significantly, our stratigraphic correlation scheme in the Lesser Himalaya (Azmi and Paul, 2004, modified after Valdiya, 1995) had also shown the existence of a big hiatus of more than 1 Billion-Year throughout in the Krol Belt and the 'Inner Carbonate Belt' of the western Lesser Himalaya and Nepal. Interestingly, both (Vindhyan and Lesser Himalaya) sequences also have common global datum markers beginning with the Terminal Neoproterozoic *Marinoan Glaciation (*650 Ma) at their base, successive appearances of Ediacaran type soft-bodied metazoan fossils, even the 'true Jellyfish', algae and organic walled microfossils (630 Ma) and mineralized small

skeletal or shelly fossils (SSFs) in abundance at or near the Precambrian - Cambrian Boundary (542 Ma). These form our main bases of the Lesser Himalaya - Vindhyan correlation. In addition, mesoscopic chancelloriid spicules, small brachiopods, gastropods and megascopic trilobites and their traces are seldom recorded in the later Early Cambrian strata of the Tal Formation, but remain unrecorded so far from the Upper Vindhyan strata of the Vindhyan Basin.

In a nutshell, the Terminal Neoproterozoic - Early Cambrian shallow platformal carbonate dominated argillo-arenaceous sequences which cover quite a vast area of the Vindhyan Basin (including the Trans-Aravalli Vindhyan Basin), Subsurface Punjab-Ganga Basin and their northern extensions in the Lesser Himalaya comprising contiguous basins of the Krol Belt (Outer Carbonate Belt) and the Sirban-Shali-Deoban-Gangolihat Belt (Inner Carbonate Belt) located between the tectonic frame of the MBT and MCT Zone, together make a huge composite basin of a very great dimension, which I call as the 'Great Vindhyan Basin' of the northern Indian Peninsula. This basin is bounded *below* by a > 1 Billion-Year Hiatus caused by the late Paleoproterozoic orogenic uplift (~1800 Ma) of the Satpura-Aravalli-Delhi Folded Mountains and bounded *above* by another big hiatus at ~500 Ma due to the Pan African Orogenic upheaval of the Indian Shield that resulted complete cessation of the marine sedimentation in the Great Vindhyan Basin of India.

Taking cue from the recent commercial gas discoveries from the Lower Vindhyan of Son Valley in Nohta Wells of Damoh (MP) by the ONGC, thick oil recovery in the Baghewala Well-1 by OIL in Bikaner-Nagaur Basin (Trans-Aravalli Vindhyan) in western Rajasthan (Peters et al., 1995) and from across the adjacent border in Karampur Well-1 of Punjab Platform in Pakistan, and also the age-old continuous gas flares in the Jwalamukhi Temple of Kangra (HP) with its historical record of at least 500 years, and some oil seepages in Inner Carbonate Belt of Shali in Mandi, HP and in western Nepal, are some of the glaring testimonies which indicate *Great Vindhyan Basin* has good potential for exploration of the 'Infracambrian – Cambrian Oil' in the Northern Indian Peninsula. Incidentally, the 'Infracambrian-Cambrian Oil Window' happens to be the oldest commercial oil windows of the world.

Readers, especially those who believe in the late Paleoproterozoic age for the Lower Vindhyan, may find the following statements also interesting which substantiate our view for a much younger age of the Vindhyan Supergroup of India:

Geochronologist Wolfgang Frank's reiteration in ***Science*** (April 1999, p. 412) about his 617 ± 3.5 Ma Ar-Ar age of the Lower Vindhyan Porcellanite (*in* Banerjee and Frank, 1999): "*All these samples gave consistent ages close to 620 million years"*. He further states, "*I am absolutely confident we can reject the very old age of 1.1 billion years".* His statement is further substantiated by a later study of Paikaray et al. (2008): *"Northwesterly paleocurrent data reported by earlier researchers and the present geochemical examination of the Son valley shales suggest that the sediments were sourced by the Paleoproterozoic metasediments and gneisses located beyond the southern basin margin of the Vindhyan outcrops".* Their conclusion is fully justified by following evidence of almost two identical radiometric dates of 1631 Ma from two contrasting domains: The zircon date of the Lower Vindhyan Porcellanite, (1631 ± 5Ma, Ray et al.,2002) was possibly sourced from the Chandil Rhyolite (1631 ± 6 Ma, Nelson et al., 2007) of Dalma Volcanic Province of the Singhbhum Mobile Belt.

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STRONG SEASONALITY IN THE FORAMINIFERAL ABUNDANCE IN TROPICAL MUDFLATS

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Mudflats are formed from the deposition of estuarine silt, clay, and organic detritus. Mudflats along with intertidal salt marshes and mangrove forests support a wide biodiversity. The abundance and distribution of benthic organisms in the mudflats is controlled by a multitude of processes. We have assessed the monthly (pre-monsoon, monsoon, post-monsoon) variation in the benthic foraminiferal abundance and diversity in two tropical mudflats, namely Panjim and Cortalim on the banks of the Mandovi and Zuari estuaries. The monthly variations in the foraminiferal distribution were compared with ambient water and sedimentary parameters. The salinity in the Cortalim mudflat was comparatively higher as compared to the Panjim mudflat, throughout the year. A decline in the salinity and pH was observed during the monsoon season in both the mudflats. Silt dominated the sediments in both the mudflats. In Panjim mudflat, sand fraction was more than clay and in Cortalim mudflat clay fraction was more than sand. Cortalim mudflat sediments had higher organic carbon (C_{org}) during the monsoon season as compared to pre- and post-monsoon seasons. However, C_{org} peaked during the post monsoon season in the Panjim mudflat sediments. In both the mudflats a diverging trend was also observed in calcium carbonate ($CaCO_3$). Panjim mudflat sediments had lower $CaCO_3$ during the pre-monsoon season and it increased during monsoon season. However, $CaCO_3$ gradually increased during pre-monsoon season in the Cortalim mudflat sediments, and decreased during the monsoon and post-monsoon seasons. Total living and dead benthic foraminiferal abundance was higher in the Cortalim mudflat. The benthic foraminiferal abundance decreased during the monsoon as compared to the pre- and post monsoon seasons. The relative abundance of calcareous benthic foraminifera decreased during the monsoon season in both the mudflats. The relative abundance of agglutinated foraminifera peaked during the monsoon season in both the mudflats. the relative abundance of rounded living benthic foraminifera was higher as compared to angular living benthic foraminifera during monsoon season in both the mudflats. The absolute abundance of broken benthic foraminifera was higher in Cortalim mudflat. The abundance of broken benthic foraminifera decreased during monsoon season in both the mudflats. Thus the seasonality in the benthic foraminiferal abundance in the Panjim and Cortalim mudflat is strongly influenced by the monsoon driven changes in ambient water and sedimentary parameters.

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LATE NEOGENE–QUATERNARY PLANKTIC FORAMINIFERAL BIOSTRATIGRAPHY AND BIOCHRONOLOGY OF IODP HOLE U1474A: AGULHAS CURRENT REGION

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Planktic foraminifera are microscopic marine organisms that inhabit oceanic waters and are subject to a range of atmospheric and environmental stresses. Due to their rapid evolutionary rates, they serve as crucial index fossils for the Cenozoic Era. Their widespread distribution, independent of depositional facies, combined with their small size, high abundance, diversity, relatively continuous presence in stratigraphic records, and significant latitudinal provincialism, make them particularly advantageous for biostratigraphic studies compared to other fossil groups.

The material investigated in the present study was acquired from the IODP Hole U-1474A. This site was drilled in the northernmost Natal Valley (31°13.00'S; 31°32.71'E), where the sediment dispersal is strongly affected by the Agulhas Current (AC). The site lies under the direct influence of AC and is located ~40 South of the latitude where the current gets fully constituted . The core obtained from IODP Hole U1474A comprises an undisturbed sedimentary sequence of ~200 m, consisting of well-preserved planktic foraminiferal assemblage . The location of the hole, along with the well-preserved fauna makes it an ideal site to examine the changes in the AC and the variations in the faunal, as well as the climate caused by those changes. We studied 700 deep sea samples from the core acquired from the IODP Hole U1474A, spanning the Late Neogene-Quaternary periods. The detailed qualitative and quantitative analysis showed that tropical-subtropical forms dominate this site, but there are intervals which consistently show a very high abundance of temperate and subpolar forms as well. The biozonation for this region, therefore, could not be completely based on either the tropical or the temperate schemes. On the basis of a detailed qualitative analysis of planktic foraminifera from IODP Hole U1474A, we have subdivided the Late Neogene–Quaternary section into eight zones, comprising of the biozones from the tropical-subtropical scheme for the Quaternary, while biozones from the temperate scheme for the Late Neogene.

The sequential order of planktic foraminiferal events (FO and LO) has been determined, and 42 events spanning the Late Neogene-Quaternary have been identified. There are 28 events marked for the Late Neogene and 14 events for the Quaternary. The numerical age estimates of the events were made by integration with the polarity zone boundaries estimated during the shipboard studies.

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ARABIAN SEA DENITRIFICATION CONTRIBUTED TO THE GLOBAL N_2O FLUX

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Nitrous oxide (N2O) is a significant greenhouse gas where, nearly 40% of its atmospheric concentration attributed to Oceanic denitrification - a process that results in the loss of N2O from the Oceans. Oceanic regions like the eastern Pacific Ocean and the Arabian Sea experience denitrification due to the presence of strong oxygen minimum zone. To understand the contribution of the Arabian Sea to global N2O flux, we reconstructed denitrification history the southeastern Arabian Sea. We analyzed nitrogen isotopes ($\delta^{15}N$) and total nitrogen (TN) in bulk sediments from the marine sediment core SSD004 GC11 (6.0000°N, 78.9312°E; 2901 m).The core's chronology was established using ^{14}C dating and $\delta^{18}O$ tie-points from *G. ruber* records, aligned with the LR04 isotopic stack, covering the last 175 kyr. Our findings show a strong coupling between $\delta^{15}N$ and atmospheric N2O concentrations over the last two glacial- interglacial cycles where, higher $\delta^{15}N$ values during interglacial indicate enhanced denitrification driven by high primary productivity. We also made use of previously published data from the Arabian Sea to assess the regional contribution to global N2O flux. The synthesis strongly corroborates the notion that same physical processes governed the entire Arabian Sea basin during the last two interglacial cycles. Our study suggests that the intensive denitrificationin the Arabian Sea during inter-glacial resulted in significant N2O loss, thereby contributing substantially to atmospheric N2O concentrations.

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APPLICATION OF STATISTICS IN FORAMINIFERA CENSUS DATA TO INFER PALEOCEANOGRAPHIC AND PALEOCLIMATIC CHANGES

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Foraminifera are ranked as the most powerful biological tools to reconstruct paleoceanographic and paleoclimatic variability due to their widespread occurrences, numerical abundance and high fossilization potential. However, most regions have more species belonging to different genera and families, based on their latitudinal positions, depth and environmental conditions. Hence, it is important to reduce the dimensionality of quantitative foraminiferal census data and to group into a set of species based on their statistical similarity to deduce paleoclimatic and paleoceanographic information. A multivariate statistical technique like Q-mode cluster analysis is used to group 284 samples into 3 groups based on the occurrence of benthic foraminifera. Out of 218 species 22 dominant benthic foraminifera species are grouped into 3 associations using R-mode factor analysis. Based on the coherent results of factor and cluster analysis we got 3 associations considered as biofacies, which suggest inflow of the Tsushima Warm Current (TWC) via the southern strait began after 1700 kyr and marked a major change in the productivity regime of the Japan Sea during the Pleistocene. Further, principal component analysis (PCA) followed by groupings of variables like biofacies, diversity patterns and other parameters using k- means clustering suggest relations among these variables that allow assessment of the processes. PCA and k-means clustering applied on the diversified microfossil data suggest TWC and East Asian Monsoon are responsible for variability in the Japan Sea surface productivity during the last 400 kyr. The Q-mode cluster analysis on the 9 most abundant species of planktic foraminifera of the East China Sea (ECS) is used to reconstruct temporal variations in ECS water characteristics and strengths of Kuroshio Current variability in the last 400 kyr. These results suggest that statistical applications on foraminiferal census data ease the interpretation even though the data are random and massive.

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PALYNOMORPHS & PALYNOFACIES ANALYSIS AND THEIR IMPLICATIONS TO PALAEOENVIRONMENT AND PALAEODEPOSITIONAL SETTINGS OF THE LATE TITHONIAN (JURASSIC) SUCCESSION OF THE JAISALMER BASIN, INDIA

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The current study aims to offer insights into the palaeoenvironmental and palaeodepositional conditions of the Late Tithonian succession exposed in Bhadasar Ridge Section of the Bhadasar Formation on the basis of palynofacies and palynological analysis. The palynofacies analysis allows the categorization of the studied succession of the Bhadasar Ridge Section into two distinct assemblages namely Palynofacies Assemblage - I (PA–I) and Palynofacies Assemblage - II (PA–II). PA-I and PA-II respectively correspond to the marginal oxic to dysoxic basin and the shelf to marginal transition. The palynomorphs study reveals the presence of various pollen genera such as *Araucariacites, Callialasporites, Classopollis*, *Microcachryidites*, *Podocarpidites*, *Ginkgoretectina, Monosulcites* and *Todisporites*. The prevalence of conifer pollens (*Araucariacites* and *Callialasporites*) represents a coastal vegetation and warm climate. However, the presence of some non-striate bisaccate pollen (*Podocarpidites*) indicates drier upland areas.

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PTEROPODS IN PALAEOCLIMATIC AND PALEOCEANOGRAPHIC STUDIES

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Pteropods constitute a major marine microfossil group, reported to have been existence since about 72 million years ago. Their abundances and preservation have varied through-out the stratigraphic records making them useful palaeoclimatic and palaeoceanographic indicators. Also known as marine butterflies, they are holoplanktonic gastropods, which secrete aragonitic shells. Pteropod shells contribute to at least 33% to export of $CaCO_3$ to shelf sediments and up to 89% to pelagic calcification and thus have been recognised to play an important role not only in the carbonate biogeochemical cycling but also in the marine ecosystem. However, because of the metastable chemistry of their shells, upon the death of the organism, the shells dissolve as much shallower depths, than those of calcitic foraminifera. Thus, they are being recognised as a group much more sensitive to changes in the surface ocean, that other widely studied groups. Additionally, their fragile shells are incapable of being transported without being broken, making them good biostratigraphic indices too!

In recent times, pteropod studies have gained impetus for their utility in understanding the impacts of increased carbon-di-oxide emissions on the ocean chemistry, especially pH. Whilst, biological studies give insights into their calcification rates and mechanisms as well as life cycles, which have cascading effects throughout the marine food-web, an understanding of their aragonitic calcification in the open ocean, its dissolution in the water column and burial / accumulation in ocean basins are of interest to geologists. For long, pteropod shells in sediments and their state of preservation have been used to draw inferences regarding past temperatures, sea levels, strengths and depths of Oxygen Minimum Zones, hydrography, productivity and monsoons. Plankton tow data, sediment trap data and new data on the distribution of pteropods from the different parts of the world oceans have helped recalibrate past inferences.

Recent taxonomic studies on pteropod distribution in the water column, surface and subsurface sediments of the oceans suggest that the distribution of shells in sediments and their state of preservation could be a product of post-mortem changes in the water column or interstitial pore waters. Thus, the presence or absence of pteropod shells in sediments does not essentially represent the climatic / hydrographic changes during their life-time or shortly after their death and thus could lead to erroneous interpretations. Instead, the relative abundances of different taxa in sedimentary records point to the extreme sensitivity and capability of pteropods in indicating hydrographic and climatic changes, in a distinct manner. Taxonomic descriptions of pteropods from ocean sediments coupled with an understanding of their modern water column distributions make this group a potent palaeoclimatic-palaeoceanographic proxy.

Whilst they remain susceptible to dissolution, it is difficult to reliably employ them for generating geochemical data. Additionally, lack of trained taxonomists in pteropods has led to a deluge of pteropod data (backed with no illustrations and taxonomic authorities) and manipulated inferences trained to match foraminiferal signatures, to validate them as proxies. However, it is a must to remember that though foraminifera and pteropods, both are calcareous microfauna, inherently they have different ecological niches and calcifying systems (calcite and aragonite, respectively, both of which have completely different saturation depths)! Thus, their palaeoclimatic signatures must be read distinctly!

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HOW THE DEAD CAN TELL TALES? SAGA OF 'VARUNA MODEL'

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Reconstruction of past-sea surface temperature (SST) has been considered a vital component for understanding past climate dynamics and monsoon variability. A precise evaluation of themagnitude and timing of SST variability are therefore crucial for the assessment of general circulation models (GCM). Given the importance of tropics in modulating the global climate, pastSST records from Arabian Sea will enable us to understand Indian monsoon in the context of global climate change. Today, the availability of large modern calibration datasets combined withenvironmental parameters from satellites, buoys and floats have facilitated the development of Machine Learning models for precise SST estimation from microfossil assemblages. Applicationof Machine Learning (ML) models for predicting environmental parameters have gained tremendous popularity owing to their robustness in handling large complicated data. However, an in-depth study of current and advanced ML models for paleoceanographic studies, including theiroperation, implementation, and performance is currently lacking. This study provides a detailed overview of the state-of-the-art application of machine learning (ML) algorithms for estimation of SST from planktic foraminifera abundance data. This study aimed at evaluating the capabilities offive (5) advanced planktic foraminifera-based benchmark ML models for estimating the SST during Pleistocene in the eastern Arabian Sea and comparison of their performances.

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MARINE BIOGENIC GEOCHEMICAL PROXIES IN PALEOCEANOGRAPHY AND PALEOCLIMATE

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The excessive use of fossil fuels has led to a significant increase in greenhouse gas levels in the atmosphere, reaching unprecedented levels compared to the past. This rapid increase in greenhouse gases has caused the Earth to warm and has led to a decrease in the ocean's pH, along with other impacts. Understanding the climate and oceanographic conditions during similar historical situations can help us properly assess the effects of greenhouse gases. Earth has experienced various periods of fluctuating greenhouse gas levels. Therefore, studying past climate and ocean conditions during similar periods helps us to understand the transient and equilibrium climate sensitivity. Both marine and terrestrial records are used to reconstruct past climates. Micropaleontological, geochemical, and sedimentological proxies are commonly utilized in these paleoclimatic studies. Interestingly, the changes in temperature, runoff, pH, and other parameters can be reconstructed using the stable isotopic and elemental composition of marine microfossils. The biogenic stable oxygen isotopic ratio is influenced by ambient temperature, isotopic composition of seawater and carbonate ions in seawater. Meanwhile, the ambient temperature strongly affects the Magnesium/Calcium ratio, and runoff influences the Barium/Calcium ratio of marine biogenic calcite. Although the main factors affecting the isotopic and elemental ratio of biogenic carbonates are similar across oceans, the regional variation in the extent of these factors must be assessed in different parts of the world's oceans. This talk will cover the research conducted to understand the factors affecting the stable isotopic and elemental ratios of marine microfossils (foraminifera) in the Indian Ocean.

