3rd INTERNATIONAL CONFERENCE ON
GEOLOGY: EMERGING METHODS
&
APPLICATIONS - GEM 2023
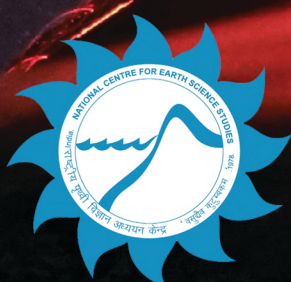

23-25 January 2023

Organized by

DEPARTMENT OF GEOLOGY & ENVIRONMENTAL SCIENCE
CHRIST COLLEGE (AUTONOMOUS), IRINJALAKUDA
THRISSUR, KERALA

MINISTRY OF EARTH SCIENCES

NATIONAL CENTRE FOR EARTH SCIENCE STUDIES

KERALA STATE DISASTER MANAGEMENT AUTHORITY

KERALA STATE COUNCIL FOR SCIENCE TECHNOLOGY & ENVIRONMENT

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Message from the Organizing Secretary

On behalf of the organizing committee, I would like to welcome you all to the 3nd edition of our conference on Geology: Emerging Methods and Applications (GEM-2023) which is being held at Christ College Autonomous, Irinjalakuda, Thrissur, Kerala. It is heartening to get great support and consideration from reputed scientists and Institutions. The conference is supported by National Center for Earth Science Studies, (NCESS) Thiruvananthapuram, Ministry of Earth Science (MoES), Govt. of India, Kerala State Disaster Management Authority (KSDMA) and Kerala State Council for Science, Technology and Environment (KSCSTE). We have also received support from private sector enterprises like, Central Scientific Instrument Corporation (CENSICO), Geo Marine Solutions Pvt. Ltd, PAN Environ India Pvt. Ltd., TerraPy Education and Geo-Transect LLP. The annual general body meeting of Association of Quaternary Researchers in India (AOQR) is also being conducted in association with the conference on 24th January 2023.

The three-day conference being multi-disciplinary in nature will have participants who are subject experts in diverse field of Earth Science, representatives of various National, International Institutes and Universities. The conference is unique in its objective of bridging the gap in research and education between the leading National and international Institutions with State Universities and Colleges. The important highlight for students and early career researchers of this conference includes well constituted keynote addresses handled by professionals in the field, oral and poster presentations, panel discussions and interactive sessions. The conference aims to bring novel and exciting questions and topics for future research to students of post graduate and research, enabling them to choose their interests from an array of disciplines within Geology. It is also aimed to create an inter-university Collaborative Academic Network among teachers and researchers of Geology.

In recent years various disciplines of Earth Science has emerged as an independent and interdisciplinary science owing to advancements in methodological and analytical capacities. These have provided a renewed interest in fathoming various fields of Geology and applying those

findings for societal use. Brining this development and knowledge to the grass-root level is essential for molding the geoscientists of the future. In the light of extreme climatic events, the conference has invited discussions on natural disasters and hazard management to envisage future policies for mitigation, by emphasizing the importance of integrated natural resource management. I would like to thank you all for attending the conference and sharing your expertize with young minds. I take this opportunity to thank the entire Team GEM 2023 who has worked tirelessly behind the scenes towards making this event possible.

Dr Linto Alappat

3rd INTERNATIONAL CONFERENCE ON Geology: Emerging Methods and Applications (GEM-2023) 23-25 January, 2023				
Annual General Body Meeting of ASSOCIATION OF QUATERNARY RESEARCHERS (AOQR), INDIA				
Day 1: 23-01-2023				
Time (Hrs)		Session/ Title		Speaker
From	To			
9:00	9:05	Prayer and welcome		Organizing Committee
Session 1: Petrology: Analytical and Field Geology (Session chairs: Dr. V. V. Sesha Sai and Dr. Anto K Francis)				
9:05	9:35	Keynote address on "Igneous Petrology - it's role in understanding crustal evolution"		Dr. V. V. Sesha Sai, Director, Geological Survey of India, State Unit Maharashtra Central Region, Nagpur
9:35	10:00	The ancient 'Little Himalayas' of Southern India: A revised tectonic framework of the Archean Dharwar Craton		Dr. Ratheesh Kumar, Assistant Professor, Department of Marine Geology and Geophysics, CUSAT
10:00	10:25	"Spatial and Stratigraphic Controls on Feldspar Burial Diagenesis and Kaolinisation in Reservoir Quality for Oil and Gas Exploration, from Triassic Mungaroo Formation, Carnarvon Basin, Australia "		Saju Menachery, Consultant Reservoir Geologist, Perth, Australia
10:25	11:10	Exsolution micro-textures in Cr-V-Ti Magnetite (Lodestones) of southern India; Remnants of complex magmatic cooling history.		DEEPCHAND V, Department of Geology, University of Kerala
		"Petrology and geochemistry of a diabasic intrusion within Angadimogar pluton, northern Kerala: implications for plume magmatism"		NANDU M R, Department of Geology, University of Kerala
		Serpentinisation and associated chrysotile mineralisation in Vempalle formation Cuddapah basin,constraints from petrographic,geochemical and stable isotopic studies.		Megha Chandran P, Department of Earth Sciences, Pondicherry University
		Genesis of Vein-type Barite deposit in Vempalle formation, Cuddapah Basin, India: Constraints from Petrological, Geochemical and Isotope studies.		Devika DS, Department of Earth Sciences, Pondicherry University
11:10	11:25	Tea		
11:25	12:00	Petrogeochemistry of the Gneissic rocks exposed in and around Thana, District-Bhilwara Rajasthan.		Rishabh Batri, Dr. Harisingh Gour Vishwvidyalaya, Sagar
		A Geochemical Comparison of the Plagiogranites of Nidar, Naga-Manipur, and Andaman Ophiolites		Naga Santosh Sree Bhuvan Gandrapu, Department of Earth Sciences, Pondicherry University

Day: 1 (23-01-2023) Monday

		Variations in the Petrophysical Characteristics of Shales from Kachchh and Kaladgi Basin	Sagar Thakurdas, Nowrosjee Wadia College, Pune
Session 2: Geochronology and Isotope Geochemistry (Session chairs: Dr. Ratheesh Kumar, Dr. C. Sreejith)			
12:00	12:30	Comparing the timing of crustal growth in Eoarchean Greenland and Canada	Daniel J. Dunkley Associate Professor Department of Polar and Marine Research Institute of Geophysics Polish Academy of Sciences ul. Księcia Janusza 64 Warsaw, POLAND
12:30	13:00	Comprehensive spectral and isotopic (C- and O-) isotopic investigation of ultramafic hosted magnesites from Salem, Southern India	Haritha A, Indian Institute of Space sciences and Technology
		Dissolved sulfur isotopic composition of the Mahanadi river, India: Seasonality and sulfate sources.	Rakesh Kumar Rout, Indian Institute of Science Education and Research, Pune
		Carrier phases of Rare Earth elements in Banded Iron Formation from the Singhbhum Craton, India	Achyuth Venugopal, Indian Institute of Science Education and Research, Pune
13:00	13:45	**Lunch**	
13:45	14:30	**Inaugural Session**	**Chief Guest: Prof. KURUVILLA JOSEPH, Ph.D.,FRSC Outstanding Professor & Dean Indian Institute of Space Science and Technology Thiruvananthapuram, Kerala**
Session 3: Artificial Intelligence and Machine Learning in Earth Science (Session chairs: Prof.Hector A. Orengo			
14:30	15:00	Big multitemporal geospatial data and the large-scale analysis of South Asia's past landscapes	Prof.Hector A. Orengo (Online), ICREA Research Professor, Catalana Institute of Classical Archaeology

15:00	15:30	Machine learning for geological applications	Mr. Prasun Kumar Gupta, Geoinformatics Department, Geospatial Technology & Outreach Program Group, Indian Institute of Remote Sensing, ISRO
15:30	15:50	Water Quality Prediction using Machine Learning techniques: A Review	Manisha S Babu, University of Kerala, Kariavattom Campus
		Python Programming in Quantitative Earth Sciences	Mr.Pragnyadipta Sen, Terrappy Education
15:50	16:05	**Tea**	
		Session 4: Climate and Sea-level Changes: Past and Future Predictions (Session chairs:Dr.Shaik Mohammad	
16:05	16:35	**Distribution of Ostracoda and their statistical aspects: Implications on (paleo) environment and high energy marine events and sediments**	Dr.Shaik Mohammad HUSSAIN, Professor and Head, Department of Geology University of Madras, Chennai
16:35	16:55	**The fate of aragonitic pteropods in the Indian Ocean under ocean acidification scenario**	Sijinkumar, A.V., Department of Geology, Central University of Kerala, Kasaragod-671316, India
16:55	17:35	Reconstruction of surface and subsurface hydrography variation records from the Bay of Bengal Sediments	Komal Shinde, School of Advanced Sciences, Vellore Institute of Technology, Chennai-600127, India
		Eocene to Oligocene benthic foraminiferal productivity and Total Organic Carbon (TOC) records from East Equatorial Pacific Ocean (ODP Hole 1218A)	SHITHA K, School of Advanced Sciences, Vellore Institute of Technology, Chennai-600127, India
		A Late Holocene Paleoclimatic Record using a Sedimentary Sequence from a Coastal Lake in Southern India	YAMUNA SALI A S, Department of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education, Manipal, Karnataka
		Benthic Foraminifera from Onshore Pit samples from the locations of kannur District, Kerala: Implications for Paleosealevel Changes.	Adarsh P, Department of Geology, University of Calicut, Kerala
17:35	18:00	**Poster Sessions at Christ College Auditorium**	

18:00	21:00	Conference Dinner @ Savera park Hotel	
		Day 2: 24/01/2023 Tuesday	
		Session 5: Remote Sensing and GIS in Earth Science (Session chairs:Dr. Girish Gopinath and Dr.Suresh Francis)	
9:00	9:25	TECHNOLOGY EMPOWERMENT TOWARDS BUILDING DIGITAL PLATFORM FOR GEOSPATIAL GOVERNANCE	Dr. Suresh Francis, Scientist, Kerala State Remote Sensing and Environment Centre (KSREC), Vikas Bhavan, Thiruvananthapuram, Kerala
9:25	9:50	Geospatial Technology in Water Resources Studies	Dr. Girish Gopinath, Department of Climate Variability and Aquatic Ecosystems, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi-682 508, Kerala, India
9:50	10:40	Shoreline Analysis and Coastal geomorphology of Northern Kerala coast, India- A remote Sensing based approach.	Pranav Prakash, University of Kerala
		LINEAMENTS AND VEGETATION LINK IN GROUNDWATER EXPLORATION: INFERENCES FROM EDC, KARNATAKA	SHARATH RAJ B, Central university of Karnataka
		Remote sensing-based geomorphological mapping of glacial and paraglacial landforms from semi-arid and sub-humid Himalaya	Subhendu Pradhan, Banaras Hindu University, Varanasi
		Delineation of Palaeochannels using Geospatial Technologies. A Case Study of the Kaduvaiyar River, Tamil Nadu, India	PASUPATHI SUBRAMANIYAN, The Gandhigram Rural Institute (Deemed to be University)
		Potential Use of Airborne Hyperspectral AVIRIS-NG Data for Mapping Sittampundi Ultramafic Complex and associated rocks in SGT, India	Monisha Mohan M, Center for Geoinformtics, The Gandhigram Rural Institute (Deemed to be University)
10:40	10:55	Tea	
		Session 6: Environmental Geology (Session chairs:Dr. Anoop Ambili and Dr. M. Suresh Gandhi)	
10:55	11:25	Molecular markers for natural and anthropogenic impact in aquatic ecosystems	Dr. Anoop Ambili, Earth and Enviromental Sciences, Indian Institute of Science Education and Research, Mohali

Day: 2 (24-01-2023) Tuesday

11:25	11:55	Micropaleontology, geochemistry, and its environmental significance studies at Yedayanthitu Kaliveli estuary, Tamilnadu	Dr. M. Suresh Gandhi, Department of Geology Univerisity of Madras, Chennai
11:55	12:25	MICROPLASTICS IN SEDIMENTS AND SURFACE WATER FROM THE AKKULAM-VELI LAKE, KERALA, INDIA	RESHMA S.R, CENTRAL UNIVERSITY OF KARNATAKA
		Microplastic distribution in mulched and unmulched farmland soils of Mattu, Udupi district, Karnataka	Ashwathi C, Department of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education, Manipal, Karnataka
		Application of Magneto-tellurics in foundation engineering:A case study	Jishma R Jayan, Government Engineering College Barton Hill, Trivandrum
12:25	13:25	**Lunch**	
Session 7: Quaternary Geology and Geoarchaeology (Session chairs: Prof. Hema Achyuthan and Dr. Binita Phartiyal)			
13:25	13:55	Paleolimnology of southern Peninsular Lakes and Holocene paleoenvironmental shifts	Prof. Hema Achyuthan, IOM, Anna University, Chennai 600025
13:55	14:25	Landscape evolution and climatic variations in Ladakh, NW Trans-Himalaya during Late Quaternary	Dr. Binita Phartiyal, Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow 226007, UP
14:25	15:00	Microbial profiling of ancient sediment: Challenges and Opportunities in methodologies of extracting metagenomic DNA	Kruti Jayeshbhai Mistry, P. D. Patel Institute of applied Sciences, Charotar University of science and Technology, Changa
		Indian Summer Monsoon variability in the past 15,000 years using planktonic foraminiferal data.	Sruthy Rose Baby, Vellore Institute of Technology, Chennai
		Provenance of the sand dunes of Thar Desert, western India	Anagha V., CUSAT, Kochi
15:00	15:15	**Tea**	
15:15	15:45	Carbon isotope analysis of a Late Quaternary fluvial, aeolian and paleosol sedimentary sequence from the Central Tapi River Valley	Dr. Prabhin Sukumaran, Dr. K C Patel Research and Development Centre, Charotar University of Science and Technology, Changa, Gujarat, India

15:45	15:55	Geoarchaeological exploration of Quaternary landscape and Middle Palaeolithic Activity Areas in North Karanpura Valley, Jharkhand	Shubham Rajak, Deccan College Postgraduate and Research Institute (Deemed University), Pune
15:55	17:00	**Poster Sessions at Christ College Auditorium**	
17:00	18:00	**AOQR GENERAL BODY @ Natural Histroy Museum, Christ College**	
		POSTER/ CAMPUS VISIT	
18:00	19:30	**Cultural program and Dinner**	
		Day 3 : 25-01-2023 Wednesday	
		Session 8: Geo-hazards, Mitigation and Management (Session chairs: Dr. Sajin Kumar K. S. and Dr. S Sreekumar)	
9:00	9:30	Towards a Safer State - Disaster Management in Kerala	Dr. Sekhar Lukose Kuriakose(Online), Member Secretary, Kerala State Disaster Management Authority & Head (Scientist)
9:30	9:50	Inventory and rainfall threshold: pre-requisites for thwarting landslides	Dr. Sajin Kumar K. S., Department of Geology, University of Kerala, Thiruvananthapuram 695581, India
9:50	10:10	Space Geodetic Applications in Earth Science: Some Case Studies	Dr. P.S. SUNIL, Department of Marine Geology and Geophysics. Cochin University of Science and Technology Kochi
10:10	10:30	Topographic drivers of landslides in Western Ghats: A machine learning perspective.	Dr. Yunus Ali Pulpadan, Assistant Professor, Indian Institute of Science Education and Research, Mohali
10:30	11:00	Predicting run-out of landslides for sustainable development	Rajaneesh A, University of Kerala
		Landslide Susceptibility Mapping of Wayanad Plateau, Kerala through Weighted, Statistical and Machine Learning Algorithms using Remote Sensing and GIS techniques	MIDHUNA VINAYAN, The Gandhigram Rural Institute Deemed to be University
		The geomorphological implication of paraglacial sediment mobilization in the upper Ganga catchment, Uttarakhand Himalaya	Maria Asim, Banaras Hindu University
11:00	11:15	**Tea**	
		Session 9: Remote Sensing and GIS in Planetary Science (Session chairs: Dr. Rajesh V.J. and Dr. KUSUMA K.N.)	