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SPATIAL AND TEMPORAL VARIABILITY OF DISTRIBUTION OF DIATOMS AND WATER QUALITY INDEX FROMSAMUTHIRAM LAKE, SALEM DISTRICT, TAMIL NADU, INDIA

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The study of macrophytes and water samples from Samuthiram Lake in Salem District, Tamil Nadu, reveals significant insights into the ecological health and water quality of the area.The analysis incorporates diatom distribution, environmental impact assessments, and water quality indices, providing a comprehensive understanding of the aquatic ecosystem. The sampleswere collected at seven distinct locations within Samuthiram Lake during the winter and summerseasons of November 2023 and March 2024 respectively. The present study indicates thatseasonal changes significantly affect various environmental parameters and biological activities. A total of 30 diatom taxa have been recorded in the study area. Among them, the diatom genera of *Anomoeoneis, Cyclotella, Nitzschia, Gomphonema, Sellaphora, Craticula* and *Tryblionella*were abundant during both winter and summer seasons. The analysis of the water quality index (WQI) were recorded indicated value range spanning from 30 to 51, thereby suggesting thepresence of mesotrophic and eutrophic conditions during the both seasons. The WQI values of 51 was recorded in summer season with dominant presence of diatom taxa *Anomoeoneis sphaerophora, Craticula vixnegligenda, Nitzschia obtusa* and *Tryblionella apiculata* indicating mesotrophic water conditions at the inlet of the lake. While the outlet of the lake displayed the values range from 46-49 with the dominant presence of pollution tolerant diatom taxa such as *Craticula ambigua, C. cuspidate, Cyclotella meneghiniana, Gomphonema exilissium, Nitzschia palea, Sellaphora pupula* and *Tryblionella hungarica* suggesting eutrophic water conditions. Thepollution in the lake may be due to the merger of industrial wastages, anthropogenic activities and stagnant water conditions.

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EARLY CRETACEOUS (LOWER-APTIAN) RADIOLARIAN CHERT FROM SHYOK SUTURE ZONE (SSZ) OFNUBRA-SHYOK VALLEY, NW LADAKH TRANS-HIMALAYA: AN ACCRETED REMNANT BACK-ARC BASIN

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An ophiolitic mélange exposed along the Shyok River in the NW part of the Shyok Suture Zone (SSZ) was studied to obtain micropaleontological and geochemical data from blocks of radiolarian chert and to enable a better understanding of age and nature of this mélange. The mélange includes blocks of ultramafic rocks, gabbro, basalts, pillow lavas and radiolarian chert. Detailed petrological & micropalaeontological investigation of cherts shows the presence of Early Cretaceous (Lower-Aptian) radiolarians. Geochemical analysis of radiolarian bearing chert indicates its high $SiO_2/(SiO_2+Al_2O_3+Fe_2O_3)$, Ce/Ce*, La_N/Ce_N ratios. Fe-Al-Mn ternary diagram shows that these biogenic sediments were deposited far away from any hydrothermal source such as an active spreading ridge. On the basis of the overall major elements and their relationships to other lithologies we conclude that these Early Cretaceous radiolarite block is derived from the sedimentary succession, developed upon Meso-Tethyan Oceanic (MTO) crust representing an accreted remnant back-arc basin. The presence of Lower-Aptian radiolarian assemblages indicate that the final closure of Shyok back-arc basin likely occurred no earlier than the Early Cretaceous.

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BENTHIC FORAMINIFERAL ASSEMBLAGES AND GRANULOMETRIC ANALYSIS OF COASTALSEDIMENTS OF GULF OF MANNAR

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The study investigates the characteristics of benthic foraminiferal assemblages and Granulometric analysis of coastal sediments from the Gulf of Mannar Marine Biosphere Reserve, Southeastern India. A total of 243 sediment samples were collected from pre-, syn, and post-monsoon seasons to plot the environmental scenario of the specified niche. The collected samples were associated with coral reefs, mangroves, seagrass beds, and macroalgalmats. Textural analysis was carried out using a Laser Particle Size Analyser and identified textural characteristics such as Mean (φ), Standard Deviation/Sorting (σ_1), Skewness (Sk_I), and Kurtosis (K_G). Benthic foraminifera associated with these sediments were handpicked using a stereo-zoom microscope. Results indicate that sediments of pre-monsoon are medium sand to silt, where the majority of the sediments belong to the silt fraction. The monsoonaland post-monsoonal samples show higher variation in mean values and belong to coarse sand to silt in nature, with major portions falling under silt fraction. Sediments from all the seasons are poorly sorted in nature. Skewness (Sk_I) indicates a low-energy depositional environment prevailed during the monsoon and post-monsoon season. The pre-monsoon shows a moderate depositional environment where fine and medium-sized particles can settle. Kurtosis (K_G) indicates a leptokurtic nature during monsoon and post-monsoon, where a single dominant sediment source selectively deposits specific grain sizes. The pre-monsoon indicates a mesokurtic nature, in which a mix of sediment sources or varied depositional processes might have prevailed. The *Calcarina, Amphistegina, Heterostegina*, and *Baculogypsina* were the common symbiont-bearing foraminiferal genera associated with the sediment samples collected. The *Elphidium* and *Ammonia* were the common opportunistic genera, while *Miliolinella, Quinqueloculina, Spiroloculina*, and *Triloculina* were the commonheterotrophic benthic foraminiferal genera from the region.

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EFFECTS OF HUMAN ACTIVITIES ON MOUNTAIN FOREST AND MERCURY POLLUTION IN DURING THE MIDDLEHOLOCENE

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China has a long history of civilization and agriculture, and its terrestrial ecosystems have long been subjected to anthropogenic impacts. However, we lack detailed knowledge of the natureand timing of human impacts on the development of vegetation ecosystems in the mountain region of northern China during the Holocene, especially during the middle and late Neolithic periods. In this study, we used pollen and charcoal data, combined with the biomization method, from a sediment core from Mayinghai Lake to reconstruct the Holocene vegetation history of a mountain region in northern China. Considering the relatively warm and wet climatic conditions indicated by independent paleoclimate reconstructions, we conclude that our results provide a record of human impacts on the natural landscapes of the study region since ~4.8 ka (1 ka = 1000 cal yr BP), which are mainly indicated by a decrease in the coverage of temperate deciduous forest (based on biomization scores), higher sedimentary charcoal concentrations, and an increase in the number of archaeological sites, both in the vicinity of the study site and throughout the whole of northern China. According to our data of geochemical studies, mercury CF has been drastically increased during the years of 1000- 2000 (Age Cal yr Bp). Our results provide new insights into the role of humans in the ecological evolution of this mountainous region during the Holocene, and we suggest that the impact of prehistoric humans on vegetation succession was potentially significant, which needs to be considered when using pollen records for paleoclimatic reconstruction.

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MONSOON-MEDIATED CHANGES IN THE UPPER WATER-COLUMN STRUCTURE OF THE EQUATORIAL INDIAN OCEAN DURING THE LATE QUATERNARY: IMPLICATION TO THE CARBON PRODUCTION AND CARBONATE DISSOLUTION

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The central equatorial Indian Ocean (CEIO) is influenced by both, summer and winter monsoon and is known for cross basin exchange of water between the Arabian Sea (AS) and the Bay of Bengal (BoB). Here, I have presented planktic foraminiferal assemblage record fromthe CEIO (SSD-044/GC-01, Water depth=3160 m), to reconstruct changes in upper water- column structure during the last 43 ka, at millennial year timescales. My data set shows an increase in mixed layer eutrophication from MIS-3 to MIS-2 which further decreased sharply during the last deglaciation and remained low thereafter in Holocene. This trend matches wellwith the sedimentary C-org content in conjunction with ratio of G. *bulloides* /G. *ruber* which is interpreted as a productivity signal, in the study region. Similarly, from the same (above) core for the same time span, our results (four sets of dissolution proxies) suggest that deep seacalcite dissolution occurred during MIS-3, LGM, and Holocene and preservation observed during the last deglacial period. Increased dissolution during the MIS-3 and LGM related to increased transport of CO_2 rich Antarctic Bottom Water (AABW) and organic matter degradation (release CO_2 in the system) on the sea floor. The intense carbonate dissolution occurred during the Holocene may be related to C-org export to the sea floor and its degradationthrough the O_2 rich NADW and release of CO_2 in the deep sea. The preservation of calcite during last deglaciation related to outgassing of CO_2 from the ocean to the atmosphere which increases the CO_3^{-2} in the deep sea. To understand the variations in carbonate burial over the period of last 30 ka, I have utilized a core (ODP-716; Hole-A) from Maldives carbonate platform at a water depth of 533 m. Data sets ($CaCO_3$ %, C-org %, and shell weights of selectedplanktic foraminifera species: G. *ruber*, P. *obliquiloculata* and N. *dutertrei*) reveals that carbonate dissolution occurred during the LGM and the Holocene, which probably is a result of organic matter degradation in sediments.

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TORTONIAN-MESSINIAN PLANKTIC FORAMINIFERAL BIOSTRATIGRAPHY FROM NORTHERN INDIAN OCEAN: PERCEPTION ON THE PALEOCEANOGRAPHY

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This study investigates a comprehensive analysis of planktic foraminifera recovered from the samples collected from Sitapur Village Section, situated near the east coast of Neil Island in the Ritchie's Archipelago, northern Indian Ocean (Andaman and Nicobar Basin). Through Bright Field microscopy and Scanning Electron Microscopy, twenty-six species of planktic foraminifera were identified that belongs to ten genera namely *Dentoglobigerina*, *Globigerinoides*, *Globoconella*, *Globorotalia*, *Globorotaloides*, *Globoturborotalita*, *Neogloboquadrina*, *Orbulina*, *Sphaeroidinella* and *Trilobatus*. A number of statistical analyses were carried out alongside taxonomic analysis to establish planktic foraminiferal biostratigraphy hitherto not known from the onshore sequence of northern Indian Ocean. Based on the biostratigarphy and presence of index taxa identified in the present study, interpretation on paleocenographic conditions has been made. Stratigraphically Constrained Cluster Analysis (CONISS) using TILIA 1.71 delineated four distinct biozones and based on specific zonal markers, Tortonian-Messinian age has been assigned and possible Tortonian-Messinian boundary has been demarcated. Notably, the occurrence of taxa such as *Globorotalia menardii* and *Globorotalia margaritae* signifies the transition from the Tortonian to the Messinian stages. Diversity metrics, including the Shannon-Wiener Diversity Index, Simpson Index, Margalef's Richness and Pielou's Evenness, were derived to assess the diversity and richness of the foraminiferal taxa. In addition, isotopic analysis ($\delta^{13}C$ and $\delta^{18}O$) on *Globigerinoides ruber* has been done to infer variations in paleotemperature if any during the transition from Tortonian to Messinian. The present contribution may serve as a reference for future studies to be carried out in this part of the world to interpret the foraminiferal biostratigraphy and paleocenography.

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RECONSTRUCTION OF THE PLIOCENE LEEUWIN CURRENT VARIABILITY: RESULTS FROM ODP SITE763A, SOUTHEAST INDIAN OCEAN

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The low-latitude seaways influenced global climate and paleoceanography, contributing to thetropical climate system's development. The Leeuwin Current (LC) plays a crucial role in transferring heat from the low latitude to the high latitude regions in the Indian Ocean. This study used planktic foraminiferal census data, stable oxygen isotope values of planktic foraminifera, and X-ray fluorescence data from the sediment core samples from Ocean DrillingProgram (ODP) Hole 763A (water depth 1367 m) to understand the surface hydrographic changes associated with the mixed layer and thermocline depth in the southeastern Indian Ocean. The site is influenced by both the warm LC and the cold West Australian Current (WAC). There is a significant increase in the abundance of mixed layer species, along with oligotrophic warm water species, suggesting a thick mixed layer and deep thermocline during5.0–3.6 Ma. This thick mixed layer may indicate a strengthening of the LC during this period. Additionally, high natural logarithmic ratios of certain elements, expressed as ln((Al + K)/Ca),suggest this interval corresponds to a wet phase in northwestern Australia. However, during themiddle Pliocene (3.6–3.2 Ma), the planktic foraminifera abundance data and high stable oxygenisotope values of mixed layer species might suggest a weakening of the LC, possibly due to the restriction of surface water flow from the West Pacific Warm Pool.

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LARGE NORTH-SOUTH GRADIENT IN THE PLANKTIC FORAMINIFERAL DISTRIBUTION IN THEANDAMAN SEA

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Due to their cosmopolitan distribution, abundant preservation, and long stratigraphic record, the shells of planktic foraminifera are widely used as recorders of the past and present ocean conditions. Factors like water depth, temperature, salinity, food availability, pH, solar irradiance, and turbidity controls the spatial and temporal variability in foraminiferal distribution. A proper and region-specific understanding of foraminiferal response to different ambient factors is important before using them as proxies for paleoclimatic studies. The Andaman Sea located in the north-eastern part of the Indian Ocean is separatedfrom the Bay of Bengal via shallow sills with the water column structure of the basins similar only up to the sill depth. The sills also prevent intermediate and deep-water circulation at greater depths thus making the basin unique and different from the Bay of Bengal. The high sedimentation rates, carbonate preservation and isolated nature of the basin makes it a unique locale for the paleoclimatic studies. We report the surface distribution and ecology of planktic foraminifera from the Andaman Basin by using coretop samples. The absolute abundance of planktic foraminifera varies from a minimum of 5 to the maximum of 35850/g sediment. The foraminiferal abundance was low in the shallow stations of the northern part of the basin, a region associated with high river input and terrigenous dilution. We also report a drastic decrease in foraminiferal abundance at depths >2000 m, suggesting a shallow foraminiferal lysocline. A total of 33 planktic foraminifera species belonging to 20 genera were recorded from the basin. *Globigerinoides ruber, Neogloboquadrina dutertrei, Globigerinita glutinata, Pulleniatina obliquiloculata, Trilobatus sacculifer* and *Globigerina bulloides* were the dominant species. A large variability was observed in the relative abundance of *G. ruber* distribution across the basin with the higher *G. ruber* abundance (> 30 %) in the riverine influx dominated northern part of the basin. The association of *G. ruber* with cooler and less saline water of the river influx dominated Myanmar shelf region is supported by its strong negative correlation with the mixed layer salinity and temperature. *Pulleniatina obliquiloculata*, widely considered as a dissolution resistant species, had higher abundance at deeper stations in the south, indicating a large dissolution at deeper depths. *Pulleniatina obliquiloculata* also shows a positive correlation with thermocline salinity. A higher abundance of *G. glutinata* at deeper stations same as *P. obliquiloculata*, suggests that these species can be considered as moderately dissolution resistant species. A higher *G. bulloides* and *N. dutertrei* abundance in the southern part of thebasin indicates higher productivity due to weak stratification and strong wind induced mixing. *Trilobatus sacculifer* does not show any spatial heterogeneity. *Globorotalia menardii* shows a positive correlation with thermocline temperature and a negative correlation with thermocline salinity. Its occurrence in warm less saline waters suggests the basin specific behavior of the species. The low foraminiferal abundance results in a comparatively low total carbon (TC) content in the surface sediments varying between a minimum of 0.28% to a maximum of 7.97%. A relatively higher TC is observed in the south- western and western part of the basin, away from the riverine influx regions. We infer that water depth,temperature and salinity of the mixed layer and thermocline, as well as food availability strongly modulate the of foraminiferal abundance and distribution in the Andaman Sea. These results will aid in future studies that will make use of planktic foraminifera as a proxy to reconstruct the past climate from the Andaman Sea.

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HARNESSING THE POTENTIAL OF MICROARCHAEOLOGICAL BIOMINERALS FOR ISOTOPE-BASED RECONSTRUCTION OF PAST CLIMATE: A CASE STUDY FROM THE INDUS VALLEY SITE OF TIGRANA, HARYANA

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Though not visible to the naked eye, 'micro-archaeological' record fulfils the objective of reconstructing past local environments. One of these is mollusc shells, which was used in thisstudy. All member genera/species of the phylum Mollusca produce shells made of the mineral calciumcarbonate ($CaCO_3$), typically in the form of aragonite, through a process known as 'bio- mineralisation.' Like biologically produced minerals of bones and teeth, molluscs recovered atan archaeological site constitute an important component of a site's micro-archaeological record. Since the mollusca shell precipitates/biomineralizes in isotopic equilibrium with the ambient water – whose evaporative flux is determined by ambient temperature –oxygen isotopecomposition ($\delta^{18}O$) of the shell can yield accurate estimations of changes in external temperature. Oxygen isotopic studies on molluscan archive have, therefore, been a well- established proxy in reconstructing environmental conditions, in archaeological as well as non- archaeological contexts. They are corroborated by many laboratory-based studies whereby molluscs have been grown in known temperatures.

Molluscs shell are found in archaeological sites globally, almost irrespective of the geographical location or time period. Its inorganic content enables its excellent preservation and makes it one of the most durable biogenic recoveries in the archaeological record. However, despite their ubiquity, their potential in accurately reconstructing palaeo- environments has been left under-utilized in the context of Indian archaeology.

Here, we present a continuous $\delta^{18}O$ record of molluscs from the Chalcolithic Indus Valley siteof Tigrana, Haryana. The site is strategically located in the upper basin of the River Saraswatipalaeochannel, in the Eastern periphery of the Indus Valley Civilisation. It witnessed continuous occupation from the Mature to the Late phases of the civilisation. Our preliminary results of $\delta^{18}O_{aragonite}$ therefore attempts to reconstruct a continuous record of past temperaturesin the Indus Valley Civilisation from 4500-4000 BP, in an attempt to find key drivers behind the disintegration of the civilisation. Further work will include multi-proxy assessments targeting oxygen as well as carbon isotopes from bones as well as organic recoveries like soil and charred botanical remains.

Abstract no: ICMS 2024/ DU/151 **Mode of Presentation: POSTER**

ATOMIC FORCE MICROSCOPY (AFM): A METHOD FOR PORE CHARACTERIZATION IN FORAMINIFERAUSING A THREE-DIMENSIONAL TECHNIQUE

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A solution to problems like climate change relies on integrating techniques from diverse scientific fields. Modern technologies have significantly improved research studies. Foraminiferal pores are currently of great interest. They serve as proxies for paleoenvironmental reconstruction such as bottom water oxygenation and nitrate content and taxonomy in foraminiferal species. Research on foraminifera pores has significantly increased.

Scanning Electron Microscope (SEM) is the preferred method for pore analysis. This study showcases a new technique for pore analysis in foraminifera using an Atomic Force Microscope (AFM). The novel technique offers enhanced metadata and 3D pore resolution. We used AFM to analyze pores in two *Ammonia* species from Chilika Lagoon - *Ammonia beccarii* and *Ammonia parkinsoniana*. There are notable differences in the pore characteristics between the two, including pore diameter (size), pore density (pore count/measured area), andporosity % (pore area). We also measured the depth and surface roughness of the pore structures, not possible with SEM.

AFM has the potential to improve our understanding of foraminifera's pore structures with finer details. AFM is expected to be used for foraminiferal studies in the near future.

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TRACING THE PALEO-OXYGEN VARIABILITY IN A LAGOON USING THE PORE PATTERNS INBENTHIC FORAMINIFERA

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The nutrient influx into the shallow marine environments has grown dramatically over recent years. As a consequence, eutrophication has greatly increased resulting in a rapid decline in oxygen concentrations. The loss of oxygen might have severe repercussions on the marine biodiversity and aquaculture industry in the days to come. To monitor these changes in oxygen conditions benthic foraminiferal pores have been recently proposed as a reliable proxy.

Foraminiferal pores promote gas exchange between the organism and the environment. It has been well documented that the pore characteristics such as diameter, porosity % and pore density are sensitive to the oxygen dynamics of the ambient condition. Changes in marine oxygen can be meaningfully assessed based on the variability in these pore features. Chilika Lagoon (Odisha) situated on the east coast of India is the largest brackish water lagoon in Asia. *Ammonia* is one of the most dominant benthic foraminifera found in the lagoon. A one-meter-long sediment core was studied to reconstruct paleo-oxygenation trends. We intend to apply multiproxy approaches using trace elements (Mn/Ca) in foraminifera, stable isotopes ($\delta^{18}O$ and $\delta^{13}C$) and total organic carbon (TOC) of the sediments to develop a comprehensive knowledge of the oxygenation pattern. The advancement of proxy research has become essential for predicting the likelihood of deoxygenation in the future which helps to develop more effective mitigating strategies. In this context, the pore proxy in foraminifera has a crucial role to play.