Day 3 : 25-01-2023 Wednesday

11:00	11:40	Geology of our Moon and Chandrayaan Missions	Prof. Rajesh V.J., Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Thiruvananthapuram
11:40	12:10	Spectral geology: A tool for exploring earth and planetary surfaces	Dr. KUSUMA K.N., Department of Earth Sciences, Pondicherry University, Puducherry, India
12:10	12:30	Compositional, Topographical and Morphological studies of Ophir Chasma and Candor Chasma, Valles Marineris, Mars using Martian Remote Sensing Data	T. Sivasankari, The Gandhigram Rural Institute (Deemed to be University)
		The Geomorphology of an Unnamed Crater in Xanthe Terra, Mars: Insights into the Subsurface Processes of the Low Latitudinal Regions	Asif Iqbal Kakkassery, Government College Kasaragod, Kerala
12:30	13:30	**Lunch**	
Session 10: Hydrogeology and Water Management (Session chairs: Prof. Sabu Joseph and Dr. Resmi T R)			
13:30	14:00	Radon: A tracer in hydrogeological and geological studies	Prof. (Dr.) Sabu Joseph Director, School of Earth System Sciences University of Kerala
14:00	14:30	Perspective of Isotope Hydrometeorology of Kerala	Dr. Resmi T.R. Senior Scientist & Head i/c, Ecology and Environment Research Group, Centre for Water Resources Development and Management, Kozhikode, Kerala
14:30	15:40	Geochemical and environmental isotopic characterisation of the aquifer system of Alappuzha district, India	SALEENA VAHID N, UNIVERSITY OF KERALA
		EVALUATION OF HEAVY METAL POLLUTION INDEX (HPI) OF GROUND WATER IN CHALIYAR RIVER BASIN AND IT'S IMPLICATIONS ON HUMAN HEALTH	NIKITHA P BHASKAR, MES PONNANI COLLEGE, Kerala
		Trend Analysis and Forecasting of Groundwater Levels (MSL) for 13 Selected District of Jharkhand State, INDIA	SEEMAB AKHTAR, IIT (ISM) Dhanbad
		IDENTIFICATION OF ARTIFICIAL RECHARGE ZONES IN UPPER KODAVANR RIVER BASIN 43USING GEOSPATIAL TECHNOLOGIES	M. LAVANYA, The Gandhigram Rural Institute - Deemed to be University

		Effect of soil ventilation on hydraulic properties in the unsaturated zone	Haritha VK, Anna University, Chennai
		Delineation of Groundwater Recharge Potential Zonation Based on GIS and AHP Techniques: a case study from Palliman watershed, South India.	Sreeja I S, University of Kerala
		Geogenic iron contamination in the groundwater resources of Kerala	Raicy Mani Christy, CWRDM, Calicut, Kerala
15:40	16:00	Tea	
16:00	16:30	Valeditory Function	

SI.No	NAME	TITLE	SESSION
	POSTER PRESENTATIONS		
1	JESHMA. P, University of Madras	RESPONSE OF LIVING BENTHIC FORAMINIFERA TO ENVIRONMENTAL VARIABLES IN THE ANCHUTHENGU ESTUARY, KERALA	Climate and Sea-level Changes: Past and Future Predictions
2	Mohammed Noohu Nazeer, CUSAT	Carapace behaviour of Bairdoppilata (Bairdoppilata) alcyonicola (Ostracoda) to EPMA from core samples of Visakhapatnam offshore, Bay of Bengal, India	Climate and Sea-level Changes: Past and Future Predictions
3	M. Sridharan, Department of Earth Sciences, Pondicherry University, Puducherry	Nitrate Pollution in Groundwater of Puducherry region, India with special insights on Human Health Risk Assessment using Monte Carlo simulation	Environmental Geology
4	Tania Mathew, Government College Kottayam Kerala	Landslide Susceptibility study of Kokkayar sub-basin of Manimala River of central Kerala using the Frequency Ratio (FR) method	Geo-hazards, Mitigation and Management
5	Pothuri Ramesh Chandra Phani, Mining & Natural Resources, Cyient Limited, Hyderabad, India.	Petrography of reef quartz from Cherlopally Dome, Ramagiri Greenstone Belt, Anantapur dt., Andhra Pradesh	Petrology: Analytical and Field Geology
6	Chandra, R., Geology, University of Ladakh, Leh	Glacio-geomorphological study in parts of eastern Karakoram: A case study of Rongdo Basin, Nubra Valley, Ladakh, India	Remote sensing
7	Samreena Mohammed, MES Ponnani College, Kerala	Analysis of shoreline changes in Central Kerala, India: an application of digital shoreline analysis system (DSAS)	Remote sensing
8	K.V. Sarath, University of Kerala, Kariavattom Campus, Thiruvananthapuram	Reconstructing a paleo-drainage from the Pampa River basin in southern India using an integrated approach	Remote Sensing
9	Shabana Ebrahim, MES Ponnani College, Kerala	Morphological Characteristics of Southern Part of Lyot Crater, Mars	Remote Sensing – Planetary
10	Srojish S. M., Kerala University of Fisheries and Ocean Studies	Exploring the Frozen Landscapes of Adamas Labyrinthus: Uncovering Water Ice Deposits on Mid Latitudinal Mars	Remote Sensing – Planetary
11	Harikrishnan Sadanandan, Department of Earth Sciences, Pondicherry University, Puducherry	Benthic Foraminifera as Bio-Indicator of Marine Pollution from the Shelf part of Southeast coast of India	Environmental Geology

12	Sanju Eldhose, Achu A L,	Coastal vulnerability assessment of Ernakulam district using Bayesian Belief Network and Geospatial technology	Remote Sensing

International and National Scientific Advisors

Chairman:

Fr. Dr. Jolly Andrews,
Principal, Christ College, Irinjalakuda

Organizing Secretary:

Dr. Linto Alappat
Assistant Professor and Head
Department of Geology and Environmental Science
Christ College, Irinjalakuda

Organizing Team:
Dr. Anto Francis K
(Assistant Professor in Geology, Department of Geology,
Government Engineering College, Thrissur)

I Ms. Anu J Ponnar I Dr. Subin K. Jose I Dr. Manju N.J. I

I Dr. Rekha V.B. I Ms. Shaima M.M. I Mr. Gopakumar P.G. I

I Dr. Swetha T.V. I Dr. Resmy K.J. I Dr. Sunitha D. I Mr. Anso M.A.I

I Ms. Ivine Joseph I Ms. Sweeshma P. Dev I Mr. Sibin Sebastian I

(Asst. Prof., Dept. of Geology and Env. Sc., Christ College)

I Mr. Tharun R. I Ms. Roshini P.P. I

(Coordinators, Asst. Prof., Dept. of Geology and Env. Sc., Christ College)

I Mr. Arish Aslam I Mr. Saleesh P.N. I Mr. Ayyappadas C.S. I

(Research Scholars, Dept. of Geology and Env. Sc., Christ College)

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INVITED TALKS

MICROPALEONTOLOGY, GEOCHEMISTRY, AND ITS ENVIRONMENTAL SIGNIFICANCE STUDIES AT YEDAYANTHITU KALIVELI ESTUARY, TAMILNADU

Lalthansangi and M. Suresh Gandhi

Department of Geology, University of Madras, Guindy Campus, Chennai – 600 025
Email: msureshgandhi@gmail.com

This study presents the first and recent result of benthic foraminifera from Yedayanthitu Kaliveli estuary, Tamilnadu. In, two season 40 samples were collected. Along with this 3 more cores were also retrieved from the area. Core(A) 65cm, retrieved from the upper river estuary, Core(B) 95cm, from the back side of mangrove and Core(C) 115cm, from the river mouth .

All the stations in the upper river estuary (stns.1-9) present dominantly sand followed by silty sand, and river mouth (stns.10-18) present dominantly sandy silt and upper estuarine region (stns.19-20) represent generally a silt substrate in Post-northeast and dominantly a sandy substrate in Pre-summer season in the whole study area. Sand is abundant in Yedayanthitu Kaliveli followed maybe because of active current in the study area. The sediments of lower mouth river and mangrove region is enriched in $CaCO_3$ in which high total species richness are observed whereas $CaCO_3$ is reduced in upper river estuarine area which result in lowered total species richness.

A total of 59 foraminifera taxa belonging to 23 genera, 16 families, 11 superfamilies, and 4 suborder of order FORAMINIFERIDA were identified from Yedayanthittu Kaliveli mangrove area. Living species *of Hanzawaia concentrica; Asterorotalia inflate; Nonionoides elongatum ; N.boveanum ; Ammonia dentata* and *Elphidium crispum*, *Ammonia beccarii ; A. tepida*; are more in pre-summer season. *Cibicides lobatulus; Cribrononion simplex; Elphidium norvang; Pararotalia nipponica; Amphistegina radiate; Rotalidium annectans* and *Quinqueloculina bicornis* are found only in some samples. In post-northeast season, the highest living species are *Ammonia beccarii; A. tepida ; A.dentata; Asterorotalia inflate; Cibicides lobatulus; Hanzawaia concentrica; Nonionoids boveanum ;Elphidium incertum; E.crispum; Nonionoids boveanum and Amphistegina radiate*. The other species such as *Ammonia dentate;Elphidium norvangi;E. discoidale; E. excavatum; Eponides repandus; E. cribro repandus; Globigerina bulloides; pararotalia calcar; P. nipponica; Asterorotalia inflate ; Rotalidium annectanans;Hanzawaia concentrica* and *Nonionoides elongatum* are found only in some depth.

In pre-summer Living/dead ratio varies from 0 to 0.15. In post-monsoon season, Living/dead ratio varies from 0 to 0.24. Sedimentation rate is very less during pre-summer and post-northeast, but quite high rate is noticed in post-monsoon season. Foraminifera data analysis from Yedayanthitu Kaliveli estuary clearly shows sudden increase in TFN and S in post-northeast season compare to pre-summer. From this it's so clear that salinity and pH is highly influencing foraminifera population in this estuary and this estuary dominate stress tolerant taxa.

From infaunal characteristic studies , In IFCore~1, the living infaunal of *Ammonia beccarri* can be seen all through the core , but high abundant of living population were found between 2 to 6cm, the living *Ammonia tepida* can be seen only between 4 to 6 cm and also the living *Trochammina inflate* were reported between 2 to 6 cm. In IFCore~2, the living infaunal of *Nonionoids elongatum* are reported between 2 to 8 cm and the living Elphidium norvangi are reported upto 4 to 8 cm. In IFCore~3, the living infaunal of Miliolina circularis are reported from 2cm to 28 cm, high abundant of living population were found between 18 to 26 cm but the living infaunal of Rectobolivina raphana and Edentostomina rupertiana are not reported throughout the cores in IFCore~4.

This study shows that the waste product from aqua culture enriches the chemical pollution in the upper river region;. from station 1-9 and the outlet of waste from nearby urban concentration also pollute in a heavy amount. The river-mouth (from station 10 to 18) and mangrove region (station 19 and 20) were facing lots of human actions like poisoning of birds, nitrates and phosphates used in trespassed agricultural land and the modifying of sediments are the main cause of pollution. So, these actions extremely effecting the dispensation; compactness and assortment of foraminifera in the Yedayanthitu Kaliveli estuary, Tamilnadu.

DISTRIBUTION OF OSTRACODA AND THEIR STATISTICAL ASPECTS: IMPLICATIONS ON (PALEO) ENVIRONMENT AND HIGH ENERGY MARINE EVENTS AND SEDIMENTS

S. M. HUSSAIN

Department of Geology, University of Madras, Guindy Campus, Chennai- 600 025, India
Email: smhussain7@hotmail.com

A meticulous knowledge in the paleoenvironmental variations through time is necessary to prepare ourselves for the future environmental modulations. Wide geological range, diverse speciation and prolific record of Ostracoda mark the micro-faunal group as a proxy in reconstructing the paleoenvironment. Ostracods are bivalved tiny Crustaceans; inhabit almost all types of aquatic environments. They are found in freshwater and athalassic habitats ranging from temporary ponds, rice fields to rivers and deep lakes. Brackish water environments such as coastal saline lakes, coastal lagoons, mangrove environments and open estuaries also support a diverse range of these fauna. In the oceans, ostracods inhabit all environments from intertidal zones to open ocean depths up to 4000 meters (psychrospheric forms). Certain freshwater ostracods can tolerate extreme environmental conditions of flourishing in hot water or sulphurous springs. Ostracods have several advantages since they cover the entire Phanerozoic time scale and occur in all aquatic environments down to abyssal depths in the oceans. Salinity, water temperature, stability of the substrate and organic material are the major factors governing ostracod distribution in estuarine and shelf environments. Ostracod species diversity decreases very rapidly when water salinity exceeds 40‰. Ostracods are almost absent in coarse substrates of active hydraulic process such as wave turbulence whereas in finer substrates rich in organic detritus they form nearly large populations.

The application of statistical data on Ostracoda, such as juveniles and adults; closed and isolated valves; males and females; right and left valves; smooth and ornamented forms, etc., besides colour variation, pyritisation and predation, to interpret the environment of deposition, rate of deposition and to assess the potentiality of sediments as source rocks for hydrocarbons has attained importance, during the last five decades. The carapace of few ostracods has smooth surface, and devoid of any sculpture. However, in many species, the carapaces are with simple to complex surface ornamentation. Hence, surface ornamentation serves as direct evidence for ecological interpretations, which can be studied with the help of Scanning Electron Microscope (SEM) photographs of the specimens. Individuals living in carbonate reef environments have much

thicker secondary ornamentation compared to individuals living in other environments. Ornamentation also reflects on the grain size of the sediment. Ostracod carapace-valve ratio helps in deducing siltation (sedimentation) of an area. The usage of carapace-valve ratio to yield palaeoecological information was pioneered [1, 2] and utilized to interpret the potential for the information of hydrocarbons, further summarized that when the ratio is high, the sedimentation is rapid, which minimizes disarticulation of carapaces into separate valves. A high percentage of carapaces in the sediments of Eocene/Oligocene from southeastern Australia and India [3], indicate rapid burial. While studying the Tertiary Ostracoda from the Lindi area, Tanzania, Ahmed *et al.* [4], on the basis of carapace-valve ratio, observed a higher rate of sedimentation in the Upper Eocene and Lower Miocene than the Oligocene sediments. A very high rate of sedimentation in the Mullipallam creek, near Muthupet and Pulicat lagoon is noticed through the carapace and valve ratio of Ostracoda [5, 6]. Since the siltation is more in the Pulicat lagoon, periodically desiltation and dredging activities are being carried out at the mouth and middle portion of the lagoon. The distributions of Ostracds along the coastal areas of vulnerable high energy marine events (tsunami) gives an insight on the identification these (Paleotsunami) [7, 8] deposits. The implications of the proxy Ostracod surface ornamentation; carapace and valve ratio, environmental interpretations and discussing the high energy marine events (tsunami) from the coast of Tamil Nadu and Andaman islands are presented and discussed in this paper.