Abstract no: ICMS 2024/ DU/153 **Mode of Presentation: POSTER**

CLAY MINERAL ASSEMBLAGES AT THE NEAR EQUATORIAL PALEOCENE-EOCENETHERMAL MAXIMA (PETM), BARMER BASIN, INDIA

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The Paleocene-Eocene Thermal Maximum (PETM) is a global dramatic climatic event however, it remains comparatively unknown in lower latitudes or equatorial regions compared to mid- and high latitudes. The present study reports the first-ever clay mineralogical evidenceof the Paleocene-Eocene Thermal Maximum (PETM) and subsequent hyperthermal occurrences in a near-equatorial area, particularly from the Akli Formation, Barmer basin, Rajasthan, India. The 32 m thick succession of the Akli formation exhibits abrupt changes in smectite and kaolin abundance before, during, and after the PETM event. In the studied open mine section, the kaolin content increases from 5-8% in the pre-PETM phase to 30-35% duringthe PETM, thereafter declining to 5-6% in the post-PETM period. However, the smectite indicates a significant decrease in its abundance. The transformation of smectite initially involves hydroxy interlayering, subsequently transitioning to kaolin throughout the PETM. Thetransformation of smectite to kaolin additionally contributed to an extensive precipitation of iron oxide in sediments. The clay mineralogical changes in the P-E transition sediments of theAkli formation were induced by a temperature rise of 3-5ºC and a 25-50% increase in precipitation during hyperthermal events. The presence of unusually high charcoal pieces (~20%) at the P-E transition indicates warming and extensive biomass combustion in the lowerlatitudes during the PETM.

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EXPLORING AGRICULTURAL DEVELOPMENT IN RELATION TO CULTURAL CONTEXT AT UREN, BIHAR: APRELIMINARY CONTEMPLATION

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Carbonized plant remains from archaeological sites are crucial for understanding the culture– climate–subsistence relationship. Ancient habitational settlements from the Neolithic onwardshave come to light in the alluvial plains of Lower Ganga Plain (Bihar). The Neolithic and Chalcolithic cultures are assigned to a general time bracket of 2500-1500 BCE. Only few siteshave been studied for plant-based subsistence economy in the region. No significant work hasbeen done to understand the cropping pattern, vegetation dynamics, and climate change in parallel to cultural context. Therefore, the present study is undertaken at Uren (lat. 25°10'3''N;long. 86°13'11''E) archaeological site since Iron Age (3000 yrs BP) onwards to understand thesubsistence pattern in relation to cultural context and climatic shift during last three millennia.This site has revealed five cultural phases from Iron Age (1000 BCE) till Pala period (900 CE).The preliminary investigation of archaeobotanical samples has revealed the crops such as cereals, pulses, oil seeds, fiber yielding crops and vegetable crops representing both summer and winter seasons and played an important role in the diet of the ancient settlers. The remainsalso indicates that crop rotation was practiced from the perspective of maximizing the agricultural production. A rich assemblage of crop remains, and associated weeds and wild taxashows advanced state of agriculture since last three millennia in Lower Ganga Plain.

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INTEROCEAN EXCHANGE BETWEEN THE SOUTHEAST ATLANTIC AND INDIANOCEAN DURING THE EARLY LATE MIOCENE

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The Southeast Atlantic Ocean is a key region for the exchange of water between the Indian and Atlantic Oceans. Recent studies indicate that Indian Ocean waters, transported via the Agulhas Leakage, have the potential to influence global climate patterns during the Pleistocene and Holocene epochs. In this study, we focus on the southern Benguela region, which receives warm Indian Ocean waters through the Agulhas Leakage. We investigated the possibility of Agulhas Leakage occurringduring the early late Miocene before the intensification of the Benguela upwelling, prior to 8 million years ago (Ma). Our findings reveal a high relative abundance of *Globorotalia menardii* between ~ 11.5 and 10.5 Ma. This species, typically found in the tropical Indian Ocean, reaches the Southeast Atlantic through the Agulhas Leakage. The significant presence of *G. menardii* suggests a continuous influx of Indian Ocean waters during this period. Additionally, the scarcity of cold-water species associated with upwelling indicates lack of upwelling and a stronger impact ofwarm tropical Indian Ocean waters on the Southeast Atlantic. During this phase, the South Atlantic Anticyclone (SAA) might not be strong enough to initiate the upwelling processes. Also, the Sub Antarctic Front (SAF) might had a more southern location that also helped flawless movement of the Indian Ocean Waters into the SE Atlantic Ocean. Between ~10.5 and 9.7 Ma, when the Benguela upwelling initiated, the relative abundance of tropical Indian species decreased. Between ~9.7 and 8 Ma, even if the upwelling reduced, the warm Indian ocean species did not increase. This suggests once the Benguela Upwelling initiated it reduced the impact of warm Indian Ocean water in the SE Atlantic Ocean.

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CO-EVOLUTION OF LIFE AND ENVIRONMENT AND THE ROLE OF LARGE SEAWEEDS FORTHE EMERGENCE OF EDIACARA BIOTA

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The reconstruction of microbial evolution and its link to the environment, which sometimes referred to as a co-evolution because significant biological processes and environmental change both influence the patterns of life. In this situation, the Ediacara biotaprovides a chance to learn about the evolutionary transition of the first primitive metazoans and metaphytes and how other factors such as dissolved oxygen and nutrients played an important role to support larger life forms. Global deglaciations, an abundance of available nutrients, and the post-mortem burial of dissolved organic carbon led to an increase in oxygenation in the ocean atmosphere, which led to the diversification of life and the evolutionof Lantian and Sonia seaweeds shortly after the Ediacaran Period began. Sonia seaweeds are large, non-carbonaceous and three-dimensionally preserved on the bedding plane of the Sonia Sandstone, which are inferred as putative seaweed. Likewise, the Lantian biota is preserved in black shale of the Ediacaran Lantian Formation, which yielded comparative smaller fan-shaped seaweeds and oldest metazoan fossils. Similar benthic seaweeds/macro-algal forms are alsoreported from the White Sea area of Russia and Ediacara Member, south Australia. These seaweeds had an excellent adaptability and susceptible to environmental changes for survivalin different taphonomic window:

These large algal forms, which are more closely related to seaweed in terms of evolutionary affinity, were the first sophisticated eukaryotic multicellular life. Phylogeneticrelationship of the Ediacara biota is debatable but more akin to animal. Animals up to meter scale (especially rangiomorphs and erniettomorphs); pose questions on food-web. Present synthesis attempts to answer this fundamental question and provide relationship between thelarge body plan of the Ediacara biota and their plausible food source.

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CARBON DYNAMICS AND SEA SURFACE TEMPERATURE IN THE LATE EOCENE TO OLIGOCENE TRANSITION IN THE SOUTH PACIFIC: INSIGHTS FROM SITE U1553, IODP EXPEDITION 378

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The late Eocene and Oligocene represent a fascinating era characterized by diverse climate conditions, ranging from 'warmhouse' to 'coldhouse' periods. This epoch also saw the presence of dynamic ice sheets on Antarctica and potentially fluctuating atmospheric CO_2 levels. Despite its importance, the relationship between CO_2 levels and the growth andretreat of ice sheets—crucial for determining CO_2 thresholds for ice sheet stability across different climate phases—remains largely unexplored. Additionally, CO_2 reconstructions for this period are limited. Using the high-latitude site U1553 in the South Pacific, we have conducted high-resolution CO_2 reconstructions employing planktonic and benthic foraminifera. Our analysis includes multiple foraminiferal species, examining stable isotopes, trace elements, and boron isotopes. This comprehensive approach allows us to explore foraminiferal 'vital effects' and various aspects of the marine carbonate system, providing a robust foundation for generating continuous, long-term records of CO_2 levels and seawater temperatures throughout the late Eocene and Oligocene. Our findings, presented here, enhance our understanding of the interactions between temperature variations, the carbon cycle, and salinity dynamics during the Eocene-Oligocene Transition.

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OSTRACODA: A LESSER KNOWN BUT RELIABLE PROXY FOR PALEOENVIRONMENT, PALEOCLIMATE AND PALEOOCEANORGAHIC STUDIES

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Ostracoda, the tiny, calcareous bivalved Crustaceans, live in all types of aquatic environments,and found in the entire Phanerozoic Eon. They live in an environment in which the controllingfactors are temperature, bottom topography, depth, salinity, dissolved oxygen, substrate, food supply and organic matter (Yassini and Jones, 1995). They can tolerate a wide salinity range and hence, can occur in different environmental settings viz., marine, brackish, fresh waters, mangrove ecosystems and even in wet paddy fields.

The application of statistical data on Ostracoda, such as closed and isolated (open) valves; juveniles and adults; males and females; right and left valves; smooth and ornamented forms, etc., besides colour variation, pyritisation and predation, to interpret the environment of deposition and rate of deposition of sediments (siltation) has attained importance, during the last few decades.

Ostracoda are, the second most abundant benthic calcareous microfossils found in deep sea sediments, after the benthic foraminifera. They are considered one of the important microfossilgroups in interpreting and reconstructing the paleoclimate and/or paleoenvironment condition such as paleotemperature and paleosalinity, since they are highly sensitive to small changes in these environmental conditions. Ostracoda shells provide valuable insight into the ecology, hydrology, and aquatic chemistry of the environment. The sensitivity of Ostracoda on feeble environmental fluctuations, make them a good marker for the interpretation of geological past. Distribution of Ostracod species varies with environmental conditions and sedimentological parameters. Ostracoda genus, *Krithe* is benthic pandemic fauna and is globally distributed which diversely occur in deep sea, escalated greatly by its paleo-environmental and paleo- oceanographic applications. Being a temperature dependent, salinity tolerant, mud loving genus and moreover a widely distributed genus across the oceans, the genus and its capacity stands unique for correlation of diverse ocean settings. The occurrence of *Krithe* is attributed to zone of upwelling and cold-water regions. The exploration on paleo-oceanography using thegenera is not receiving any mileage, because of lack of a proper compilation.

Studies have shown that organic flux to the sea floor, bottom water chemistry and sediment characteristics strongly influence faunal densities, assemblage composition and diversity. Distribution of the genera viz., *Krithe, Poseidonamicus, Argilloecia and Cytheropteron* in ocean sediments make them stand apart from all other Ostracoda genera for paleo- oceanographic evaluation (Carlos A. Alvarez Zarikian, 2013) Salinity, temperature, nature of sediments and depth of the water column impacts the occurrence of the species. Preferably, thegenus *Krithe* adapt cooler environment species and is useful as glacial and interglacial markers.Evidential from the studies, the different species of the genus *Krithe* are found occurring in different marine settings which marks them a valid species for biomonitoring the ocean bottom(Noohu Nazeer *et al*., 2019). Therefore, the Ostracod fauna despite their lesser studies give better insights on the paleo-oceanographic implications.

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COMPETING EFFECTS OF ATLANTIFICATION AND MELTWATER DISCHARGE ON THE PRODUCTIVITY AND BURIAL OF ORGANIC CARBON OFF KONGSFJORDEN, SVALBARD DURING THE HOLOCENE

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The unprecedented warming in the Arctic has altered the physiographic conditions resulting in contrasting variations in marine productivity. In the present study, we investigate the competing effects of enhanced warming, Atlantification and glacial melt on the productivity of an Arctic fjord (Kongsfjorden) in the western Svalbard margin during the Holocene (10.5 kyr BP). Productivity and preservation of organic matter have been reconstructed using element and isotopic characterisation of sediment (C_{org}, C_{org}/N, $\delta^{15}N$, TN, $\delta^{13}C_{org}$), grain size and benthic foraminifera. The results suggest enhanced productivity but reduced preservation of organic carbon (C_{org}), dominated by regional influence for the early Holocene (10.5 – 7 kyr BP). In contrast, the mid-Holocene (7 – 4 kyr BP) was marked by strong nutrient utilisation and moderate marine productivity but with elevated preservation of organic carbon. The late Holocene was also less productive, albeit with few episodes of fluctuations in productivity. Moreover, the last ~200 years productivity variations are similar to those of modern-day patterns in the Kongsfjorden. With the ongoing rapid pace of warming, productivity is expected to increase despite large glacial meltwater discharge. The present study helps in delineating the processes and vis-à-vis regional influences on the productivity variations, their preservation patterns and the eventual burial of organic matter in the fjordic sediments.

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IMPLICATIONS OF OSTRACODA TO ASSESS COASTAL ECOLOGY AND PALEOENVIRONMENT IN A LAGOON ENVIRONMENT: A CASE STUDY ALONG THE NORTHEASTERN COAST OF INDIA

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Salinity gradients are typically produced by the variable seasonal interaction of both fresh andmarine waters in lagoon ecosystems, and these gradients have a substantial effect on the benthos' microhabitat. This study evaluated the spatial-seasonal abundance and diversity of ostracods along the salinity gradient of Chilika Lagoon (India) by collecting seasonal substratesediment samples from twenty-two fixed stations. Additionally, the environmental parametersof lagoon-bottom water have also been measured from the same stations. The sediment sampleswere analyzed for living and dead ostracod species abundance, diversity and correlated with the measured environmental parameters. The river mouth proximal region having sandy silt substrate under low energy conditions and high total organic carbon, had a higher abundance of low salinity tolerant ostracod species. The interior region of the lagoon showed a high abundance and diversity of variable salinity tolerant brackish water species, with a high proportion of dead specimens. The region proximal to the sea mouth is influenced by high energy conditions and sandy substrate. This region possess low ostracod abundance and diversity with only a few very high salinity tolerant ostracod species. Canonical correspondence analysis of living ostracod species and articulated valve abundance with the environmental preferences suggest environment-specific ostracod assemblages. The Ostracodassemblages point towards the particular environment that are consistent with the traditional use of ostracod species as a proxy to reconstruct the paleoecology and paleoenvironment in thecoastal region.

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FLORAL DIVERSITY AND BIOSTRATIGRAPHIC AGE OF LOWER PERMIAN SEDIMENTS FROM GIRIDIH COALFIELD SECTION, DAMODAR BASIN, INDIA

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Permian Gondwana sediments of peninsular India, have attracted geoscientists and palaeontologist for its economic significance and rich flora in terms of its potential to contain large coal deposits. Among the Gondwana sedimentary basins, Damodar Basin is considered as the master basin. The present study deals with the Permian floral diversity, age assessment and associated paleoenvironment of the coal forming sequences of Giridih Coalfield. The macrofloral assemblage procured form the grey to carbonaceous shale sequence reveals occurrence of Glossopteridales and Cordaitales belonging to 4 genera (*Glossopteris, Gangamopteris, Vertebraria, Noeggerathiopsis*) and scale leaves) and 17 species. The presence of *Gangamopteris* and *Noeggerathiopsis* firmly establishes the age of these sediments to be Early Permian. The presence of Glossopteridales along with the Cordaitlean plant groups infers the co-evolution of these groups during Early Permian. Fossil scale leaves are commonly distributed in the Glossopteris flora and are known from almost all the geologic formations of Lower Gondwana. The recovered palynoassemblage is characterized by the dominance of *Scheuringipollenites sp*. and the sub-dominance of *Faunipollenites sp.* along with the presence of stratigraphically significant taxa namely, *Striatopodocarpites, Parasaccites, Primuspollenites, Alisporites* and *Rhizomaspora*. This palynoassemblage correlates with the *Scheuringipollenites barakarensis* assemblage zone of the Early Permian (Lower Barakar Formation) in the Damodar Basin, therefore, an Early Permian (Artinskian) age is inferred for the studied sediments. The floral composition exhibits prevalence of warm and humid climate during that time. In addition, the well preserved macrofloral remains suggest that parent plant groups were growing near the depositional site. The lithoarchitecture of the fossil bearing horizons also signifies that deposition took place in relatively low energy conditions.

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DISTRIBUTION, ECOLOGY, AND PRESERVATION OF SHELLED PTEROPODS IN THE WESTERNBAY OF BENGAL

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Pteropods are a crucial element of the ocean's planktonic community, but their aragonite shells make them vulnerable to the increasing atmospheric CO2, and they are often considered as thefirst indicators of ocean acidification. Pteropods are also widely used as paleoclimatic proxies,mainly to assess the changes in aragonite saturation depth in the past. Despite this, the ecological characteristics and biogeographic distribution of pteropods remain poorly understood. This study presents the surface distribution and ecology of pteropods in the westernBay of Bengal and assesses the aragonite dissolution in the region using 175 coretop samples collected from depths ranging from 24 m to 3505 m covering the entire eastern margin of India.A total of 19 species belonging to 13 genera were identified, with *Heliconoides inflatus* beingthe dominant species. The Aragonite compensation depth (ACD) in the western Bay of Bengalwas estimated to be at approximately 510 m based on the absolute abundance of pteropods andthe ratio of pteropods to planktic foraminifera.

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MULTIPLE PERIPHERY IN EOCENE AND OLIGOCENE NUMMULITID(FORAMINIFERIDA) OF KUTCH

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The shallow marine Eocene and Oligocene rocks of Kutch play an eminent role in the history of Indian micropaleontology. This stratigraphic interval, hosting diverse species of larger foraminifera *Nummulites* Lamarck and *Assilina* d'Orbigny, have been investigated since Sowerby's (1840) time. Presently, we provide the first report of multiple periphery in sixnummulitid species viz. *Assilina exponens* (Sowerby), *Nummulites acutus* (Sowerby), *N. fitcheli* Michelotti, *N. maculatus* Nuttall, *N. vredenburgi* Prever and *A. laxispira* de la Harpe systematically collected from the Eocene and Oligocene sequence of SW and NW Kutch.

Development of additional peripheries, as separate from the omnipresent median periphery, gives rise to multiple periphery in foraminiferal test. Additional peripheries extend on the lateral part of the test. About 5-7% individuals of the examined species show development ofidentical multiple periphery. Such individuals are morphologically distinct from conspecific specimens with median periphery. Externally, the additional peripheries form straight or feebly sinuous low narrow grooved ridges of varying length on one or both sides of the test. The ridges run mostly along the central part of the test and may show bifurcation at one end. Internally,these ridges comprise 1 to 4 sets of vertically stacked marginal cord and chambers. Marginal cord, chambers and septa do not show morphological aberration. Occurrence of intercalated whorl was noted in the additional periphery of some *N. maculatus* Form B specimens. *Nummulites* and *Assilina* are flat planispirally coiled taxa with bilateral symmetry about the median plane. In specimens with multiple periphery, additional peripheries develop on the lateral part of the test without losing the main median spire. Little information is presently available in the literature regarding multiple periphery in foraminifera. Multiple periphery in *N. tchihatcheffi* d'Archiac & Haime and *N. millecaput* Boubée have been attributed to abnormal growth. In *N. obtusus* (Sowerby) Form B, taxonomic importance has been accorded to the growth of marginal cord and chambers in the lateral and median parts of the outer whorls of adult test. Occurrence of marginal cord on the lateral part of the holotype of the Upper Paleocene *N. rockallensis* Hinte and Wong from Rockall Plateau, North Atlantic has been regarded as intraspecies morphological variation. Occurrence of multiple periphery in the extant *Amphisorus hemprichii* Ehrenberg from Gulf of Aqaba and *Daviesina langhami* Smout from Paleocene of Pakistan have been regarded as teratological growth and intraspecific variation respectively. Thus, there is considerable difference in opinion regarding taxonomic relevance of multiple periphery in foraminifera. In this backdrop it was observed that marginal cord and chamber associated with the additional peripheries have no morphological abnormality. Teratological origin cannot explain the development of identical multiple periphery in unrelated nummulitid taxa occurring at different stratigraphic levels and at different geographic locations of the Eocene-Oligocene sequence of SW and NW Kutch. That the niche environments of the presently examined nummulitids were not stressful is evident from the occurrence of diverse associated benthic biota. It is argued that multiple periphery reflects similar phenotypic response towards bioclast induced growth disruption of the median spire of 5-7% nummulitid individuals of different examined species rather than teratological growth. Multiple periphery in the present case providestrong taphonomic feedback of live-dead interaction among foraminifer in a depositional scenario characterized by high foraminiferal abundance and low sedimentation.