GEOSPATIAL TECHNOLOGY IN WATER RESOURCES STUDIES

Girish Gopinath

Department of Climate Variability and Aquatic Ecosystems, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi-682 508, Kerala, India.

Water resources development and its availability is one of the crucial factors for sustainable development of nation. Though, water is omnipresent and abundant since oceans cover 70 percent surface of the earth, but usable fresh water available on land is just about 2.7 percent. The population explosion has also increased the demand of water resources for various purposes. Both natural resources and the socio-economic situation are integral parts of any watershed and should be given equal attention. Soil and water conservation measures on watershed basis can play an important role in formulating a long-term comprehensive land and water management strategies. Therefore, development of water resource is essential for sustainable development of nation. Remote sensing technology deals the requirements of reliability and speed, and is an ideal tool for generating spatial information which is pre-requisite for planned and balanced development at watershed level. The Geographical Information Systems (GIS) technology provides suitable alternatives for efficient management of large databases. Integration of Remote sensing data and GIS technologies has proved to be an efficient tool for water resources development and management projects as well as for watershed characterization and prioritization. The recent developments in Artificial Intelligence-Machine Learning-Deep learning leads to the development in GeoAI. GeoAI effectively harnesses the vast amount of spatial and non-spatial data collected with the new automatic technologies. The fast development of GeoAI provides multiple methods and techniques, although it also makes comparisons between different methods challenging. Overall, selecting a particular GeoAI method depends on the application's objective, data availability, and user expertise. GeoAI has shown advantages in non-linear modeling, computational efficiency, integration of multiple data sources, high accurate prediction capability, and the unraveling of new hydrological patterns and processes.

MACHINE LEARNING FOR GEOLOGICAL APPLICATIONS

Prasun Kumar Gupta

Indian Institute of Remote Sensing, ISRO, Dehradun
Email: prasun@iirs.gov.in

Fast computing platforms are currently driving research in several branches of earth sciences. With data driven techniques such as machine learning, large amounts of in-situ and remotely acquired data are being processed on cloud-based platforms for near real time predictions. In this talk, we delve into the recent advances in the use of remote sensing data for several geological applications. As machine learning is primarily being employed for classification and regression problems, new research undertaken at the Geoinformatics Department, Indian Institute of Remote Sensing in the fields of planetary mapping, ground water draft estimation and coal fire mapping will be discussed.

In this talk, we shall see the capabilities of machine learning in characterizing non-linear natural phenomena. Current research studies show extensive use of machine learning for a variety of geological applications. These studies are primarily fuelled by large amounts of open access satellite imagery and machine learning models of varying complexities. Machine learning models can be categorized into primarily three categories (1) supervised classification, (2) unsupervised classification, and (3) reinforcement learning. Most of these algorithms can be modified to work on regression problems. Algorithms such as random forest, decision tree and support vector machines have been extensively used to solve the problems stated above and lie in the supervised category. K-means, DBSCAN are some clustering algorithms, which fall under unsupervised classification and have been reported to be used for several geological applications.

Artificial neural networks, another model in machine learning research, has evolved into multilayer perceptron's or deep feed forward networks or simply, deep learning. Deep learning has opened the Pandora 's Box in applied geological research. We discuss our current research attempts to investigate lunar domes on the Moon using one such state-of-the art deep learning model called Faster RCNN. Proposed research is on using machine learning techniques rather than using computationally expensive physical methods to predict groundwater resources using satellite based gravity anomalies and process based distributed hydrological models. Finally, use of cutting-

edge deep learning algorithms such as generative adversarial models for data fusion in a coal fire monitoring application will also be discussed.

The variety of applications discussed are just the tip of the iceberg. Machine learning is fuelling a large gamut of research work in earth sciences. This talk aims to highlight state-of-art in applied machine learning research and ignite ideas in early stage researchers.

INVENTORY AND RAINFALL THRESHOLD: PRE-REQUISITES FOR THWARTING LANDSLIDES

Sajinkumar K.S.[1,2*], Rajaneesh A.[1], Krishnapriya V.K.[1]

[1]Department of Geology, University of Kerala, Thiruvananthapuram 695581, India
[2]Department of Geological and Mining Engineering and Sciences, Michigan Technological University, Houghton, MI 49931, USA
*email: sajinks@keralauniversity.ac.in

Documenting the extent of landslide phenomena, called inventory, forms a quintessential component of landslide analysis as it is a preliminary step toward landslide susceptibility, hazard, and risk studies. This inventory could have information on a wide variety of parameters like dimension, distribution, type and pattern of landslides in relation to morphological and geological characteristics. Furthermore, information on static (conditioning) and dynamic (triggering) factors can also be added together with a documentation on the loss of life and property. Such inventories can also aid in the study on evolution of landscapes dominated by mas wasting processes. Landslide study should never end with identification of prone areas; rather it should give robust mitigation measures. One of the commonest and viable (both geographically and economically) method is creating an early warning system. Since most of the landslides are temporally constrained to monsoon season, especially in tropical regions like Kerala, rainfall-based early warning will be the most appropriate. It works on the principle of a threshold. Threshold is the amount of rainfall required to trigger a landslide, which was documented in an inventory. Threshold varies for different region based on soil texture and thickness, and slope, apart from rainfall. By establishing a threshold, early warnings can be alerted to the community, so that life at risk can be eliminated.

Keywords: Landslide, inventory, susceptibility, hazard, disaster, rainfall threshold, early warning

TECHNOLOGY EMPOWERMENT TOWARDS BUILDING DIGITAL PLATFORM FOR GEOSPATIAL GOVERNANCE

Suresh Francis

Scientist, Kerala State Remote Sensing and Environment Centre (KSREC), Vikas Bhavan, Thiruvananthapuram, Kerala - 695033

Mapping with the help of the local volunteers having local knowledge is the best way to get realistic, granular and governance ready data, which can give information its true perspective, as the data can be spatially visualized by the local officials and corrected/updated by the volunteers as per need. Participatory mapping is the area where the stakeholders feel the responsibility of the data and thereby have confidence in the developmental activities which has a bearing to the data they collected. The data collected once integrated to a Governance platform, will ensure the inclusive governance of their area.

GRAMAM (**Gra**ss Root Level **Ma**pping and **M**onitoring) is thus a mobile platform developed for citizen/plot level participatory mapping and to build "Digital Kerala" by feeding the data in to the Decision Support System for Geospatial Governance. This study is thus an empowering activity which helped the volunteers to map almost everything they see around into the digital platform. The application has got 8 modules and 20 sub applications for mapping plot level and citizen level information. Using the application modules presently around one lakh kilometer local government owned roads out of 1.5 lakh kilometer expected roads have been mapped using 5009 volunteers, 7.5 lakh water abstraction structures out of 65 lakhs expected have been mapped using 2272 volunteers and more than one lakh assets (buildings and structures falling within 271 classes of asset categories) out of 100 lakhs expected using 4500 volunteers have been plotted. The data is collected at a very granular level which help the local bodies to build action plans on transportation network and water management of the locality. The information of the roads, wells and assets were collected by local volunteers, majority women, who are empowered by KSREC for the mapping activity. The mapping was done using Android mobile application in the local language where all the Geological terms were converted to local usages in Malayalam so that they can understand and map. For example Laterite is termed as "Chenkallu" which is the local usage and weathered zone is termed as "kothiyal ilakunna para". Similarly the entire profile of the well is taken which helped to bring out the strata thickness very precisely with lakhs of closely spaced data points. Similarly drying wells of each month, polluted wells, groundwater fluctuation, per day draft etc. along with

other granular parameters required for the water management of the local body is captured and processed for the planning and decision support. The mapping of the roads is coordinated and managed by Local Self Government Engineering wing of Kerala Government, well mapping is coordinated by the Groundwater department of Kerala Government. Asset mapping is coordinated presently by the Forest department to identify the assets within the one kilometer buffer area of 24 Wild Life Sanctuaries in Kerala.

Apart from the capabilities listed GRAMAM application have immense mapping potential and data capturing modules. The complete application is now getting implemented in a wholistic way, Local Self Government body wise, as part of their plan activities and is launched by Honorable Chief Minister in Dharmadam Assembly Constituency. By implementing in the fullest potential it is expected to build "DIGTIAL KERALA" and to transform Kerala into a Geospatially Governed State with a spatially aware community.

Key Words: - Geospatial Technology, Geospatial Governance, Participatory Mapping, GRAMAM, Digital Kerala, Granular Data, Citizen Centric Mapping.

MOLECULAR MARKERS FOR NATURAL AND ANTHROPOGENIC IMPACT IN AQUATIC ECOSYSTEMS

Anoop Ambili

Assistant Professor, Earth and Environmental Sciences
Indian Institute of Science Education and Research Mohali
Email : anoop@iisermohali.ac.in

In recent decades, the aquatic systems were subjected to rapid deterioration driven by multiple stressors such as climate change and human activity. The understanding of organic matter source(s) and its variability in aquatic systems is critical for constraining the ecological status and evaluating appropriate conservation methods. In this talk, I will talk about biomarker tools, the applicability of straight-chain hydrocarbons (*n*-alkane) to discriminate allochthonous and autochthonous organic matter sources inputs in aquatic systems. Further, the utility of emerging organic contaminants, polycyclic aromatic hydrocarbons (PAHs), phthalates and sterols and their long term history of accumulation and distributions in aquatic environment for discriminating the anthropogenic activity and pollution source will also be discussed.

LANDSCAPE EVOLUTION AND CLIMATIC VARIATIONS IN LADAKH, NW TRANS-HIMALAYA DURING LATE QUATERNARY

Binita Phartiyal

Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow 226007, UP

The Himalayan system is a complex and youngest fold mountain chain, which stretches across six countries, namely Afghanistan, Pakistan, India, Nepal, Bhutan and China. The NW part of Himalaya especially the Trans Himalaya exhibits a cold desert environment and is a part of the rain shadow area. The area receives very little rainfall and is mostly dry and barren. Such regions are sensitive to the environmental changes and where a little perturbation may lead to massive sediment production, erosion and sedimentation resulting dynamic evolution of the landform development and evolution of the area. This sector offers a rich platform for Quaternary palaeoclimatic studies as it has numerous sites where thick sections of glacio-fluvio-lacustrine sediments are exposed. It is tectonically very active lying in the vicinity of the Karakorum fault and the Indus suture zone. Presently, this is the only region of Indian territory which is under the influence of westerlies and experiences the peculiar cold dessertic climate and is bounded by the Tibetan Plateau region in the north east and the Himalayan syntaxis region of Pakistan in the western side. Thus, strategically as well as critically placed Ladakh region provides an opportunity to unravel the signatures of palaeoclimate and neo-tectonics preserved in these Quaternary deposits and their relation with the regional and global climate and morphosedimentary records this area can be used as proxy to global scale climatic shift and regional tectonism.

Ladakh region has enormous deposits of glacial, lacustrine, palaeo-lacustrine, fluvial and aeolian origin. The whole region displays a wonderful play of tectonics in its multiple levels of terraces and the recurrence of soft sediment deformation structures in its sediments. The main source of water is the glacial and ice melted water, which feeds the rivers-Indus, Shyok, Tangtse. Thick deposits with soft sediment deformation structures are exposed at several places, Nyoma, Kiyari, Spituk, Gupuk, Saspol, Uleytokpo, Khalsi, Leidoh, Bhima and Batalik in the ~450 km stretch of the river. An attempt to date the seismic events with the help of OSL/AMS dating techniques along with a multi proxy data (sedimentology, mineral magnetism, geochemical analysis, clay minerals) on palaeoclimate of the region is under study. Studies suggest that the Indus valley has undergone

tectonic disturbances, which are seen in the deformed lacustrine sediments moreover these lakes are formed due to the damming of the rivers by different landslides (either due to seismic disturbance or abrupt monsoon year's) at different periods in the past. The unsorted glacial sedimentary records deposited during the LGM (OSL dates to 23000 and 21000 yrs BP). The initial onset of climate change at the end of the glacial seems to be marked by a period from ca. 11,000–1000 yrs BP and ca. 17500 -~14000 yrs BP with a lake records. These periods possibly represent the strengthened southwest monsoon system and marks the transition into the Holocene and post LGM times. The seismic activities concentrate at ~ 10000 yr BP and 6000 yr BP. The glacial lakes north and south of the Khardungla Pass at North and South Pulu show a sedimentary record (based on AMS radiocarbon ages) from ~4500 yrs BP to almost ~500 yrs BP.

This region aptly knows as the roof of the world has a very good archive of sediments that is preserved along the river valleys which would answer questions of climatic perturbations, geomorphological evolution and tectonics.

PALEOLIMNOLOGY OF SOUTHERN PENINSULAR LAKES AND HOLOCENE PALEOENVIRONMENTAL SHIFTS

Hema Achyuthan

IOM, Anna University, Chennai 600025
Email: hachyuthan0@gmail.com

Paleolimnology is a scientific sub-discipline of earth sciences closely related to both limnology and paleoecology. Paleolimnological studies focus on reconstructing the past environments of inland waters (e.g., lakes and streams) using the geologic record, especially with regard to events such as climatic change, eutrophication, acidification, and internal ontogenic processes. Paleolimnological studies are mostly conducted using analyses of the physical, chemical, and mineralogical properties of sediments, or of biological records such as fossil pollen, diatoms, or chironomids and are multi and interdisciplinary in approach. Reconstruction of the past is often reconstructed using lake sediments collected from dug trenches and lake sediment cores.

In this presentation, a review of a few lake records from southern India is presented. Limnological studies in Kodaikanal (Kukkal ~1890 masl, Berijam Lakes ~ 2165 masl, and Parsons lake~2285 masl) were carried out to determine paleoenvironmental shifts and their possible impact on vegetation since the late Pleistocene period. This region dominantly receives the southwest monsoon rains from June to September. The lakes are structurally controlled. To reconstruct past environment Lake trenches and sediment cores retrieved from these lakes were radiocarbon dated and the ages reveal non-linear phases of deposition. Berijam lake core is dated from 2400 yrs BP to the present and older ages for Kukkal (9000 yrs BP to Present) and Parsons Lake (~29,800 yrs BP to present). Integration of all the proxy data signifies six distinct paleoenvironmental phases: 1) Warm and humid conditions with a high lake stand before the last glacial maximum (LGM-~29,800 cal yr BP), subsequently altering to a relatively cool and dry phase during the LGM. 2) Drier conditions and lower precipitation occurred between ~16,300 and 9500 cal yr BP causing vegetation to shrink and possibly be confined to moister pockets or riparian forest cover. 3) An outbreak in the shift of monsoonal precipitation was witnessed at the beginning of the mid-Holocene in Parson's lake, around 8400 cal yr BP, implying alteration in the shift toward warm and humid conditions, resulting in relatively high pollen abundance for evergreen taxa. However, wet, Holocene climatic optimum (9000 yrs to 5000 yrs BP) was noted in the Kukkal sediment core. 4). From 5000 yrs BP to the present, drier conditions prevailed due to the decline in southwest

monsoon intensity and its amount. During this long dry period, several wetter events of shorter duration occurred. 5). Medieval warm period and Little Ice Age events were noted in the Berijam lake core. 6) Around ~1850 yr BP, a shift to heavier $\delta^{13}C$ values with the emergence of moist deciduous plants points to drier conditions. Anthropogenic activity contributed to the high percentage of *Acacia* and *Pinus* pollen during the Little Ice Age. Variations in the grain size distribution indicate paleoflood events influenced by regional climatic conditions and identified by the silty sediment matrix around ~29,838 and ~8405 cal yr BP.