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INVESTIGATING FORAMINIFERAL ASSEMBLAGES IN A SEDIMENT CORE FROM THE SATAPADA REGION, CHILIKA LAGOON

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Chilika Lagoon, a large brackish water lagoon in India, has undergone environmental changes due to natural and human factors. This study examines foraminiferal distribution in ashort sediment core to understand environmental changes.

The preliminary core analysis showed temporal variations in foraminiferal diversity and abundance. Agglutinated forms such as *Miliammina fusca*, *Miliammina obliqua*, *Textularia agglutinans*, and *Trochammina* sp. dominate the upper sediment layers (0-6 cm). The assemblages suggest stagnant water in the ecosystem. Calcareous foraminifera, such as *Ammonia parkinsoniana*, *Ammonia sobrina*, *Ammonia tepida*, *Cribroelphidium hispidulum*, *Pararotalia nipponica*, and *Haynesina germanica* dominate in the core's deeper depth (>6 cm). The change in foraminiferal test composition indicates improved water circulation for their survival. The 125 µm sand fraction contained only calcareous forms, while the 63 µm sand fraction had both calcareous and agglutinated forms, indicating variations in abiotic factors and substrate type.

The study emphasizes the value of foraminiferal assemblages as bioindicators for assessing environmental changes and understanding the lagoon's ecological response to human and natural influences. Historical variations are key for effective management strategies to preserve Chilika Lagoon.

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LATE-HOLOCENE CLIMATE VARIABILITY RECORDED FROM BENTHIC FORAMINIFERA MORPHOGROUP INWESTERN BAY OF BENGAL, INDIA

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A preliminary study has been conducted in order to determine the climate of the Holocene period from assemblages of benthic foraminifera in sediments of the western Bay of Bengal. This study investigates the offshore sediment samples obtained from National Gas Hydrate Programme (NGHP) Hole 01-15A (16°05.6983° N, 82° 09.7467° E, water depth 926m). We perform Accelerator Mass Spectrometry (AMS) analysis of mixed benthic foraminifera to establish the chronology of the studied sites which cover time span of 1690 years from 335 BC to 1355 AD. To determine if the deep-sea environment at the core site was impacted by theorganic flux generated by the primary productivity of the ocean during intensified SW monsoon, we examined temporal variation in benthic foraminiferal morphogroup. On the basis of external symmetry of benthic foraminifera, we identified two morohogroups classified as Angular asymmetric benthic foraminifera and Rounded symmetric benthic foraminifera. In addition, we compared foraminifera morphogroups with published data of isotopes, ^{14}C data sets, sunspots hematite-stained grain, and summer monsoon index data. A significant variationin morphogroup abundance can be observed during the Roman warm period, Dark Age Cold Period, Medieval warm period and Little Ice Age. The increasing abundance of Rounded symmetrical benthic foraminifera with the planoconvex test occurs during RWP and MWP, whereas the relative abundance of Angular asymmetric benthic foraminifera increases during DACP and LIA. According to faunal studies, there was a relatively oxic environment when theorganic matter flux to the seafloor was low during intensified summer monsoons attributing tostratification of surface water and less nutrient availability in the mixed layer. Spectral analysis of AABF and RSBF shows significant periodicities of 563 and 281 years at 95%-Chi2 and 563,281, 22 and 16 years at 95%-Chi2 respectively which corresponds to various proposed solar cycles which influences the monsoon cycle.

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INSIGHTS INTO BERGAUERIA TRACE FOSSILS FROM THE NAGAUR GROUP, MARWAR SUPERGROUP, INDIA

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Ichnofossils provides profound insights into the early biosphere and the organisms that once thrived within it. Among the notable trace fossils of the Cambrian period, Bergaueria is particularly prominent. This eurybathic trace fossil, identified across various environments, is primarily interpreted as a cubichnia or domichnia, attributed to ceranthid or actinian anemones (Pemberton et al., 2001). Within the Marwar Supergroup (MSG), numerous studies have documented these trace fossils, though their evolutionary significance remains largely unexplored. Bergaueria burrows, ranging from the Cambrian to the Ordovician periods and even appearing in the Neogene Period, exhibit considerable temporal breadth. Despite its extensive range, Bergaueria—an r-strategist species—holds significance due to its characteristics, broad geographical distribution, and frequent co-occurrence with contemporary trace fossil assemblages (e.g., Cruziana, Rusophycus, Skolithos). In this study, we analyzed 46 specimens from the Dulmera quarry within the Nagaur Group of MSG to elucidate the characteristics of Bergaueria trace fossils, discuss their paleoenvironmental implications, and explore their evolutionary history within the context of Marwar Supergroup and their global inferences from the early phanerozoic biosphere.

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NORTHEAST MONSOON VARIABILITY DURING THE LAST GLACIAL PERIOD AND ITS FORCING FACTORS

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The Northeast (NE) monsoon plays a vital role in the hydrology of the Indian Ocean and significantly influences the climate of the surrounding countries. Despite its importance, the NE monsoon has not been as extensively studied as the more dominant Southwest monsoon. In our study, we present a new record of NE monsoon variability over the past 70,000 years from a location where NE monsoon winds govern the ocean's mixed layer depth (MLD) dynamics. We have generated carbon and oxygen stable isotope records from a sediment core (SK375–GC01) taken from the northern equatorial Indian Ocean to reconstruct regional surface and thermocline δ18O and δ13C records, allowing us to examine NE monsoon variability over this period. Our findings reveal that during the Last Glacial Maximum (LGM) and Marine Isotope Stage 4 (MIS4), a deeper MLD was observed, indicating a stronger NE monsoon. In contrast, a shallower mixed layer during the early Holocene and the middle to late Marine Isotope Stage 3 (MIS3) suggest a weakened NE monsoon. These results are corroborated by time slice simulations for the last glacial period. Additionally, we compared our NE monsoon reconstruction with transient simulations of SST in the southern extratropics. We discovered that warmer SST in the southern extratropics corresponded to enhanced NE monsoon on a millennial timescale. Our study suggests that this teleconnection may have been driven by the Mascarene High and the intermediate waters of the Southern Ocean.

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ASSESSMENT OF MIDDLE PLEISTOCENE TRANSITION INFLUENCE ON THESEA SURFACE CONDITION OF JAPAN SEA

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The Middle Pleistocene Transition (MPT) mark a significant change in the Earth's climate cyclicity that occurred between ~1.2 and 0.8 Ma. During the MPT, glacial-interglacial cycles switched from 41 to ~100 kyr, resulting in thicker and more stable ice-sheets during the Chibanian. The semi-enclosed basins like the Japan Sea are influenced more due to this transition and planktic foraminifera is an ideal proxy to assess the same. This study analysed the planktic foraminiferal assemblages and variations in trace element concentration on the testof *Neogloboquadrina pachyderma* and *Globigerina bulloides* from the Integrated Ocean Drilling Program (IODP) Site U1426 covering the period between ~1.4 and 0.6 Ma. The high abundance of *N. pachyderma* during the MPT suggests cold sea surface temperature due to thesouthward expansion of sea-ice. The variability in *N. incompta* and *N. pachyderma* suggest anintensified cooler period during the MPT and relatively warmer periods before and after MPT.The warm periods are marked by higher abundances of *N. incompta* and *G. bulloides*. *N. pachyderma* was found to be the most sensitive to glacial-interglacial periodicity switch from 41 to 100 kyr, which is evident from spectral and cross-wavelet analyses. Pyritization within the tests of *N. pachyderma* and *G. bulloides* suggest existence of reducing conditions near theJapan Sea floor during MPT, which is further supported by higher Total Organic Carbon (TOC) values. The reconstructed Mg/Ca based paleothermometry suggests a temperature range between ~7 and -7 ^{o}C. This study suggests that Mg/Ca paleothermometry is not reliable for temperature below 0 ^{o}C.

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TRACKING THE STRATIGRAPHIC STATUS OF UPPER KAIMUR SILICICLASTICS FROM VINDHYAN SUPERGROUP OF RAJASTHAN AND SON VALLEY: GEOCHEMICAL APPROACH

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The largest Late Paleoproterozoic-Mesoproterozoic Vindhyan Supergroup of rocks is centrally located in peninsular India and is exposed in the three sub-basins - Rajasthan, Son Valley and Bundelkhand. The Vindhyan sequence is stratigraphically divided into Semri, Kaimur, Rewa and Bhander Groups; arranged in order of superposition. The Kaimur Group of rocks are exposed in all the three sub-basins of Vindhyan Basin (VB) and are named differently. For example, the Akoda Mahadev Sandstone (AMS), exposed as outliers near the Bundi area of Rajasthan, is considered as stratigraphically equivalent to the upper part of the Kaimur Group in the Rajasthan area, and is considered contemporaneous to the Mangesar Formation and Dhandraul Sandstone (DS) of the Son Valley. The present work is a comparative study between the Akoda Mahadev Sandstone and the Dhandraul Sandstone to understand the stratigraphic equivalency between the Vindhyans of Rajasthan and Son Valley, using geochemistry as tool. The Akoda Mahadev Sandstone (AMS) Formation overlies the Hindoli Group (1.8 Ga) and initiates with Bandanpur conglomerate that is successively followed upward by shale- sandstone sequence and coarse-grained reddish-greyish platformal sandstones. The Mangesar Formation in the Son Valley overlies the argillaceous Bijaigarh Shale (1210 Ma), reddish in colour and represented by sandstone–shale sequence that grades upward to off-white to white thickly bedded Dhandraul Sandstone (DS). In the present study the equivalency is probed between the Akoda Mahadev sandstone with the topmost coarse- grained sandstone of Dhandraul Formation. On the basis of Herron classification diagram coarse Akoda Mahadev Sandstone (AMS) is identified as lithic to sub-lithic arenite in composition while Dhandraul Sandstone is inferred as quartz arenite. From K_2O/Na_2O (32.83) and SiO_2/Al_2O_3 (14.41) values, it is interpreted that the AMS sediments are less matured than Dhandraul Sandstones (DS). The CIA values, A-CN-K ternary plot, CIA vs Al/Na and CIA vs ICV diagrams show that both AMS and DS have undergone moderate to high extents of chemical weathering in a warm humid climate. Th/Sc vs Zr/Sc shows that the source of AMS and DS have suffered similar extent of sediment recycling. The discrimination diagram K_2O/Na_2O vs SiO_2, La/Sc vs Ti/Zr and ternary plots Th-Sc-Zr/10, Th-Sc-Zr/10 show that AMS and DS both were deposited in a passive margin setting. The trace element ratios La/Sc, Th/Sc, Th/Co, Th/Cr, La/Cr and various discrimination diagrams like Al-Ti, La-Sc, La-Th-Sc, Ni-Cr, Th-Sc and Gd/Yb vs Eu/Eu* plots show that both AMS and DS were derived from a post-Archean felsic igneous source. The present geochemical analyses of AMS anfd DS reveals that despite difference in the sandstone type, a post-Archean felsic Igneous provenance (probably granite) is suggestive for both. A role of climate may be the reason behind different maturity of sandstone; a more warm humid climate is suggested in the provenance of DS. The present geochemical work thus implies that AMS and DS may be stratigraphically equivalent despite their different petrological characteristics. This conjecture, however, demand further sedimentological and geochronological works.

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DEPOSITIONAL ENVIRONMENT RECONSTRUCTION OF KANWAR LAKE IN THE CENTRAL GANGA PLAIN,INDIA INCORPORATING PALYNOFACIES AND SEDIMENT TEXTURE

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The Ganga Basin, an active foreland basin formed due to compressional stress between the Indian and Eurasian plates, was fully developed during the Paleogene-Neogene epoch. Situated within this basin, Kanwar Lake (25° 36′ 36″ N, 86° 08′ 24″ E) lies in the northern Begusarai district of Bihar, India. Located in a tropical wet zone, Kanwar Lake is Asia's largest freshwater residual lake, created from a cut-off meander of the Burhi Gandak River, a tributary of the GangaRiver. In the present study palynofacies and grain size has been used for reconstruction of depositional setting from a sediment core of ~3m. Palynofacies involves studying and classifyingorganic matter and palynomorphs in sediments or sedimentary rocks, and presently, it hasidentified five distinct zones within the lake's sedimentary record. Zone I (KLP-235 to KLP-303)is characterized by high silt and clay content with a low sand percentage, mainly composed of very fine to fine sand. This zone is dominated by brown degraded organic matter (OM), structured OM, and amorphous organic matter (AOM), with low pollen/spore content but moderate fungal remains, which diminish towards the top. This indicates a weak Indian Summer Monsoon (ISM) and a reduction in water column during the deposition period. The Zone II (KLP-140 to KLP-201), exhibits high silt and low sand content, with a significant presence of brown degraded OM, structured OM, low to moderate opaque phytoclasts, and fungal remains, alongside low AOM percentages. These features suggest the onset of a weak humid period with aslight rise in organic matter. Zone III (KLP-65 to KLP-140) is marked by a high content of opaque phytoclasts, including burnt and degraded charcoal. Brown degraded OM remains high, while AOM fluctuates, indicating potential oxic-redox conditions during this period. Zone IV (KLP-26 to KLP-65), displays high silt and sand content, with the highest record of opaque phytoclasts, followed by degraded brown OM, low structured OM, moderate fungal remains, andAOM. This zone reflects humid climatic conditions during deposition and suggests human activities in and around Kanwar Lake. Finally, Zone V (KLP-1 to KLP-65) is dominated by a high sand percentage over silt, this zone is characterized by a reduction in all types of organic matter, with the remaining OM being primarily oxidized plant remains and AOM. This study demonstrates that the type and distribution of organic matter in the sediments can reveal whether the depositional environment was oxic or anoxic, and whether it occurred in shallow or deep water. Coarse organic particles are indicative of high-energy environments, whereas fine particles suggest low-energy settings such as deep lakes or offshore marine areas. Additionally, the composition of pollen and spores reflects past vegetation, providing insights into historical changes in ecosystems and landscapes. This research also helps to monitor environmental changes driven by natural processes and human activities.

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THE RESPONSE OF SOUTHERN INDIAN OCEAN CALCIFYING NANNOPLANKTON TO THECHANGING CLIMATE

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Coccolithophores are a key component of the marine ecosystem and sequester large amounts of dissolved CO_2 in the ocean interior through biological carbon and carbonate counter pumps.It is estimated that, out of the global oceanic carbonate deposits, ~50% is contributed by coccolithophores alone. However, on the verge of changing climatic scenarios, coccolithophores may alter their biogeographic boundaries and functioning, which may reworkthe biological carbon and carbonate counter pumps. We have assessed the coccolithophore biogeography and calcification in the Southern Indian Ocean during the past ten years utilisingdata collected in seven Southern Ocean/Antarctic expeditions between 30°S and 67°S within the austral summer period. Our study indicates that (1) the coccolithophore southward expanseis highly dynamic which shifts from 48°S during the early-austral summer (November- December) to 65°S in the mid-austral summer (January-February) and returns to 45°S during the late austral summer, attributing to variations in nutrient concentrations, and grazing pressures; (2) coccolithophores calcite production (specifically *Emiliania huxleyi*) is higher in the subantarctic region owing to larger coccosphere size compared to subtropical and polar frontal regions; and (3) *E. huxleyi* in the polar waters are more heavily calcified by extracellularcalcite precipitation, as a defence mechanism against low temperature and pH. In addition, we documented several new coccolithophore species/varieties from the Southern Indian Ocean with distinct morphologies and probably native to the region. In the coming decades, lowering pH, increased irradiance, meltwater and stratification may affect coccolithophore abundance, standing stock, calcification, and thus carbonate drawdown. In addition, in the changing climatic scenario, coccolithophores may show more genotypic and phenotypic plasticity, whichwill lead to the formation of new species/varieties.

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DEEP SEA CARBONATE DISSOLUTION: IMPLICATION TO THE CO2 SINK ANDASSOCIATED CIRCULATION

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Global thermohaline circulation plays a crucial role in transporting significant amounts of heat, carbon, and nutrients across latitudes in the ocean, thereby modulating the global climate. The Global Oceanic Conveyer Belt (GOCB) initiates in the deep subpolar-North Atlantic region, characterized by the sinking of cold and saline waters. Subsequently, these deep waters migratetowards the south and get intermingled with circum-Antarctic waters, thereby ventilating the Indian Ocean and the Pacific Ocean. The GOCB loop is completed by the return of surface currents from the Indo-Pacific (via Indonesian Through Flow) to the North Atlantic. It is intriguing to mention that, the deep water masses acts as a mega storehouse for the atmosphericCO_2. Studies employing diverse proxies have highlighted variations in past (glacial-interglacial)CO_2 concentration both in the atmosphere and deep sea. Here we display significant changes in the carbonate content and its variability from Tropical Indian Ocean during the Last Glacial Maximum (LGM). LGM represents an extreme cold interval in the Last Glacial Cycle characterized by the enhancement and extension of Northern hemispheric ice sheets. In addition,studies also reveal that LGM is associated with the slowdown of thermohaline circulation and enhanced sinking of atmospheric CO_2 in the subpolar ocean combined with poor ventilation in the deep waters of the tropical Indian Ocean. The eroded test of planktic foraminifera was well aligned with the CO_2-rich condition in the deeper waters of the tropical Indian Ocean. Erosion/peeling of the test of selected Planktic foraminifera reflects dissolution due to deep-seaacidification in the region. In general, the planktic foraminifera, and its abundance relates to ocean hydrographic conditions, associated with the changes in temperature and salinity. Here, based on our observation related to dissolution of the calcareous test, we proposed that the planktic foraminiferal test can also be used as a deep sea tracer to understand past variations in deep water circulation.

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SOUTHEASTERN ARABIAN SEA DENITRIFICATION VARIABILITY SINCE 28 KA

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Denitrification is the process by which nitrate and nitrite are reduced to nitrogen gas when the oxygen concentration falls below 1 μM in the oxygen minimum zones (OMZ; oxygen concentration on <20 μM) of the world oceans. The process of denitrification plays an important role in the release of N_2O (agreenhouse gas) to the atmosphere. Evidence of denitrification has been reported from various ocean basins, including the Arabian Sea, but there is still lack of information about the basin wide variabilityof denitrification in the eastern Arabian Sea and Indian Monsoon intensity through time. Here, we present nitrogen isotope ratios ($\delta^{15}N$, indicating denitrification), and total nitrogen (%N, surface productivity) from a sediment core SK 148/6 from the southeastern Arabian Sea (9□20' N and 75°33'Eat water depth of 890 m). The age-depth model of the core is based on fifteen C^{14} Accelerator Mass Spectrometer dates (Gourlan et al., 2020). The $\delta^{15}N$ varies from 4.4 ‰ to 6.8 ‰, with an average valueof 5.5 ‰ and total nitrogen varies from 0.2% to 0.7% with an average value of 0.3%. We consider 6 ‰ ($\delta^{15}N$) as empirical threshold for denitrification (Tripathi et al., 2017). □^{15}N shows an increasing trend during the early Holocene which further increased during the late Holocene. We compared our recordswith published denitrification records from the eastern, north-eastern and western Arabian Sea. We alsocompared the denitrification record with the atmospheric N_2O concentration. The study revealed that the denitrification in the Arabian Sea might have significantly contributed to the atmospheric N_2O during the last 28 kyr.

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PALEOBIOLOGIC STUDY OF THE BEACH ROCKS EXPOSED ALONG KOKAN COAST OF WESTERN INDIA: IMPLICATIONS ON PALEOCLIMATES

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The Konkan coastline between Maharashtra and Goa has been marked by diverse geological formations and the beach rocks exposed along the coastline are significant to understand depositional environment and paleogeography of the area. The Quaternary sediments exposed along beach consist of fine sand, calcarenite and calcareous conglomerates.

In the present study, samples from five selected beaches viz., Kshid, Adgaon, Diveagar, Aravi and Ganpatipule were studied to understand baleobiologic aspects and associated depositional environment and climate. The microscopic study of the beach rocks has been carried out to examine the distribution of paleobiota. Foraminifera and coralline algae are the dominant biota along with gastropods, barnacles and echinoid spines. However , Coralline algae have been recorded and studied in detail for the first time from the Quaternary sediments of the area.

This paleobiologic study based on associated biota indicate that the deposition of the beach rock occurred in shallow water marine environment with bathymetry fluctuating from interdital zone to a depth of about 60 m in tropical to subtropical climate.

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SEDIMENT GEOCHEMISTRY AND FORAMINIFERAL STUDIES IN THE ENNORE CREEK,SOUTHEAST COAST OF INDIA

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In last decades, the sediments in the Ennore creek has been intensively studied in numerous environmental studies focused on elemental (heavy metal) distribution in relation to anthropogenic impacts. The integrative approach we propose to assess the potential anthropogenic impacts (port activities, industry, municipal activities) on the Ennore creek is based on the benthic foraminifera assemblages. Benthic foraminifera are useful ecological indicators of depositional dynamics owing to their abundance and adaptations to different environmental conditions. This study evaluates the impact of the anthropogenic influence on benthic foraminifera and geochemical proxies. It is focused on the spatio-temporal comparison of geochemical properties (element concentrations) of sediments and benthic foraminifera from the surface and subsurface sediments in the creek with different degrees of anthropogenic load. 12 surface sediments and one core samples were collected to assess the trace metal distribution and its impact of the foraminiferal tests in Ennore creek. Based on the foraminiferal studies, 25 genera / species have been identified. Various sedimentological parameters such as $CaCO_3$, organic matter and sand-silt-clay ratio were determined for the samples in order to study the relationship between substrate and foraminiferal populations, and to evaluate the favored substrate of dominant species populations. All the samples are dominated by coarse fraction of the sediments. In general, all the core samples have higher concentration of OM and are depleted in $CaCO_3$ concentration. Foraminiferal assemblages are more in the silty sand and sand substrate environments. Based on the foraminiferal distribution, in the western part of the creek, species diversity are very rare in abundance due to the tidal fluctuation. In the middle and eastern part of the creek the species diversity is slightly higher due to the salinity influence.Sediment samples were analyzed for a range of heavy metals using Inductively Atomic Absorption Spectrometry (AAS). The results reveal elevated concentrations of these metals, exceeding natural background levels, indicating substantial anthropogenic input. Spatial distribution patterns of heavy metals were mapped to identify hotspots of contamination, closely associated with industrial discharges, urban runoff, and port activities. Enrichment factor (EF), Contamination Factor (CF) and geo-accumulation index (Igeo) calculations were employed to quantify the degree of pollution and assess the potential ecological risk. The study also incorporates multivariate statistical analyses, such as Principal Component Analysis (PCA) and Cluster Analysis (CA), to distinguish between natural and anthropogenic sources of contamination. It was found that the benthic foraminifera respond to elevated concentrations of certain heavy metals by changes in their test morphology and size. This work contributes to detect anthropogenic stress against a background of natural conditions in the Ennore creek.

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ASSESSING FLORAL RESOURCE CHANGES AND BEE FORAGING TRENDS INRESPONSE TO CLIMATE VARIABILITY: A MELISSOPALYNOLOGICAL STUDY

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Climate variability has profound impacts on ecosystems worldwide, influencing not only the distribution and abundance of plant species but also the foraging behaviour and survival of pollinators, particularly bees. Bees are crucial for the pollination of many crops and wild plants, making them vital to both agricultural productivity and biodiversity. However, changes in climate, such as shifts in temperature, precipitation patterns, and the frequency of extreme weather events,can disrupt the availability of floral resources, affecting the foraging patterns of bees. This study based on Melissopalynology (the study of pollen grains in honey) has been taken to investigate how climate change affects pollen variety and distribution in Kanpur and the surrounding areas. Honey pollen spectrum is influenced by a variety of land use types, as seen by the samples that were collected from residential, agricultural, and densely vegetated locations. We examine how shifting climatic circumstances affect the variety and accessibility of floral supplies that are vital to bee populations by examining these samples ina range of seasons. The pollen/spore recorded in the present study from residential sites comprise *Syzygium cumini*, *Azadirachta indica*, *Cassia fistula*, *Acacia catechu*, *Rosa indica*, Anacardiaceae, Asteraceae, while the vegetated localities include *Ziziphus*, *Caesalpinia pulcherrima*, *Eucalyptus*, *Azadirachta indica*, *Bombax ceiba* and many more. The agriculture dominated sites records *Brassica campestris*, *Coriandrum sativum*, Asteroideae, Cichorioideae, Cereals, and Non-Cereals and many more in sporadic counts. The results show considerable changes in pollen composition, suggesting that climate change may be theprimary driver of these changes in vegetation patterns. Examples of how temperature and precipitation variations have affected important plant species; flowering cycles include differences in the kinds of pollen that pollinators collect. These modifications reflect wider biological adjustments in the regions biodiversity as well as changes in bee foraging behaviour. The significance of comprehending how pollinator health, ecosystem stability, and climate change are interdependent is highlighted by this research work. In order to, preserve pollinator populations and guarantee the adaptability of regional ecosystems to climatic shifts, apiculturists, and conservationists, need to know the insights thathave been obtained.

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ORBITAL SCALE CHANGES IN THE INDIAN SUMMER MONSOON CONDITIONS

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The Indian summer monsoon (ISM) is among the most complex climate phenomena on the Earth. It transports ~75-80 per cent of the annual precipitation in most of the regions of South Asia and has a great bearing on regional hydrology and ecology as well as socio-economic growth of billions of people in South Asia. Because of its significance, numerous attempts have been made to use modeling and paleoclimatic studies to comprehend the variability of the ISM at different time scales, as well as its forcings and influencing mechanisms. However, the scarcity of paleoclimatic records at this scale, particularly from continental areas, makes understanding of s orbital scale ISM changes elusive. In the present study, we have developed a speleothem oxygen isotope ratios ($\delta^{18}O$) from the Bhiar Dhar cave, Uttarakhand showing changes in the ISM conditions in the northwestern Himalaya during late marine isotope stage (MIS)-9 and early MIS-8. The findings show that there was strong ISM from 292 to 287 kyr BP and weakening ISM conditions between 309 and 292 kyr BP and 286 to 264 kyr BP. Around 287 kyr BP, there was a sudden increase in ISM-linked precipitation, which was followed by a weakening of the ISM. A weak ISM with secular variations is suggested by the oxygen isotope ratio between ~286 and 264 kyr BP, when the monsoon significantly strengthened thereafter. The orbital scale changes in the ISM rainfall from 309 to 260 kyr BP in the study area seem to have been influenced by the global ice cover and atmospheric CO_2 concentration superimposed by the northern hemisphere solar insolation.

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LATE PLIOCENE-EARLY PLEISTOCENE PALAEOBIODIVERSITY AND PALAEOENVIRONMENT OF JAMMU PROVINCE

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The Upper Siwalik Subgroup of Jammu province contains rich assemblage of vertebrates, invertebrates, microfossils and trace fossils. The Upper Siwalik Group of Jammu classified into three formation viz. Purmandal Sandstone Formation (=Tatrot Formation), Nagrota Formation (=Pinjor Formation) and Tawi Conglomerate Formation (=Boulder Conglomerate Formation). Among three formations, Nagrota Formation Contain rich assemblage of fossil specimens as compare to Purmandal Sandstone Formation and Boulder Conglomerate formation. In the present study, the author discussed the palaeobiodiversity and Palaeoenvironment of the Nagrota Formation (Late Pliocene to Early Pleistocene) based on the fossil specimen recovered by authoritself and the data collected from published literature by various author from time to time. The sequence of palaeobiodiversity of the of the fauna and flora of Late Pliocene-Early Pleistocene ofthe Jammu region from richest to poorest as under Ostracodes → ichnofossils → Charophytes →Rodents → Fishes → microgastropods → Lizards → Angiospermae seeds. As far as Palaeoenvironment is concern, a terrestrial-interfluvial- lacustrine palaeoenvironment is suggested for Late Pliocene-Early Pleistocene sections of Jammu region based on the fauna and flora

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FUTURE WARMING WILL DECREASE MIXED LAYER DEPTH IN THE TROPICAL CENTRAL INDIAN OCEAN

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The Indian Ocean is the fastest-warming region in modern times. The model observations suggest that the Indian Ocean's mixed layer depth (MLD) will decrease under global warming. However, in-situ Argo profile studies indicate a deepening of the MLD by 4 m during 2006-2021. To address this model-data discrepancy, studying high-resolution analogues warming records can help us to better understand the fate of MLD in future. To do so, we have reconstructed high-resolution sub-centennial scale MLD variability from the tropical central Indian Ocean using a marine sedimentary archive, SSD004 GC03. We made use of planktic foraminiferal assemblages, the difference in the stable oxygen isotopes ($\Delta\delta^{18}O$) and Mg/Ca-based temperatures (ΔT) of surface-dwelling (*Globigerinoides ruber*) and thermocline-dwelling (*Neogloboquadrina dutertrei*) planktonic foraminifera over the last 24 kyr. Our resultsshow a shoaling of MLD during the period of rapid warming, such as Heinrich stadial 1 (HS1)and Younger Dryas (YD). Our findings indicate that the monsoon winds intensity played a significant role in regulating the MLD in the tropical Indian Ocean. A warmer tropical Indian Ocean leads to a lower ocean-land pressure gradient, resulting in weaker monsoon wind strength. We further suggest that the projected warming of the Indian Ocean in the near futurewill weaken monsoon winds and consequently decrease the MLD.

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UNDERSTANDING PALEOCLIMATIC VARIABILITY IN SIWALIK HIMALAYAS FOR LAST 700 YEARS

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The Himalayan region is home to many lakes, rivers and glaciers. It is a major contributor of the hydrological budget of Central, south east and south Asia. Indian Summer Monsoon (ISM) is responsible for majority of rainfall in the Indian Himalayas, whereas Western Disturbances (WD) contribute about 15-25% of rainfall at higher altitudes of the Himalayas. Proxy records from lakes, speleothems, tree-rings from Indian Himalayas show temporal and spatial variation of rainfall. Furthermore, in order to understand the forcing mechanisms behind paleoclimatic variability, we have chosen a one-meter long core from Tikkar Taal Lake in Morni Hills, Panchkula district of Haryana, located in the Siwalik Himalayas. Grain size, major and trace element ratios, Total Organic Carbon (TOC) %, and stable isotope (δ13C ‰) in combination with five Accelerated Mass Spectrometry (AMS) 14 C dates (based on gastropod and bulk organic matter) produce a continuous paleoclimatic record of the past 700 years, from ~1300 to 2018 CE. Statistical analysis consisting of End Member Models (EMMs), Principal Spectral Analysis (PCA), spectral analysis and continuous wavelet analysis are done. Based on the above-mentioned analyses, the lake paleoclimatic records Little Ice Age (LIA) (~1300 -1900 CE), and Current Warm Period (CWP) (~ 1900- present). The lake also records intense arid phase during Maunder Minimum (1645- 1715 CE) and Dalton Minimum (~1870-1900 CE). The data records also show solar variability coupled with North Atlantic Oscillation (NAO), El Nino Southern Oscillation (ENSO), and Pacific Decadal Oscillation (PDO) plays an important role in the control of moisture in this region.

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FIRST RECORD OF TORTONIAN-MESSINIAN SILICOFLAGELLATES FROM THE ONSHORE OF ANDAMAN ANDNICOBAR BASIN

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Biostratigraphic studies from the onshore of Andaman and Nicobar Basin documented well developed marine Neogene sequence that includes Burdigalian, Langhian to Tortonian and Piacenzian ages based on micropalaeontological investigations of calcareous nannofossils, planktic foraminifera, radiolarians and diatoms. However, the Messinian sequence from the onshore of Andaman and Nicobar Basin has not been identified till date. Moreover, the Tortonian-Messinian boundary/transition in this basin has not been demarcated earlier. Using multiple microfossil biostratigraphy based on calcareous nannofossils and radiolarians, the topmost Tortonian sequence, the boundary/transition between Tortonian and a substantial part of the Messinian sequence have been identified from the Sitapur Village Section of Neil Island nearNeil East Coast of Ritchie's Archipelago, South Andaman. The present study is specifically focused on the silicoflagellate biostratigraphy. With the aid of both light microscopic study and Scanning Electron Microscopy the following silicoflagellate taxa have been identified: *Bachmannocena elliptica, Diastephanopsis crux, Dictyocha calida, Dictyocha extensa*, *Dictyocha extensa* (medusid), *Dictyocha extensa* subsp. *longa*, *Dictyocha fibula, Dictyocha fibula* (naviculopsid), *Dictyocha fibula* subsp. *ausonia*, *Dictyocha fibula* subsp. *mutabilis*, *Dictyocha perlaevis*, *Dictyocha varia*, *Stephanocha speculum* (5 sided), *Stephanocha speculum*(6 sided) and *Stephanocha speculum* var. *tenuis.* Biostratigraphically, the silicoflagellate assemblage is assignable to *Dictyocha extensa* Partial Range Zone which is defined by the Last Common Occurrence (LCO) of *Dictyocha varia* to the Top common (Tc) of *Dictyocha extensa*. Qualitative estimation of palaeotemperature changes has been done from the ratio of *Dictyocha/Stephanocha* (=*Distephanus*) in the analyzed samples.

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UNDERSTANDING THE SENSITIVITY AND THRESHOLDS OF MICROFOSSILS FROM PALEOCENE-MIOCENESECTIONS IN INDIA

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The Cenozoic history of Earth comprises of climatic perturbations, which swing from the extremes of the greenhouse to the icehouse. These extreme climatic conditions have caused changes in species abundance of microfossil groups like foraminifera, diatoms, dinoflagellates, pollens, and spores. To better understand the causal relationships between climatic conditions of the past and their effect on various microfossil groups, we need to employ robust statistical tools like Principal Component Analysis, Detrended Correspondence Analysis, and Diversity Analysis. For this study, we have compiled a microfossil dataset spanning the Paleocene-Miocene interval within the Indian subcontinent. We observe that the Shallow Benthic Foraminifera dataset showcases a threshold between seawater temperature and species diversity as well as abundance. In this work, we will demonstrate seawater temperature limits for several microfossil groups and discuss our preliminary dataset with its implications for future research in this area.

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INCREASED CARBON BURIAL BY BENTHIC FORAMINIFERA IN A WARMING WORLD

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The seawater temperature is a crucial ecological parameter for all marine organisms, significantly affecting their growth, survival, and reproduction. The specific temperature limits for these processesvary among the communities and can be accurately determined only through in vitro investigations. Understanding these temperature dependent responses is vital to predict the resilience of benthic foraminifera, a dominant community in the marine regions, and their function in marine ecosystems as global temperatures continue to rise. In a majority of the previous studies, a few specimens of an individual species were subjected to a fixed temperature under controlled conditions. Here for the firsttime, we examined the response of the complete coastal water benthic foraminiferal community to adiurnally varying range of temperature (24-28°C, 25-29°C, 26-30°C, 27-31°C, and 28-32°C). The seawater salinity was consistently maintained and freeze-dried feed was uniformly provided to all theexperimental sets. Interestingly, the highest abundance of both the living and dead benthic foraminifera was observed at the warmest temperature, while the lowest number was recorded at 25-29°C in living benthic foraminifera, suggesting a large increase in benthic foraminiferal population withincreasing temperature. The abundance of calcareous benthic foraminifera increased as temperature increased, suggesting their greater ability to adapt or withstand higher temperatures, while the number of agglutinated benthic foraminifera decreased, suggesting their vulnerability to thermal stress. The increased benthic foraminiferal population resulted in the higher total inorganic carbon, highlighting a potential increase in benthic foraminiferal calcification lead carbon burial at higher temperatures. The results of the study highlight the importance of temperature in regulating the growth, survival, and ecological function of benthic foraminifera.

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PALEOCEANOGRAPHIC EVOLUTION OF THE SOUTHEASTERN PACIFIC OCEAN OVER THE LAST ~400 KA

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The formation of Antarctic Intermediate Water (AAIW) in the Southeastern Pacific (SEP) is influenced by the upwelling of Circumpolar Deepwater and the downwelling of Antarctic Surface Water, which potentially affects atmospheric CO_2 concentration. Antarctic Circumpolar Current (ACC) was stronger throughout the interglacial stages, which might have influenced the Patagonian Icesheet (PIS) dynamics. Hence, to assess the AAIW and ACC variability and their linkages to PIS dynamics at SEP, sediment core samples from International Ocean Discovery Program (IODP) Site U1542 (~1100m water depth, spanning over ~400 ka) are examined for benthic foraminifera and major minerals. Coherent results of the multivariate statistical analysis allowed to identify six benthic foraminiferal biofacies, which are used to reconstruct the paleoceanographic changes at SEP. From Termination-IV to Termination-III (T-III) stronger ACC and enhanced AAIW formation are suggested by the dominance of oxic biofacies. However, the intermittent retreat of PIS caused increased nutrient flux, and more oxygen consumption, which caused the dominance of suboxic biofacies between T-III and Termination-II (T-II) with an intermittently stronger influence of ACC. Shortly after the T-II, oxic bottom water remained until ~100 ka, followed by suboxic to dysoxic conditions towards the Holocene. Our findings suggest that PIS expansion and contraction control the nutrient flux, which are influenced by ACC strength at SEP, and is related to AAIW formation. These dynamics of ACC and AAIW can be linked to atmospheric CO_2 sequestration affecting the low-latitude climate system.

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SIGNIFICANCE OF GREEN ALGA *Pediastrum* IN FOSSIL RECORDS: NEW PALAEOENVIRONMENTAL INSIGHTS FROM PALAEOGENE SEDIMENTS OF INDIA

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The multicellular planktonic green algal genus *Pediastrum* (Order Sphaeropleales; Family Hydrodictyaceae) is characteristic of modern freshwater habitats with a cosmopolitan distribution. Fossilized coenobia of this alga have been recorded from marine sediments of the late Ypresian-early Lutetian Subathu Formation (Shimla Hills, Himachal Pradesh and Morni Hills, Haryana) as well as the Bartonian Fulra Limestone Formation (Kutch Basin, Gujarat). The current study involves the morphological assessment of the genus *Pediastrum* Meyen 1829 and its palaeoenvironmental inferences.A variety of morphological features like the shape, size, number of coenocytes, presence or absence of central coenocytes etc., were considered for the identification of *Pediastrum* specimens up to the species level. Several morphotypes have been identified at the species rank viz., *P. ovatum* and *P. boryanum*. The fossil specimens of the genus have been compared with the extant analogues reported from India to understand its diversification and palaeoenvironmental affinities in the deep time perspective. The co- occurrence of *Pediastrum* with the marine dinoflagellate-dominant assemblages comprising genera like *Achomosphaera*, *Lingulodinium*, *Operculodinium* and *Spiniferites*is a noteworthy observation. It is interpreted that *Pediastrum* thriving in freshwater ecosystems close to the nearshore environments might have been transported by means of some water channels connecting the two diverse environmental habitats.

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DIATOMS: RECORDERS OF WETLAND AND CLIMATE CHANGE

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Recent years have revealed the changing climatic conditions across the globe caused due to emission of greenhouse gases through myriad human activities. Therefore, the study of changing climatic conditions and its controlling mechanism using natural climatic archives is of utmost importance. Wetlands are considered as important carbon sinks which can help not only in understanding signatures of the past climatic cycles on land but could also be used as potential source areas to understand the mitigation strategies on the global warming. Diatoms are one of the potential groups of the siliceous microfossils usually occurring in all the aquatic (freshwater, brackish and marine) environments and respond quickly to any environmental, ecological and climatic changes owing to their high sensitivity to these factors. Therefore, diatoms are often used to study present and past water quality (pH, conductivity, alkalinity, nutrients and salinity), climatic changes, wetland management etc. apart from their several uses in coastal, marine, industrial, geo-archaeological, forensic sciences etc. Diatom based "Transfer Function" is one of the significant methods developed using simple weighted averaging for pH, conductivity, Mg%, Ca%, Na+K(%), sulphate(%), chloride(%), Temperature and salinity content of lakes/wetlands with strong correlation coefficient (R^2) values. Similarly, eutrophication and productivity of the wetlands in the past can be comprehended by means of diatom based P (µg/l) values. The transfer function can be build up for the reconstruction of past hydrochemistry using fossil diatoms from sediment cores. Many natural wetlands and closed lake basins show highly resolved sediment accumulation rate and may be used to access to ENSO-scale or inter-annual (even intra-annual) monsoonal variability of diatoms and phytoliths. Mean linear diameter (MLD) of diatom frustules may also be used to interpret paleo-climatic/ paleo-monsoonal conditions as climatic conditions directly influence the concentration of nutrients in the wetlands limiting the growth of diatoms. The fossil diatom records present perspective for contemporary wetland ecology and time framework assimilating ecology and climate. Thus, the study of significant wetlands including the Ramsar ecological types could open a new window for earth scientists' to wetland management and their global appraisal.