SPECTRAL GEOLOGY: A TOOL FOR EXPLORING EARTH AND PLANETARY SURFACES

K. N. Kusuma

Assistant Professor, Department of Earth Sciences, Pondicherry University, Puducherry, India – 605014.

Email: kusuma.kn@gmail.com.

Mineral and rocks exhibit diagnostic spectral features at different wavelength regions of the electromagnetic spectrum, depending on their composition and internal structures. The wavelength position of the absorption band center and the band depth provide important clues about presence of the object and their abundances. Spectral geology involves analysis and measuring of diagnostic spectral features of minerals and rocks, and quantifying their abundances on the the earth and planetary surfaces. The spectral geology is useful in identifying mineral deposits, rock type discrimination by in situ measurements as well as from space. Minerals such as chlorite, amphibole, sericite, biotite, epidote, and clay etc are spectrally active in the SWIR region (1400-2500 nm) are used as path-finders identify the hydrothermal alteration. The visible and near infrared region (400 nm-1300 nm) is particularly employed in mapping oxides and Thermal infrared region (8-14 µm) is sensitive to the rock forming minerals such as silicates. Airborne/spaceborne multispectral and hyperspectral images such as Landsat, ASTER, EO-1 Hyperion, HyMap, AVIRIS, PRISMA etc are used for narrowing down on the ore bodies using their surface mineral distribution. Various space missions to the Moon and Mars by the global space agencies have used the optical and infrared remote sensing to derive surface compositional such as mineralogy and abundances and infer about the geological evolution. The various missions to the moon have generated a global map of elements and minerals. Spectrometers on board Chandrayaan-1 and 2 have first reported presence of Mg-spinel, presence of water on the Moon surface and generated global map. Spectrometers such as Observatories pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA), Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) have reported minerals such as phyllosilicate and other hydrous minerals on the Martian surface that indicate presence of water in the geological past.

RADON: A TRACER IN HYDROGEOLOGICAL AND GEOLOGICAL STUDIES

Prof. (Dr.) Sabu Joseph
Director, School of Earth System Sciences
University of Kerala
jsabu@keralauniversity.ac.in

Radon (^{222}Rn) is a colorless, odorless, inert, and radioactive noble gas (t1/2 = 3.8 days) that emanates from rocks and soils as a result of the alpha decay of its parent, radium (^{226}Ra) in the decay series of uranium-238, is the focus of this study. Radon is produced in the crystal lattice of the minerals and emanates out through alpha recoil. It is present in soil and air environments, and is found in dissolved form in water. Its distribution in water is more relevant for scientific investigations. Certain properties of radon enable it to serve as an ideal tracer, viz., short-half life, inertness, high abundance in groundwater than surface water, preferential partitioning, sensitivity to sudden changes in subsurface conditions, non-invasiveness etc.

This paper reviews the potential applications of radon as a tracer and precursor in several hydrogeological and geological applications viz., understanding the surface water - groundwater interactions, hydrograph separation of streams, Submarine Groundwater Discharge (SGD) estimations, study of hydrodynamics and water balance of lakes, earthquake predictions, locating geological structures (faults/lineaments), geochemical explorations, NAPL contamination studies etc. In comparison to the numerous applications discussed, radon based technique is found to be more reliable in the water resources domain than seismic precursory investigations. The interpretations made in the present study will provide a better understanding of hydrological processes and enable planners for the sustainable development and management of water resources.

BIG MULTITEMPORAL GEOSPATIAL DATA AND THE LARGE-SCALE ANALYSIS OF SOUTH ASIA'S PAST LANDSCAPES

Prof Hector A. Orengo

ICREA Research Professor, Catalana Institute of Classical Archaeology, Spain
Email:horengo@icac.cat

The last few years have seen an unprecedented advance in the application of computational approaches for the geospatial analysis of past landscapes, settlements and features. This progress is mostly related to improvements in availability, quality and resolution of remote sensing (RS) data acquired from multiple platforms (ranging from satellite imagery to UAVs) and sensors (e.g. multispectral, radar, lidar, thermal) but also to increased access to high performance computing. This is partly related to the development of multi-petabyte catalogues of geospatial datasets linked to cloud computing environments, which have granted the geospatial community unparalleled access to RS data and computing power. These have allowed the development of large-scale, multitemporal and multi-sensor analyses of the Earth's surface but also the implementation of intensive computational processes such as machine learning-based data classification, multi-scale topographic analysis, long-term time series analysis, and so on.

This talk will showcase some of these current approaches to the analysis of past landscapes developed by the Landscape Archaeology Research Group (GIAP) at the Catalan Institute of Classical Archaeology (ICAC). Several South Asian large-scale case studies will be employed to illustrate how the use of multitemporal and multisource data can be analysed using machine learning and deep learning approaches within a probabilistic frame.

bSPATIAL AND STRATIGRAPHIC CONTROLS ON FELDSPAR BURIAL DIAGENESIS AND KAOLINISATION IN RESERVOIR QUALITY FOR OIL AND GAS EXPLORATION, FROM TRIASSIC MUNGAROO FORMATION, CARNARVON BASIN, AUSTRALIA

Saju Menacherry, PhD.

Sedimentologist / Petrographer/ Reservoir Quality Geoscience Consultant
GeoReservoir Solutions, Perth, Australia.
Email: smenacherry@gmail.com

The Triassic fluvio-deltaic Mungaroo Formation is the main reservoir in the multi-TCF gas plays offshore Northern Carnarvon Basin, Western Australia. Mungaroo Formation sandstone framework grains are dominated by mono crystalline quartz, with minor polycrystalline quartz, feldspar and lithic fragments, mica, heavy minerals, organic matter and detrital clay. Sandstone classifications are mostly subarkose and quartzarenite with sublitharenite and rare arkose, lithic arkose, feldspathic litharenite and litharenite. Sands are typically fine-to coarse-grained and poorly-to well-sorted. Diagenetic events are responsible for the subsurface modification of the sediments after it was deposited and buried to the present depth. Integrating diagenesis and sequence stratigraphy can provide a better way of predicting reservoir quality.

The composition, grain size and sorting vary laterally and vertically even within a single depofacies, due to the high complexity of the Mungaroo Formation sediments and environment of depositional setting. Reservoir quality data were compiled from sedimentological descriptions, petrographic analytical data sets (i.e., petrography, QXRD, MICP, and SEM) and routine core analysis data from various fields in the basin. A detailed depofacies and lithofacies analysis was performed on the sampled intervals to provide sedimentological context to the petrology data and to evaluate the compositional variation in diagenesis. Within the stages of diagenesis spatially, **the kaolinisation diagenetic style** have been identified which emphasize or de-emphasize different burial stage changes.

Diagenetic modifications involve a complex arrangement of compaction, alteration and dissolution, with abundant authigenic cements. The kaolinitic style is focussed throughout the basin where Jurassic uplift and erosion are best developed, and is best showcased in Gorgon and West Tryal Rocks fields. Kaolinisation diminishes to the west and north away from Gorgon as structuring becomes more subtle and erosion less influential. Kaolinitic style is important at deep burial prospects (depths) where it (a) inhibits later quartz cementation (especially $>80^0$C) and

thereby preserves the intergranular primary porosity, (b) pores within kaolinite become significant at deeper depths because of the commencement of quartz cementation in the primary pores, leaving the kaolin pores open and preserve gas productive porosity, and (c) complete kaolinisation prevents illitisation and thus retains the permeability at higher temperatures ($>120^0$C).