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MICROVERTEBRATE RESEARCH IN INDIA: SOME RECENT ADVANCES FROM PENINSULAR INDIA

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In recent years, several fossil finds from the Late Cretaceous-Miocene sequences of peninsular India have underscored the importance of microvertebrate records in the context of intercontinental faunal dispersal, evolutionary (phylogenetic) relationships, paleogeographic setting, and the geological age of the continental horizons. The first and the only eutriconodontan mammal (*Indotriconodon magnus*) from the Cretaceous of India, recently described from the Deccan intertrappean beds at Anjar, highlights the unique nature of the late Cretaceous (Maastrichtian) mammal faunas of India, which is characterized by mixed influences of Gondwanan and Laurasian affinities. This new taxon from Anjar represents the first relatively large-bodied faunivore among the intertrappean mammal faunas, suggesting a mature lacustrine ecosystem with abundant prey. Another recently reported discovery from India is that of a new nyctitheriid insectivore *Indonyctia cambayensis* from the early Eocene (~ 55 Ma) Cambay Shale of Gujarat. In several respects, the Indian nyctitheriid is closely similar to a late Palaeocene taxon (*Voltaia*) from Central Asia, suggesting terrestrial faunal exchanges between India and the Mainland Asia close to the Palaeocene-Eocene boundary (~56 Ma), around the time of India-Asia collision. These faunal exchanges between India and Asia may have been facilitated by the Kohistan- Ladakh Arc which acted as a filter bridge between the two landmasses. Finally, a recently described diverse assemblage of Miocene rodents from Kutch, which includes murines, primitive bamboo rats, chipmunks, is significant in the context of palaeogeography because it suggests a largely homogeneous mammalian fauna (with some differentiation) throughout much of the Indian Subcontinent in the Late Miocene. The Kutch rodent assemblage is estimated at about 10 to 11 Ma and provides an early Late Miocene window on the evolutionary history of the small mammal fauna in the Indian subcontinent. Non-mammalian microvertebrate finds include a new cordyliform lizard (*Deccansaurus palaeoindicus*) from the Upper Cretaceous Deccan intertrappean beds of the lower Narmada valley. Close resemblance of *Deccansaurus* with the Late Cretaceous *Konkasaurus* from Madagascar documents faunal exchanges between the two landmasses during India's northward drift even after its separation from Madagascar. Finally, the recently reported occurrence of a batoid fish (stingray genus *Igdabatis*) provides first compelling evidence of potential marine influences during the deposition of freshwater Deccan intertrappean sediments (Late Cretaceous, Maastrichtian) in the lower Narmada valley of west-central peninsular India.

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VARIABILITY AND ADAPTATION OF DEEP-SEA BENTHIC MEIOFAUNA *Desmoscolex* NEMATODE AND AGGLUTINATED FORAMINIFERA AT THE HIGH-LATITUDE SOUTHERN PACIFIC

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The high-latitude regions are known for diverse array of benthic meiofauna, yet our understanding of these communities remains limited, particularly in the deep ocean. This studyseeks to investigate the variability and adaptation of nematodes and rare agglutinated foraminifera in the modern sediments of the South Pacific Ocean at water depths >3500 m. Theanalysis of mudline samples from International Ocean Discovery Program Sites U1539, U1540, U1541, and U1543, revealed morphologically similar nematodes during the microscopic study belonging to the *Desmoscolex* genus. However, detailed analysis using scanning electron microscopy and energy dispersive spectroscopy revealed striking differencesin their test construction materials. One nematode species utilized calcitic grains exclusively derived from the coccoliths of *Calcidiscus leptoporus*, while another incorporated fine-grained siliciclastic material into its test, cemented with calcareous and organic compounds. Among the agglutinated foraminifera, a diverse array of species was observed, including *Reophax* spp., *Rhabdammina* spp., *Hormosinella globulifera*, *Lagenammina difflugiformis*, *Ammodiscus anguillae*, and *Paratrochammina* sp. Interestingly, some specimens exclusively utilized tests from planktic foraminifera such as *Globoconella inflata* or coccoliths from species like *C. leptoporus*, *Coccolithus pelagicus*, or *Helicosphaera carteri*, and other siliciclastic material, intheir test construction. This selective behaviour suggests a high level of adaptation of these meiofaunas to the surrounding environment. Overall, our findings highlight the remarkable ability of these benthic nematodes and agglutinated foraminifera to adapt and selectively choose grains for their test construction.

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ECOLOGICAL EVOLUTION OF SEASIDE REGION OF THE CHILIKA LAGOON

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Chilika lagoon, situated on the east coast of India, is a complex ecological system controlled by wave and tide actions of the Bay of Bengal along with the freshwater from the Mahanadi rivers. Several seasonal ecological studies have been done in the lagoon, but less ecological evolution records are available from the seaside region of the lagoon, which is of extreme importance as the lagoon regularly shifts its sea mouth and a few mouths artificially opened inrecent decades. Hence, to assess the ecological variations in the seaside region, a 75 cm sediment core is recovered and analyzed for micro-organisms (Foraminifera and Ostracoda)and grain size parameters. Seasonal study over the region suggests the transition from marine to tidal environment significantly impacts the foraminifera and ostracod abundance anddiversity. The diversity and abundance of foraminifera and Ostracoda along with grain sizeparameters and deduced energy conditions, from this study, suggest that the seaside region hasexperienced three different environmental conditions within 75 cm of the core. The high tideand energy condition tolerant *Ammonia beccarii* are abundant in the core between 75 and 50cm which is positively correlated with sandy substrate, high energy conditions suggestingsediment deposition took place by wave and tide activities. Sudden change has been observedabove 50 cm, when silt domination and deposition started to take place initially in mediumenergy condition and later in low energy conditions. The foraminifera are diversified withenrichment of agglutinated foraminifera like *Textularia, Milliamina,* and *Haplophragmoides*species along with *Ammonia tepida,* in between ~50 and 20 cm. This might be the time ofswitch in sea-mouth or associated with the closure of sea-mouth. The top 20 cm of the core,were deposited in relatively fresh and low energy condition having fresh to brackish waterostracod and *Quinquiloculina* spp. Most part of this deposited when sea-mouth was blockedand lagoon started to become fresh. However, later new sea-mouth was artificially opened andadditional sea-mouth was opened due to cyclones, which restored the lagoon's brackishness.

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LARGER FORAMINIFERAL BIOSTRATIGRAPHY, PALEOENVIRONMENT AND PALEOGEOGRAPHY OF THE EARLY EOCENE KONG FORMATION OF THE ZANSKAR, TETHYAN HIMALAYA

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Formed by the powerful collision of tectonic plates, the Himalayas stand tall as a testament toEarth's dynamic forces. This 2,500 km long Mountain range stretches from eastern Tibet to northwestern Pakistan. Its eastern and western limits are marked by the Namche Barwa and Nanga Parbat syntaxis respectively (Gansser 1964; Le Fort 1975; Srikantia 1988; Yin 2006; Bhargava 2008b; Bhattacharya et al.2021). From north to south, the Himalaya is divided into four lithotectonic zones; the Tethyan Himalayan zone (THZ), the Greater Himalayan zone (GHZ), the Lesser Himalayan zone (LHZ) and the Sub-Himalayan zone (SHZ), and these unitsare bounded by South-Tibet Detachment System (STDS), Main Central Thrust (MCT) and theMain Boundary Thrust (MBT) (Gansser, 1964; Le Fort, 1975; Hodges, 2000; Yin and Harrison,2000; Yin, 2006; Bhattacharya et al., 2021). In the NW Himalaya, the Cretaceous andPaleogene succession is developed along Zanskar Tethyan Zone (ZTZ) of Tethyan Himalaya (TH). A succession of Precambrian to Eocene formations were deposited on the northern margin of the Indian Continent. The environment is predominantly that of a shelf. Interesting information on the geodynamic evolution is deduced from the distributions and changes of sedimentary facies in the final stages before the beginning of the Himalayan orogenesis. Cretaceous and Early Tertiary formations are the youngest beds of the Tethyan Zone which cover large areas in Ladakh. In the present study, we report *Nummulite mamillatus, Nummulitesatacicus, Assilina laminosa, Assilina placentula, Assilina spinosa, Assilina sub spinosa, Assilina sublaminosa,* and *Discocyclina dispansa* from the Kong shale consisting of white shale, limestone lenses, and calcareous shale. The thickness of this formation is 85 metres in Kong river area. On the basis of the above mentioned larger foraminifers, a Shallow Benthic Zone (SBZ) of 7-12 is assigned corresponding to an early Eocene age and a neritic zone of thedeposition. Based on the present finding, we also infer paleogeography and tectonic evolutionof the Zanskar Tethyan Zone.

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STUDY OF SURFICIAL FORAMINIFERA FROM THE BANKS OF MATLARIVER, INDIAN SUNDERBANS

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The largest mangrove wetland vegetation of India is the Sunderbans present in the southern part of West Bengal, which supports a huge biodiversity. This wetland is primarily a tide-dominated wetland. Many tributaries and distributaries rivers of the Ganga can be found here, including the Muriganga, Saptamukhi, Thakuran, Matla and Bidyadhari, among others. Foraminifera are highly sensitive marine protists which are excellent indicators of climatic changes. This study examines the foraminiferal population, both living and dead, in the surficial marshes along the banks of the Matla River. A total of twenty eight surface sediment samples of 100 cm^3 were collected, covering differentmarsh environments along the banks of the Matla River (Kaikhali to Banashyam Nagar area) in the month of November 2023. Standard procedures for sample collection and processing have been followed for this study. A total of fourteen species of benthic foraminifera were identified. Among them, nine calcareous hyaline species were found; namely, *Ammonia beccarii*, *Ammonia tepida*, *Ammonia parkinsoniana, Cocoarota madrasensis, Cribroelphidium poeynum, Cribroelphidium hispidulum*, *Elphidium advenum*, *Haynesina depressula* and *Haynesina germanica.* Four agglutinated species are observed: namely, *Trochammina inflata, Haplophragmoides canariensis, Haplophragmoides wilberti, Miliammina fusca* with minor sporadic instances of calcareous porcelaneous foraminifera *Quinqueloculina seminulum.*
To understand the distribution pattern of foraminifera, the fauna were analyzed using Murray'sTernary Diagram and multivariate statistical analysis. Murray's Ternary diagram shows the post-monsoon (November) samples have a dominance of calcareous hyaline forms in this region. The total foraminiferal number (TFN) per gram of dry sediments varies from 0 to 708.Living foraminifera constitutes up to about 50% of the assemblage in certain sampling stations.Diversity of the overall assemblage is low (α = 1-2). The areas corresponding to lesser abundances of foraminifera show more anthropogenic involvements.

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DEEP WATER CARBONATE CHEMISTRY AND VENTILATION OF THE ARABIAN SEA DURINGTHE LAST DEGLACIATION

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It is well accepted that sequestered carbon was outgassed to the atmosphere by upwelling of deep water in the Southern Ocean during the last deglaciation. However, there is evidence of CO_2 outgassing from the northern Indian Ocean too. The first boron isotope-based pCO_{2sw} (pCO_2 of seawater) reconstruction from the eastern Arabian Sea using the planktic foraminiferaspecies *Globigerinoides ruber* from the sediment core AAS9/21, showed that ΔpCO_2, the sea-air pCO_2 difference, was in significant excess during the last deglaciation (Naik et al., 2015). Ventilation changes in the deep waters of the northern Indian Ocean over the past 25 kyr BP using paired benthic and planktic foraminiferal radiocarbon, from the gravity core SSD- 044/GC-01 (3160 m water depth) collected from Central Equatorial Indian Ocean showed a greater proportion of southern sourced CO_2-rich, poorly-ventilated Antarctic Bottom Water (AABW) during the Last Glacial Maximum (LGM) and Heinrich Stadial (HS1) (Nisha et al., 2023). Furthermore, there was an improved ventilation during the Bølling-Allerød (B-A) whichis consistent with the rapid resumption of Atlantic overturning circulation and inflow of NorthAtlantic Deep Water (NADW) into the northern Indian Ocean at the onset of the B-A, which caused flushing of the deep-carbon pool. Deep-water carbonate ion concentrations ($[CO_3^{2-}]$) estimated using B/Ca ratios of epibenthic foraminifera *Cibicidoides wuellerstorfi* from three cores bathing in different water masses of the EAS reveals the existence of stored CO_2 in deepwaters of the EAS during the LGM, and a further rise in $[CO_3^{2-}]$ of deep waters, during the deglaciation. The rise in $[CO_3^{2-}]$ during the deglaciation indicates outgassing of stored glacial CO_2 from deep waters.

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MICRO-MORPHOMETRY OF CEREAL AND NON-CEREAL POLLEN USING LM, CLSM AND FESEM: IMPLICATIONS TO DECIPHER PAST ANTHROPOGENIC ACTIVITIES IN THE CENTRAL GANGA PLAIN

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One of the most important criteria to distinguish wild grasses from those of cultivated ones lies in their pollen micro-morphological characteristics, which has proven to be an immensely useful tool in reconstruction of the past human influence and paleoecology. The investigation of 22 species of cereal and non-cereal pollen using Light Microscopy (LM), Confocal Laser Scanning Microscopy (CLSM), and Field Emission Electron Microscopy (FESEM) is a maiden attempt from India to develop a biometric threshold for distinguishing cereal and non-cereal pollen. When we realize pollen studies to solve the query related to anthropization or inception of agricultural activities, it is important to clearly distinguish pollen grains of wild from cultivated grasses from Central Ganga Plain, which is regarded as the food basket of the country. The eight species of cereal and fourteen species of non-cereal pollen possess significant differences in pollen grain (GD) and annulus diameter (AD). The paired threshold (46-9 μm) appeared to be a discriminant pair, where cereal pollen bears the pollen grain and annulus diameter of above than threshold (>46; >9 μm) and non-cereal possess less than (<46; <9 μm). The pollen surface ornamentation of Poaceae pollen grains was also investigated extensively using FESEM for developing new tools to reconstruct past human habitation and climate. The Principal Component Analysis (PCA) of the 22 grass species revealed two major clusters along with *Zea mays* as an outlier, based on the major pollen morphological characters. However, the overall Hierarchical Cluster Analysis (HCA) indicates three clusters at a dissimilarity of 0.255. This extensive pollen morphological examination wouldprovide a comprehensive dataset for the identification of fossil cereal and non-cereal pollen (up tothe species level) retrieved from the sedimentary sections of the Ganga Plain for deciphering pasthuman influence and anthropogenic activities.

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VARIABILITY IN THE UPPER WATER COLUMN STRUCTURE DURING THE GLACIAL-INTERGLACIAL TRANSITION

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The influence of summer and winter monsoons on the past water column structure from the Indian Ocean are still limited. Hence, a multi-proxy approach is used on a sediment core from the west central Bay of Bengal to document the variability in the water column structure for the last ~28 kyr. Our dataset includes faunal abundances of *Globigerina bulloides*, mixed layer and thermocline species of planktic foraminifera and $\delta^{18}O$ of *Globigerinoides ruber*, which reveal large reorganisation in the water column structure during the last glacial-interglacial transition. The intense upwelling shoaled the thermocline during a part of the glacial interval (~26.5–28.4 kyr BP), last glacial maximum (~18.5–24.0 kyr BP), late deglaciation (~10.5–14.5 kyr BP) and Meghalayan Age. The later phase of the deglaciation was a very dynamic phasewhere a large reorganization of the water column structure took place. The thermocline shoaled significantly which was clearly driven by strong upwelling during the summer monsoon. An increased M/T index during ~24.0–26.5 kyr BP, the early deglaciation (~14.5–18.5 kyr) and Late Greenlandian- Northgrippian Age, suggests a deepening of the thermocline. The deepened thermocline during these intervals coincided with reduced abundance of *G. bulloides* and $\delta^{18}O_{sw\text{-}ivc}$ suggesting reduced upwelling and stronger winter monsoon.

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VOLCANIC ASH AND FORAMINIFERA: A DUAL ARCHIVE FOR UNDERSTANDING GLACIAL-INTERGLACIALTRANSITIONS IN THE NORTH ATLANTIC (IODP 395)

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International Ocean Drilling Program (IODP) Expeditions 384/395C/395 drilled contourite sediments at diverse locations in the North Atlantic Ocean providing high-resolution records across Plio-Pleistocene glacial and interglacial periods. The study of ash layers and the presence of foraminifera within the marine contourite deposits of the Bjørn Drift south of Iceland provides crucial insights into volcanic activity, sedimentation processes, and paleoenvironmental conditions during the Quaternary Period. The present study encompasses sediments from the last 350 ka from Bjorn Drift (Site U1554) and identifies and characterizesdistinct ash layers within the contourite sequence, correlating them with known volcanic eventsin the North Atlantic region, particularly from Icelandic volcanoes. Visual interpretation reveals the thickness of these ash layers varies between 10s of a centimeter of very fine-grainedsize fractions. These are found to be mixed between bulk sediments comprised of silty clay with moderate bioturbation. Here, we find a relationship between an increase in the sedimentation rate and most of the ash layer deposition comprised within MIS 8. As ice sheetsbegan to retreat during the transition from glacial to interglacial conditions, the reduction in pressure could have led to enhanced volcanic eruptions. This could result in increased deposition of tephra in the marine core, contributing to the sedimentary record during MIS8. The deposition of volcanic ash leads to changes in the overall composition of marine sediments, including the dilution or enrichment of foraminiferal remains during that period. Ash layers also create distinct horizons within the sediment column, potentially affecting the preservation and concentration of foraminifera. The study of these layers helps in understanding the sedimentary processes and the post-depositional effects of volcanic ash on foraminiferal records. These initial findings contribute to a more detailed reconstruction of the North Atlantic's paleoceanography and provide a valuable framework for future research on volcanic influences in deep-sea environments.

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ADVANCING FORAMINIFERAL RESEARCH THROUGH INTEGRATION OF TRADITIONAL MORPHOLOGY WITH DNA BARCODING AND METABARCODING TECHNIQUES

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DNA barcoding and metabarcoding have revolutionized foraminifera studies by enabling precise identification and characterization of these microscopic marine organisms. Traditional morphological methods, often experience limitations due to the morphological similarity among species and the presence of cryptic species. DNA barcoding, which uses short, standardized genetic sequences, provide an morphological independent information that has facilitated species-level identification with greater accuracy, especially in distinguishing morphologically indistinguishable species. Metabarcoding, leveraging high-throughput sequencing, extends this approach by allowing the simultaneous analysis of environmental samples containing mixed foraminiferal communities. This method provides a more comprehensive view of foraminiferal diversity and their ecological roles in various environments. The integrated classical morphological and ribosomal DNA based techniques are crucial for paleoenvironmental reconstructions, biodiversity assessments, and monitoring environmental changes, as they offer more detailed insights. The integration of morphological methods with DNA barcoding and metabarcoding in foraminiferal studies thus holds significant potential for advancing our understanding of marine ecosystems and the evolutionary history of foraminifera.

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STRATIGRAPHIC UPDATE ON SANDHAN FORMATION: CENOZOIC SUCCESSION, WESTERNKUTCH, INDIA

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Kutch basin of the western India provides excellent exposures and almost complete marine Cenozoic succession in India. The deposition in the Cenozoic of Kutch took place in a passive margin setting, sedimentation primarily controlled by relative sea-level fluctuations vs. rate of siliciclastic supply, with minimal tectonic intervention. The Sandhan Formation represents the terminal Cenozoic succession of Kutch, dominated by siliciclastic sediments. The type section is exposed along the Kankawati River which extends from 2 km south of Vinjhan village to the south of Sandhan village, where it is overlain by the Quaternary to sub-Recent sediments. The observations are further supplemented by data from Kharod, Rukmawati and Nagmati River sections located further S to SE. The precise depositional ageof the Sandhan Formation is debatable due to absence of age diagnostic fossils, however, Strontium isotope analysis of bivalves from the limestone of underlying Chhasra Formation indicates Langhian-Serravallian age (Middle Miocene). Based on depositional gap and stratigraphic superposition, the Sandhan Formation is designated as Pliocene. The process-based facies analysis suggests that the Sandhan Formation was deposited in a high-energy, open shoreline condition; deposition is characterized by a lower shallow marine bar-trough system followed by continental fluvial deposits. The shallow marine part is dominated by moderate-well sorted sandstone (138m thick) comprising (1) foreshore (beach), (2) upper shoreface, (3) lower shoreface, and (4) lagoon and barrier bar facies associations. The upper unit is dominated by the poorly sorted gritty sandstone (150m thick) consisting of: (1) channel and channel fill, (2) sandy and gravel bars, and (3) overbank fines and paleosols facies associations, indicating braided fluvial deposits. At the basinal scale towards S to SE part of the basin (i.e. towards Kharod, Rukmawati and Nagmati River sections), thickness of both marine and fluvial deposits reduces with decrease in fluvial energy. Based on the distinct lithology, facies assemblages and contrasting depositional environments of the two units, this study proposes to sub-divide the Sandhan Formation into: Vandi Nani Member (marine, Kankawati river) and Tekari Member (fluvial, Kharod river).

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PROVENANCE AND BURIAL HISTORY TRACKING FROM QUARTZITE HOSTED DETRITAL GARNET GRAINS: A CASE STUDY FROM THE DELHI SUPERGROUP OF ROCKS, FARIDABAD, DELHI-NCR, INDIA

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Quartzites of the Delhi Supergroup, exposed along the Firozpur- Jhirka ridge in Faridabad, Gurgaon areas of Delhi-NCR, host detrital garnet grains. The garnet grains are studied for understanding provenance and diagenetic history. Samples were collected from the Badkhal Lake area, Faridabad. XRD study identifies quartz, garnet, magnetite, and goethite as major mineral phases. Whereas quartzites show recrystallization texture, garnet grains record intense fractures and magnetites form large acicular grains. From EPMA garnet grains are identified as almandine with high spessartine content and a pegmatite source is suggested. From preserved in-situ exsolution of magnetite from garnet it is inferred that a temperature exceeding 5500C (> 17km burial depth) in the course of burial history and magnetites exsolved below 5500C from garnet during uplift of quartzite.

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MID-LATE HOLOCENE CLIMATE AND SEA LEVEL VARIABILITY FROM THE MUDFLATS OF SOUTHERNSAURASHTRA, WESTERN INDIA

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Unlike glacial-interglacial cycles when the boundary conditions significantly varied causing dramatic perturbations in climate and sea level variability, the mid-late Holocene period seldom witnessed suchextreme climatic perturbation, and thus, the investigation on climate and sea level oscillations remainspoorly understood. Further, the dynamics of the Earth's climate system rely on the oceanic and atmospheric heat transport from low latitudes to high latitudes. The low-latitude climate is modulated by the monsoon intensity as a function of lateral migration of the Intertropical convergence zone (ITCZ). The present study aims to decipher the climate vis à vis monsoon and sea level variability during the mid-late Holocene from the mudflats of the southern Saurashtra coast. In the present study, both relict and active mudflat sections were investigated which were chronologically supported by AMS radiocarbon ages. A multiproxy approach has been adopted on the AMS radiocarbon dated sediment section. The study underscored warm and wet climates with a high sea level of 4.7-3.0 ka followed by a dry climate during 3.0-2.0 ka with the simultaneous sea regression. During the last 2 ka,there has been a warm and wet climate followed by a cool and wet climate during the Medieval Climate Anomaly (MCA; ~1 ka) and Little Ice Age (LIA; ~0.5 ka), respectively. The present study demonstrated that the southward migration of the ITCZ instigated the influence of western disturbances, causing enhanced winter precipitation during LIA, while the warm and wet climates have been associated with the high solar forcings, causing a northward shift of ITCZ resulting in strong Indian Summer Monsoon (ISM). Further, the geomorphic evidence along the southern Saurashtra coast demonstrated ~2 m high sea levels during 4.7 ka with a gradual regressive trend and the present-day coastal configuration attained after 1500 yr BP. Considering the tectonic instability and coastal notch of Gujarat (Saurashtra coast), the effective mid-Holocene Sea level has been estimated to be ~1 m higher than the present with a tectonic overprinting of ~1 m. The present study has implications in addressing the paleomonsoon and paleo sea levels and decoding the past sea level variability with a possible imprint of tectonic signatures.

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A STUDY ON THE EPIPHYTIC FORAMINIFERA COMMUNITY FROM THE COAST OF CHANDIPUR, ODISHA, INDIA

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Chandipur is a tide dominated coast situated eastern coast of India. Presence of a vast tidal flat, an estuary and a bar provided different sub-environments in this coast. Due to almost flat nature of the tidal flat and presence of different tidal creek, thin layer of stagnant water is found within the tidal flat. This helped to grow vegetation, mostly grasses within the tidal flat in patches. The growth of vegetation is also found in the back bar region. Total 26 number of samples collected from different sub-environments, viz., tidal flat away from the shore, tidal flat near to shore, marsh behind the back bar. Total 1,541 number of specimens are recovered from all the samples. These specimens belong to 18 genera and 34 species. These are *Ammonia beccarii, Ammonia tepida, Ammonia inflate, Ammonia parkinsoniana, Ammonia dentata, Asterorotalia trispinosa, Haynesina germanica, Hemirotalia* sp., *Elphidium excavatum, Elphidium limpidum, Elphidium clavatum, Elphidium incertum, Rectuvigerina* sp., *Bolivina dilatata, Bolivina striatula, Melonis baeleeanus, Melonis* sp., *Rosalina bradyi, Quinqueloculina seminula, Nonion* sp., *Nonionella decora, Cibicides* sp., and *Pseudoeponides* sp. Among these genera *Ammonia* and *Rosalina* are common epiphytic foraminifera present in this assemblage. Different statistical analysis like Principal Component Analysis (PCA), Q-Hierarchical Cluster Analysis (Q-HCA) and linear r (pearson) correlation were performed to check the ecological or sedimentological control over the foraminiferal distribution. It is observed that the total foraminiferal number (N), species richness (S) and Shannon Index (H) is highly controlled by the presence of epiphytic foraminifera. In the cluster analysis like PCA and Q-HCA the sample no. B17 is separated out as a different cluster due to the abnormally high N which is totally contributed by the epiphytic foraminifera *Rosalina bradyi*. *Ammonia* and *Rosalina* are reported from different sea grass meadow around the world. Thus, it can be concluded that the growth of vegetation within the tidal flat is one of the controlling factors for the foraminiferal assemblage at Chandipur coast and can be used for palaeoenvironmental analysis.

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Psammophaga (FORAMINIFERA): A SOFT-BODIED FORAMINIFERS DISCOVERED FROM RAJAPURI CREEK, MAHARASHTRA, INDIA

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Psammophaga is an organic-walled (monothalamous) foraminiferal genus that has in common the ability to ingest and retain mineral grains within its cytoplasm. The diversity of *Psammophaga* is well documented in diverse environments worldwide, except India. In this study, two new species were discovered from the west coast of India, *Psammophaga holzmannae* sp. nov., and *Psammophaga sinhai* sp. nov. Both the species have the characteristic property of the genus to ingest heavy mineral grains within their cytoplasm. The examination of individuals of each species using SEM-EDS showed selective enrichment of titaniferous minerals inside their cytoplasm. *Psammophaga holzmannae* sp. nov. being ovoid to spherical shaped, 103–246 µm in length, single aperture, translucent to orange colored cytoplasm, and *Psammophaga sinhai* sp. nov. being oblong, elliptical, or droplet-shaped, 279–448 µm in length, single aperture, yellow olive colored cytoplasm, with exterior surface of agglutinated fine clay particles, and the ingested mineral grains dispersed throughout the body. Molecular phylogenetic analyses were performed using partial smaller subunit ribosomal DNA (SSU rDNA) placed in Clade E (monothalamous), which has distinct genetic and morphological characteristics compared to its sister species. In addition, our elemental characterization of engulfed mineral grains utilizing the SEM-EDS and X-ray fluorescence (XRF) analysis of ambient sedimentary grains revealed preferential selection and uptake of heavy opaque titaniferous minerals (e.g., Ilmenite). The new findings of *Psammophaga* from India extend the known bio-geographic range outside Pacific, Atlantic, and Antarctic waters.

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NATURAL HISTORY MUSEUMS: A PALEONTOLOGICAL AND PHILATELICAL PERSPECTIVE

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Natural History Museums are repositories for fossils and are used for paleontological, academic and outreach activities (Lipps, 2018). They have immense social significance for spreading knowledge and programmes of awareness. In recent times philatelic materials (this study) relating to these museums have emphasized the voluminous information and significance of museums the world over. Recent information indicates there are more than 1 lakh (100 thousand) museums in the world. Selected postage stamps used for this study address the history and role of museums needed in education and awareness programmes. An example is the American Natural History Museum (ANHM) which provides insight about the importance and usefulness of museums and their role in promoting paleontology, in particular, and science, in general.

The Smithsonian National Museum of Natural History (NMNH) is an international centre of activities thanks to its huge collection of animal, plant and microorganism fossils. It houses about 30 million objects and is the largest museum in the world. The museum routinely conducts exhibitions, lectures and conferences for the benefit of students and researchers. In this way the Smithsonian Institution has generated tremendous interest from the public and researchers as well.

Lipps (2018) has made recommendations about the preservation and conservation of museums and addressed the need to make museums lively and active places for the public to visit. In India, The Indian Museum, Kolkata housing about 2.5 million objects is the oldest and largest museum in the Asia-Pacific region. To increase the visibility, efforts are being made to use advanced technology to attract the public, students and academicians.

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FOSSILIZED DENTAL REMAINS OF FISHES FROM THE LOWER SIWALIK OF RAMNAGAR (JAMMU HIMALAYA): DIVERSITY AND ECOLOGICAL IMPLICATIONS

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The Lower Siwalik rocks in the Jammu region are well exposed in the vicinity of Ramnagar town that lies about 40 km northeast of Jammu city. Various localities around Ramnagar, which occur within the southern limb of Udhampur Syncline, yield fossil vertebrates that include hominoids as well. The fossilized dental remains of fishes reported here comes from a Lower Siwalik section K2, located about 10 km southeast of Ramnagar town, near the village of Kalaunta. The fossiliferous horizon at K2, a yellow gritty sandstone layer forms part of the Ramnagar Formation (= Chinji Formation), which based upon its mammalian content has been dated between 13.8–13.5 Ma. The sandstone sample collected from K2 was disintegrated employing oil–water immersion method to release micro remains of fishes. The recovered piscean assemblage from the study area comprises Cyprinidae: *Cyprinus* sp., cf. *Scardinius*, *Schizothorax* sp., Cyprininae indet., Cobitinae indet., and Channidae: *Anabas* sp. and *Channa* sp.The spatial and stratigraphic distribution of fossil fishes in the Siwalik Group of the Indian Subcontinent was ascertained which demonstrate that some fish taxa identified in the present collection include new forms that were previously unknown from the Siwalik Group of Jammu as well of the Indian subcontinent. The fish diversity analysis for the Siwalik depicts temporal variation of fish taxa at various taxonomic levels. The prevailing composition of the fossil assemblage suggests deposition of the fossil entombing sediments in a pond environment that existed within the context of a braided river system.

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LASER RAMAN MICRO-SPECTROSCOPY BASED KEROGENOUS CHARACTERIZATION OF CHERT HOSTED PERMINERALIZED MICROBIOTA OF THE CHHATTISGARH SUPERGROUP, INDIA

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Ancient microbiota preserved in certified horizon provides critical insights into evolution of life on early Earth. The Meso-Neoproterozoic Chhattisgarh Supergroup, divided into the Singhora, Chandarpur, Raipur and Kharsia Groups, reveals the anthracitic type of microfossils preservation in the Raipur Group. The rocks of Raipur Group are considered as Early Neoproterozoic age. Non-mineralized but completely carbonized anthracitic microfossils are rare in Proterozoic assemblages. 'Raman Index of Preservation', an approximate measure of the geochemical maturity of the kerogens, offers a new window to understand the extinct ecosystem and taphonomy of the microorganisms. An abundant assemblage of microorganisms preserved in the carbonate facies of the Neoproterozoic Saradih Limestone of the Raipur Group is dominated by filamentouscyanoprokaryotes represented by cellular trichomes which are up to 500 µm long. Morphologically straight to gently curved, uniseriate, unbranched, and unsheathed trichomes occur in the assemblage which are composed of approximately isodiametrical cells, linearly arranged in continuous or small chains of 2-3 individual cells, considered as septa and gradually tapering towards apices. Based on cell arrangements and apices patterns, these microfossils are identified as *Biocatenoides, Cephalophytarion, Cyanonema, Filiconstrictosus, Heliconema, Oscillatoriopsis, Partitofilum, Tenuofilum* and *Veteronostocale* belonging to oscillatoriaceae and nostocaceae family of cyanobacteria. Under light microscopy, all the microfossils are characteristically black, microfossils appeared as arrangements of pyrite framboids. Laser Raman micro-spectroscopy, a non-destructive analytical technique, provides molecular information based on the vibrational modes of chemical bonds of the preserved organic matter. This method is beneficial for distinguishing between biogenic and abiogenic carbon and identifying specific organic compounds associated with ancient microbiota. The kerogenous characterization of cell walls of the Saradih microfossils Laser Raman Spectroscopy (LRS) is the first study of such kind on the Chhattisgarh Supergroup that revealed the cells are made up of anthracite (D band = 1334 cm^{-1} and G band = 1601 cm^{-1}). Further, the Raman Index of Preservation (RIP) value of the fossils is comparable to the Neoproterozoic Skillogalee Dolomite (RIP = 3.9; ~770 Ma). Such characterization on the preservation is a new addition to the growing knowledge on the microfossils.

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A STUDY ON FREQUENT AND ABUNDANT FORAMINIFERA SPECIES IN LITTORAL SEDIMENTS OF NORTH ODISHA BEACHES, EAST COAST OF INDIA"

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This study investigates the frequent and abundant foraminifera species present in the littoral sediments of North Odisha Beaches, located on the east coast of India. Foraminifera, a group of amoeboid protists characterized by their intricate shell structures, serve as valuable bioindicators for environmental and climatic changes. Sediment samples were collected from various points between Chandrabhaga and Gopalpur, covering a distance of approximately 150 km following standard methods and procedures. The sampling locations included Chandrabhaga, Ramchandi, Beleswar, Puri, Bison, Aleswar, Bateswar, Nuagaon, Aryapalli, and Gopalpur beaches. These samples were analyzed to identify and quantify the foraminifera species, following standard methods and procedures. The results reveal a diverse assemblage of 24 foraminifera species, namely *Spiroloculina communis, S. planulata, Quinqueloculina venusta, Q. vulgaris, Triloculina rotunda, T. tricarinata, T. trigonula, Globigerina bulloides, Bolivina semicostata, Amphistegina radiata, Nonian asterizans, N. commune, Nonionella lubradoria, Hanzawaia concentrica, H. nipponica, Pararotalia sp. int., Pararotalia nipponica, Pseudorotalia schroeteriana, Pseudorotalia indispecificana, Rotalidium annectens, Ammonia beccari, Asterorotalia pulchella, Elphidium advenum*, and *E. crispum*. Certain species, such as Pararotalia nipponica, *Rotalidium annectens*, and *Elphidium crispum* respectively, exhibited higher frequencies and abundances form the all stations. The foraminiferal species belong to the suborders Rotaliina (16 species), Miliolina (7 species), and Globigerinina (1 species). The results also reveal the beach species distribution from east to west as follows: Chandrabhaga (14 species), Ramchandi (15 species), Beleswar (17 species), Puri (16 species), Bison (18 species), Aleswar (11 species), Bateswar (14 species), Nuagaon (15 species), Aryapalli (11 species), and Gopalpur (16 species). These findings contribute to the understanding of the ecological dynamics of littoral zones and provide baseline data for future environmental monitoring and conservation efforts in the region.

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NORTHWARD MIGRATION OF THE ANTARCTIC POLAR FRONT AND ITS IMPACT ON THE AGULHAS CURRENT DURING EARLY QUATERNARY PERIOD: PLANKTIC FORAMINIFERAL EVIDENCES FROM THESOUTHWEST INDIAN OCEAN

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The Agulhas Current (AC) is the world's largest western boundary current, which also impact the thermohaline circulation. The strength of this current is impacted to a large extent by the migration of the Antarctic Polar Front (APF), which causes the incursion of the cold temperate waters to the lower latitude. The APF migrates in response to the waxing of the Antarctic Ice Sheet (AIS) due to glacial events. The planktic foraminifera were grouped into Agulhas Fauna (AF) and Southern Ocean Fauna (SOF) based on their latitudinal preference and relative abundance. The AF comprises of the species *Globigerinoides ruber, Trilobatus sacculifer, Globoturoborotalita rubescens, Pulleniatina obliquiloculata,* and *Menardella menardii*. The species constituting the SOF are *Truncorotalia truncatulinoides, Globoconella inflata, Globoconella puncticulata, Neogloboquadrina incompta,* and *Globigerina bulloides.* Based on planktic foraminiferal census counts and stable isotopic analysis of *Globigerinoides ruber*, we show that during the early Quaternary, there were five intervals when the APF migrated northwards, causing the weakening of the AC. These events, occurring at 2.5 Ma, 2.15 Ma, 1.75 Ma, 1.6 Ma and 1.24 Ma, are marked by an abrupt rise in the abundance of the cold Southern Ocean fauna to almost half of the total faunal assemblage. We demonstrate here that these events mark intense cooling, leading to the expansion of the AIS, thereby significantly reducing the strength of the AC and severing the thermohaline circulation.

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PLANKTIC FORAMINIFERAL RESPONSE TO THE CHANGES IN MONSOONAL UPWELLING AND PRODUCTIVITY IN THE NORTHWEST ARABIAN SEA DURING THE PAST ~145 KA

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We studied changes in the planktic foraminiferal distribution along with some sedimentological data at ODP holes 723A (lat. 18°03.079´N, long. 57°36.561´E) and 722B (lat. 16°37.312´N, long. 59°47.755´E) in the Northwest Arabian Sea for the last 145kyr. This study attempts to reconstruct monsoon upwelling lead surface productivity at Oman margin and in the relatively open ocean above Owen Ridge and link them to millennial scale variability of the North Atlantic (YD, Heinrich events). We have observed broadly two major intervals (MIS5 & 1) of higher biogenic production off Oman indicated by distinctly increased total planktic foraminiferal flux along with *Gg. bulloides* and *Ga. glutinata* fluxes at 723A. This observation is also complimented by higher values of SW monsoon assemblage, increased abundance of *Gg. bulloides, Ga. glutinata* and total carbonate at 723A and 722B during the same intervals. This indicates that SW monsoon was very strong in the entire region during MIS5 and 1. The drop in the PF flux along with lesser gradient of relative abundance of *Gg. bulloides* and *Ga. glutinata* during MIS2 and 3 as compared to the other inter-glacials suggest the effect of SW monsoon was limited and contributed to the significant upwelling only in coastal regions. The millennial-scale variabilities are also marked in the productivity parameters of the planktic foraminiferal data (SW monsoon, *Ga. glutinata,* and *Gg. bulloides*) and sedimentological proxies (OM, total CO_3). Decline in the values of these parameters in most of the YD and Heinrich events indicate existence of lower trophic conditions in the Northwest Arabian Sea due to weaker monsoon during the intervals of the extreme cold YD and Heinrich events of the North Atlantic. The spectral analysis of total PF flux, SW monsoon upwelling assemblage flux, *Ga. glutinata* flux, and *Gg. bulloides* flux revealed prominent periodicities at 19.1, 3.9, 2.1, and 1.8 kyr at hole 723A. These are the harmonic tones of the precession cycle (23kyr) and indicate that the high-resolution variabilities in surface productivity and monsoonal strength are primarily governed by the precession cycle, which is largely influenced by the orbital forcing.

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PALYNOLOGY AND GEOCHEMICAL ANALYSIS OF THE BARAIL SHALE IN AND AROUND RAENGHZAENG VILLAGE, TAMENGLONG, MANIPUR (INDIA): IMPLICATION ON PALEOCLIMATE AND DEPOSITIONAL ENVIRONMENT

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This study focuses on the Barail Group of rocks exposed in and around Raenghzaeng Village, Manipur, North-East India. The research aims to analyse the depositional environment of the Barail shale and reconstruct the paleoclimate using palynological and geochemical analyses. Palynofacies analysis recovered palynotaxa, such as *Hammenisporis multicostatus*, *Hammenisporis susassae*, *Phragmothyrites eocaenicus*, *Inapertisporites* sp., *Palaemycite robustus*, *Pinuspollenites* sp., *Tricolporopollenites* sp., *Todisporite* sp., *Seniasporite verrucosus*, *Lakiasporite* sp., and *Liosphaeridia* sp., suggest a shallow marine environment with tropical to subtropical conditions, warm and humid climates to mixed terrestrial environments during sedimentation. XRD analysis identified mineral compositions such as quartz, muscovite, montmorillonite, franklinite, biotite, anatase, albite, and magnetite. It further suggests the range ofenvironments from shallow marine to continental margins with a tropical, warm, and humid climate. Geochemical analyses, including Sr/Ba, Sr/Cu, and Rb/Sr ratios, further support the warmand humid climatic conditions during deposition. The Sr/Ba ratios and V/Ni-Sr/Ba plots suggest deposition occurred in freshwater or continental environments. The V/(Ni+V), V/Cr, and U/Th ratios also indicate paleoredox conditions ranging from oxic to dysoxic, consistent with shallow depositional environments. The higher average total Rare Earth Element (REE) values compared to the North American Shale Composite (NASC) standard, along with negative Eu/Eu* values, further suggest a warm and humid climate during deposition. The average value of Ce/Ce* is nearly 1, and Ce_{anom} is greater than -0.01, indicating sub-oxic conditions reflective of minimal oxidation. In conclusion, the integrated palynological and geochemical analyses of the Barail Group of shale in and around Raenghzaeng Village reveal a depositional environment that was predominantly shallow marine to continental, with climatic conditions fluctuating between warmand humid.

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ADVANTAGE OF CONFOCAL LASER SCANNING MICROSCOPY IN DECIPHERING NEW MORPHOLOGICAL CHARACTERS: A CASE STUDY BASED ON THE NEOPROTEROZOIC KURNOOL MICROFOSSILS

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The recent advancements in the field of Optical Microscopy (OM) revealed several morphological characteristics of the microfossils that were hitherto unknown to the Precambrian palaeobiologists. Confocal Laser Scanning Microscopy (CLSM) is an advanced technique to understand the fine-scale morphological features of microfossils that were not documented underthe commonly used optical microscope. Unlike traditional OM, the CLSM generates a micron- scale detailed cellular morphology, without physically damaging the original specimens, and prepares a three-dimensional image of the microfossils. In the present study, OM and CLSM both were used to document the fine-scale morphological features of the organic-walled microfossils recovered from the Neoproterozoic Owk Shale of the Kurnool Group, south India. The Kurnool Group is the youngest group of the Cuddapah Supergroup and contains around 450 m thick sedimentary sequence that is divided into six formations: the Banganpalle Quartzite, the Narji Limestone, the Owk Shale, the Panium Quartzite, the Koilkuntla Limestone and theNandyal Shale. The Owk Shale microfossils belong to the Terminal Neoproterozoic in age and show diversity varying from smooth-walled sphaeromorphs to process-bearing forms. The forms selected for the CLSM study include *Valeria lophostriata, Plicatidium latum* and *Octoedryxium truncatum, Obruchevella* sp. *Weissiella grandistella, Galeasphaeridium bicorporis, Galeasphaeridium* sp. *Germinosphera bispinosa* and *Tanarium tuberosum*. The paper discusses the new distinct identifiable morphological features, recorded under the CLSM, in the Kurnool assemblage. Someof these morphological features add to the refinement in the taxonomy of microfossils. Our studies add to the global endeavors in documenting the additional morphological featuresleading to the taxonomical refinements of different Neoproterozoic successions of the world. TheCLSM study offers a new window to investigate the microfossils.

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RECENT ADVANCES IN ARCHEAN PALAEOBIOLOGY OF INDIA

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Although in the last three decades, the Archaean cratons and covering sedimentary successions of the Indian peninsula were well studied, yet the evidence of the palaeobiological remains is meager. Renewed global interest in the Archaean palaeobiology and recent exploration in the Singhbum craton in eastern India and the Dharwar craton in south India revealed new occurrences of stromatolites and microbial mats. Less metamorphosed chemically precipitated rocks are a new target of investigation for palaeobiological studies. Stratiform, tiny cumulate, domical, pseudocolumnar, and columnar stromatolites are recorded at the Kasia locality, Iron Ore Group (IOG) in the Singhbhum Craton. The newly recorded stromatolites are part of the Mesoarchaean sedimentary succession exposed in Keonjhar district, Odisha, India. The biogenecity of these stromatolites is corroborated by δ^{13}C-organic carbon signatures (-39.4 to -28.0‰) obtained from distinct layers indicating the role of microbial communities that contained anoxygenic photo-synthesizers to methanotrophs as stromatolite builders. Apart from that, newly discovered Neoarchaean age 'egg carton shaped stromatolites' from the Dharwar Craton are the second record of such stromatolites in the world after those in the Strelley Pool Formation, Western Australia. Neoarchean stromatolite in the dolomite beds of the Aleshpur Formation of the Chitradurga Group (older than 2600 Ma) in the Shimoga Schist Belt, western Dharwar Craton has been discovered. Stratiform, laminated, and columnar with some showing branching forms indicate an advanced stage of evolution of stromatolites and are an important addition to the inventory of Archaean stromatolites. In addition to stromatolites, microbial mats are also recorded from the Dharwar craton. 'Microbially Induced Sedimentary Textures' (MIST) are found preserved in thin sections of chert from the Neoarchaean Banded Iron Formation in Sandur Schist Belt (SSB) in Dharwar craton. Apart from conventional approaches of describing palaeobiological signatures to prove biogenicity, investigations on the Indian early-life fossils are also undertaken with new analytical techniques (high-resolution microscopy and spectroscopy, biochemical methodology, and isotopic fractionation values).

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RELATIONSHIP BETWEEN THE INDIAN MONSOON VARIABILITY AND ORBITAL CYCLICITIESDURING THE LATE QUATERNARY

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The Indian monsoon is a large land-ocean-atmosphere coupled system involving transportation and redistribution of substantial amounts of heat and moisture at a large geographical scale affecting thelivelihood and economy of the whole Indian subcontinent. Indian monsoon studies, through variousinstrumental and proxy data records, have shown temporal and spatial variability ranging from annual cycles to orbital cycles. The timing (phase) of the response of different Indian summer monsoon (ISM) records to orbital phases and the degree to which they vary is poorly understood. Hence, we try to investigate here the ISM variability in relation to orbital bands using various previously documented/published proxies (both marine and continental) from the Indian subcontinent region for the past 500 kyr by looking into the phase relationships between the Northern Hemisphere Summer Insolation (NHSI) (at precession and obliquity bands) and the Maximum response of the ISM records. At the precession band, the Maximum ISM from the Arabian Sea and the Bay of Bengal lags NHSI Maxima (Pmin, 21 June perihelion) by ~ 6 - 9 kyr. And, at the obliquity band, the phases between Maximum ISM and NHSI Maxima is less consistent.However, the Maximum ISM of some of the records are nearly in phase with NHSI Maxima. Furthermore, spectral analysis was performed on the ISM records and significant power spectra were identified at ~23 ka, 41 ka and 100 ka, leading to the suggestion that temporal and spatial ISMvariations may have been primarily driven by external insolation forcing with dominated precessioncycles, while the role of obliquity and eccentricity is lesser understood due to lack of good long- term consistent records.

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PALEOENVIRONMENTAL STUDIES OF TSUMANG LAKE, WOKHA DISTRICT KOHIMA, NAGALAND STATE,NORTH-EAST, INDIA WITH DIATOM AND WATER QUALITY AS PROXY

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Diatoms are a varied species of unicellular algae that have long piqued scientists' interest because of their extraordinary adaptations to a wide range of aquatic habitats and ecological significance. This study utilizes diatom assemblages from surface sediment samples collected during pre-monsoon and post-monsoon seasons from Tsumang Lake of Nagaland to reconstruct paleoenvironmental conditions in a freshwater ecosystem. By comparing the diatom community composition and diversity between these two periods, we aim to identify seasonal variations. The current study shows the existence of total 74 species belonging to 33 genera in the pre monsoon season and 68 species belonging to 34 genera in the post monsoon. The most abundant species observed during the both the seasons are Achnanthidium minutissimum, Discostella stelligera, Achnanthidium catenatum, Aulacoseira granulata and Navicula cryptotenella in pre-monsoon and Achnanthidium minutissimum, Nitzschia amphibia, Ulnaria ulna, Navicula cryptocephala and Achnanthidium catenatum during post-monsoon season. The pre-monsoon samples are characterized by diatom species indicative of lower water levels and higher temperatures, while the post-monsoon samples reveal a dominance of species associated with increased water levels and cooler temperatures. The diatom community is more abundant in the pre-monsoon than the post-monsoon season and these seasonal shifts in diatom assemblages reflect the influence of monsoonal precipitation on the aquatic environment, highlighting the dynamic nature of freshwater ecosystems in response to climatic fluctuations. The pH of Tsumang Lake is substantial ranging from 8.5 in pre-monsoon and 8.8 during post-monsoon season, indicating alkaline water. With time and the chemicals that towns and businesses release into the environment have an impact on the pH of lakes. The study underscores the importance of diatoms as effective bioindicators for reconstructing past environmental conditions and provides insights into the long-term impacts of seasonal climate variability on freshwater ecosystems.

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Trace Element Bioaccumulation in Benthic Foraminifera from Beypore Estuary, Southwest Coast of India: Implications for Coastal Anthropogenic Contamination

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The ecological, biological, and taxonomic characteristics of benthic foraminifera are commonly used as proxies to assess fragile marine environmental conditions. This study advances the use of benthic foraminifera by examining the chemical composition of their shells to gauge their response to anthropogenic metal contamination in coastal regions. We analyzed sediment characteristics and foraminiferal test compositions to delineate pollution zones and investigate the impact of anthropogenic pollution on foraminiferal proxies. A juvenile form of *Ammonia parkinsoniana* and *A. tepida* from ten stations were studied by using Scanning Electron Microscopy (SEM) and Energy-Dispersive Spectroscopy (EDS) to obtain elemental content from the shell aperture and thirteen elements were detected. Oxygen was the most prevalent with an average concentration ranging from 45.36% to 51.45% by weight, followed by calcium which ranged from 23.88% to 39.34% by weight. MP-AES was employed to measure metal concentrations in the sediment, and the findings were compared with existing literature. Particle size analysis provided insights into the energy conditions of the estuary and assessed the capacity to accumulate trace and heavy metals. Principal Component Analysis (PCA) and Cluster Analysis revealed trends in elemental weight percentages, highlighting variations in trace metals and sediment particle sizes. These findings, compared with historical data, demonstrate significant decadal changes in trace metal distribution and the correlations between sediment and foraminiferal shell elements, providing evidence of anthropogenic impact in the Beypore estuary, southwest coast of India.

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PLEISTOCENE CALCAREOUS NANNOFOSSIL EVENTS FROM THE NORTHEAST INDIAN OCEAN: INSIGHTS INTO PALAEOCLIMATE AND SEDIMENTATION RATES

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The Pleistocene Epoch is significant for its glacial-interglacial cycles, which profoundly impacted the environment. These cycles led to changes in both terrestrial and marine floral and faunal assemblages. Calcareous nannofossils are highly sensitive to climatic and environmental shifts, and make a powerful proxy for high-resolution age and palaeoenvironmental profiling of marine sediments. This study presents an in-depth analysis of calcareous nannofossils from Pleistocene sediments, ranging from 99.05 mbsf to 0.03 mbsf, in deep-sea cores recovered during the NGHP Expedition (NGHP-01-17A) in the northeast Indian Ocean. Three calcareous nannofossil zones (NN19-NN21) of Martini and five zones (CNPL7- CNPL11) of Backman et al. have been identified in the studied samples. The preservation quality ranges from moderate to good. Significant nannofossil events that have enabled relative dating include the first occurrences (FOs) of *Emiliania huxleyi* (0.29 Ma) and *Gephyrocapsa* spp. (≥4 μm) (1.71 Ma); last occurrences (LOs) of *Pseudoemiliania lacunosa* (0.43 Ma), *Helicosphaera sellii* (1.24 Ma), and *Calcidiscus macintyrei* (1.60 Ma); and the top absence (TA) of *Gephyrocapsa* (≥4 μm) (1.06 Ma). A diversity decline is noted in the Pleistocene compared to the late Miocene to Pliocene sequences. Twenty-six taxa from 14 genera have been identified, with 20 identifiable to the species level. Notably, an event with a high abundance (~70%) of small placoliths belonging to *Gephyrocapsa* suggests cooler, nutrient-rich conditions in the Pleistocene. This is further supported by the rare occurrence of *Discoaster* spp. throughout the Pleistocene. The average sedimentation rate during the Pleistocene is higher than Pliocene, estimated at around 65 m/Ma. This study from the northeast Indian Ocean will help to understand the response of small placolith species with the change in climate and to determine the biotic productivity during Pleistocene.

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Benthic Foraminifera in Methane Hydrate Bearing Sediments from various Ocean

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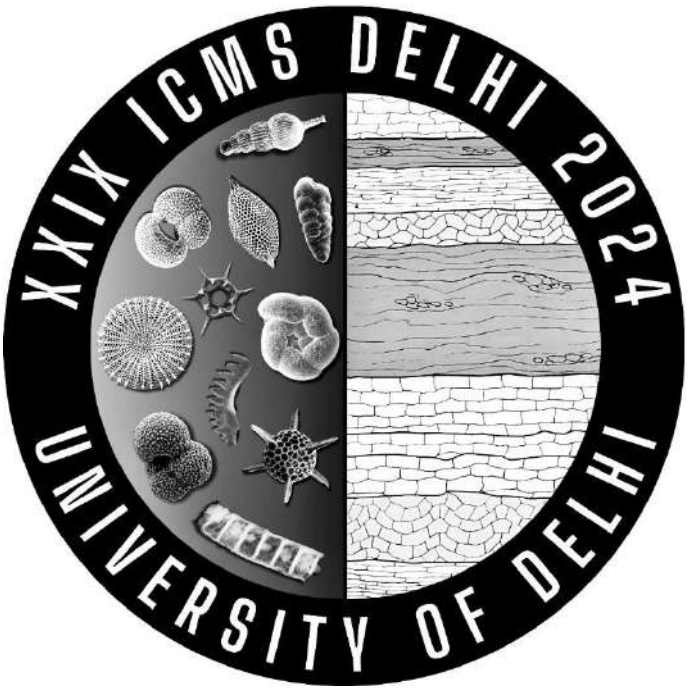
Methane is an important greenhouse gas, which plays a vital role in driving the global warming, In recent years, the regions rich in gas hydrates or methane seeps have attracted the attention of marine geologists, ecologists, marine biologists and paleoceanographers to understand the impact of methane or cold seeps on benthic foraminiferal records. Owing to the economic potential of gas hydrates as future energy resources, several oil companies have started studying these deposits using geochemical, geological and geophysical tools. Bottom Simulating Reflector (BSR), used to infer the presence of offshore methane hydrates is discussed. Geochemical data studies indicate methane enrichment and sulphate reduction around the globe. Benthic foraminifera have been widely used as proxy for paleo-methane emissions, mainly based on their stable isotopic signature. Deep-sea benthic foraminifera found in different marine settings including gas seepages, gas hydrates have great potential to reconstruct the past climate and oceanic changes owing to their wide distribution. In this study, we evaluate the benthic foraminiferal response to methane seepage in North Atlantic Ocean, NE Pacific and Arctic sediments. The detection and assessment of gas hydrates are essential to evaluate future energy resources and environmental changes. Therefore the key intuition of the present review is to make the reader understand the concept and background of the gas hydrates scenario and the implemented proxy techniques to infer the subsurface gas hydrates.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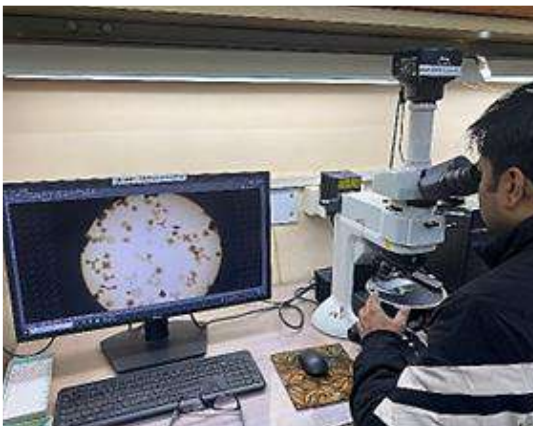
Announcement from the Palaeontological Society of India

On **26th January 1950**, a Memorandum of Association to establish **the Palaeontological Society of India (PSI)** was signed by M. R. Sahni, Raj Nath, S. R. Narayan Rao, R. C. Misra, B. S. Tewari, S. N. Singh, G. W. Chiplonkar and others. It was registered under the Societies Registration **Act 1860 (XXI)** in Lucknow on **12/08/1950**. Since then, the society has continuously functioned and served the palaeontological fraternity in India and internationally.

Next year, the society will enter **75 years of existence** and service to academia and the geological fraternity. It has been pivotal to the cause of paleontology in the country by organizing field workshops, national and international conferences/ meetings/ workshops, and coursework. The Executive Council of the Palaeontological Society of India has decided to celebrate the **Platinum Jubilee of the Palaeontological Society of India in a befitting manner in 2025**. For organizing the Platinum Jubilee of the society, an appropriate body/organizing committee has been constituted for planning and generating the funds for this purpose. A subsequent announcement will be made after the modalities have been decided.

Micropaleontology and Paleoceanography Laboratory, Department of Geology, University of Delhi



PALEONTOLOGICAL SOCIETY OF INDIA STUDENT CHAPTER- NORTH ZONE
UNIVERSITY OF DELHI

Department of Geology, University of Delhi is the NODAL CENTRE of the Palaeontological Society of India-Student Chapter North Zone under the Convenorship of Prof. Ashutosh K Singh, Joint Secretary of PSI Executive Council. The student Chapter is run by a dedicated team of students of the Department of Geology, and the core team includes a President, two Vice Presidents, a secretary, and a Joint Secretary. The students organize talks from eminent personalities in paleontology from India and abroad and celebrate International Fossil Day. Frequently, the Chapter organizes visits to museums, quizzes, and competitions, and certificates are distributed to the performers.

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