The new data derived from the integration of the stratigraphic controls with burial diagenesis and quantitative interpretation techniques can predict the reservoir quality and rock properties (e.g., geochemical, geomechanical, petrophysical) of the Mungaroo Formation sands that directly influence good reservoir presence, lower pre-drill risk allocation, resource estimates and optimised recovery strategies.

THE FATE OF ARAGONITIC PTEROPODS IN THE INDIAN OCEAN UNDER OCEAN ACIDIFICATION SCENARIO

Sijinkumar, A.V[1]., Sreevidya, E[1], Nath, B.N[2]., M. B. L. Mascarenhas-Pereira[2]

[1]Department of Geology, Central University of Kerala, Kasaragod-671316, India
[2]Geological Oceanography Division, CSIR-National Institute of Oceanography, Dona Paula, Goa-403004, India.

Pteropods are marine gastropods made up of aragonitic shells, a metastable polymorph of $CaCO_3$, which is more susceptible to dissolution than calcite. Hence, their preservation and accumulation on the seafloor is controlled by the aragonite compensation depth and changes in the properties of water masses. The analyses of the Quaternary pteropods preservation records from the Indian Ocean reveal characteristic changes in the water masses and water column chemistry from the last glacial period to the present. Generally, better preservation is reported during glacial cold periods and very poor preservation during Holocene. The poor preservation during the present interglacial is a subject of interest since they are the most vulnerable among the major plankton producers of $CaCO_3$ in the current ocean acidification scenario. Modern aragonite preservation has dropped nearly as low as those experienced in the late Pleistocene interglacial periods. However, pteropod preservation is better during the last interglacial period (Eemian). The poor preservation/absence of pteropods during the Holocene in the Indian Ocean may have implications on ocean acidification driven by enhanced atmospheric CO_2 concentration. The preservation spikes are present in all the records which are well correlated with time. The last preservation spike was during the deglacial period, consistent with Atlantic and Pacific Ocean records. The deglacial preservation spike indicates the global nature of deepening aragonite compensation depth, changes in water column chemistry, and intermediate water circulation.

Keywords: Aragonite pteropods, Preservation spike, Late Quaternary, Indian Ocean.

COMPARING EOARCHEAN CRUSTAL GROWTH IN LABRADOR, CANADA AND GREENLAND

Daniel J. Dunkley[1] Monika A. Kusiak[1] Martin J. Whitehouse[2] Simon A. Wilde[3]

[1]*Institute of Geophysics, Polish Academy of Sciences, Warsaw, Poland*
[2]*Department of Geosciences, Swedish Museum of Natural History, Stockholm, Sweden*
[3]*School of Earth and Planetary Sciences, Curtin University, Perth, Australia*
Email: daniel.dunkley@igf.edu.pl

In high-grade gneiss terranes, much of the interpretation of geological history relies on the microbeam dating of zircon, especially where it is the only mineral that survives metamorphism and deformation. This is especially the case in the Eoarchean, where most rocks of this age have been converted into amphibolite or granulite-facies gneisses.

The western edge of the North Atlantic Craton (NAC) possesses large domains of Eoarchean crust. The best known is in the Itsaq Gneiss of SW Greenland, which includes the Isukasia Terrane with the best-preserved Eoarchean field relationships. On the northern Labrador Coast of Canada, the Saglek Block includes the Eoarchean Uivak Gneiss, dominated by tonalite-trondhjemite-granodiorite (TTG). Through careful sub-grain dating of zircon, the Neoarchean metamorphism and deformation that pervades the gneisses of the NAC can be rendered transparent to identify remnant Eoarchean terranes. were possibly assembled during a ca. 3.6 Ga tectonothermal event.

New SIMS dating from a ~100 km section of coast between Ramah Bay and Hebron Fjord in Labrador reveals ages between 3.75 and 3.70 Ga, followed by high-grade metamorphism at ca. 3.6 Ga. Thus, the effects of a major tectonothermal event at the end of the Eoarchean, which juxtaposed terranes in SW Greenland, are also evident in the Saglek Block. However, the generations of TTG in the Saglek Block are not the same age as those in the Isukasia Terrane. Specifically, an abundance of ages between 3.75 and 3.70 Ga, and localised remnants of pre-3.85 Ga TTG crust, are found in the Saglek Block but not in the Isukasia Terrane.

Although both the Saglek Block and the Isukasia Terrane have been affected by a 3.6 Ga regional tectonothermal event, the differences between the protolith ages of the Saglek Block and the Isukasia Terrane leads us to propose a new 'Uivak Terrane' that was juxtaposed with Isukasia at the end of the Eoarchean. Similar ages to the 'Uivak Terrane' are also found in the Færingehavn Terrane of the Itsaq Gneiss in SW Greenland, suggesting the latter may include fragments of both the 'Uivak' and Isukasia Terranes, reworked during assembly of the NAC in the Neoarchean.

SPACE GEODETIC APPLICATIONS IN EARTH SCIENCES: SOME CASE STUDIES

Sunil P.S.
Department of Marine Geology and Geophysics
School of Marine Sciences
Cochin University of Science and Technology
Kochi – 682016
Email: sunilpscusat@gmail.com

Over the past few decades, Space-Geodetic methods have become very important in Earth exploration and geodetic research. Examples include very long baseline interferometry (VLBI), global navigation satellite system (GNSS), satellite laser ranging (SLR), interferometric synthetic aperture radar (InSAR), Doppler orbitography and radio-positioning integrated by satellite (DORIS), satellite altimetry and gravimetry, etc. The establishment and maintenance of the Earth's reference frame, the Earth's rotation and geodynamics, high-precision navigation and positioning, gravity fields, geodetic observation, remote sensing and modelling of the Earth's atmosphere and ionosphere etc. are made possible by the rapid development of these space-based observing systems. In view of this, the current session focuses on the researches and finding done by our group using GNSS and InSAR applications in space and ground observations for Earth Sciences.

CARBON ISOTOPE ANALYSIS OF A LATE QUATERNARY FLUVIAL, AEOLIAN AND PALEOSOL SEDIMENTARY SEQUENCE FROM THE CENTRAL TAPI RIVER VALLEY

Prabhin Sukumaran[1], Stanley H Ambrose[2] and Parth R Chauhan[3]

[1] *Dr. K C Patel Research and Development Centre, Charotar University of Science and Technology, Changa, Gujarat, India*
[2] *Department of Anthropology, University of Illinois, Urbana, USA*
[3] *Department of Humanities and Social Sciences, IISER-Mohali, Punjab, India*
* Corresponding author: prabhinsukumaran.cv@charusat.ac.in

ABSTRACT

Plants that follow the C_4 photosynthetic pathway, mainly tropical grasses and herbs adapted to strong sunlight, have $\delta^{13}C$ values averaging -12‰. Carbon isotope analysis of soil organic matter ($\delta^{13}C_{SOM}$) can be used to reconstruct proportions of tree and grass biomass in tropical savanna ecosystems. The carbon isotope composition of pedogenic carbonate ($CaCO_3$) primarily depends on the isotopic composition of soil CO_2, which reflects that of plant root and soil microbial respiration. The $\delta^{13}C$ values of pedogenic carbonates can also be used to estimate the proportion of trees to grasses in the past environment [1-5]. Organic and carbonate $\delta^{13}C$ should provide closely similar estimates of C_3 and C_4 biomass. However, they often differ significantly [6]. Soil carbonate forms at variable depths below the soil surface that provides the root-respired plant CO_2, so carbonates may form at the same levels as older organic carbon that had formed in environments with different proportions of C_3 and C_4 plants. Diagenesis of organic or carbonate fractions, and assimilation of air CO_2 in carbonates formed close to the surface, may also contribute to differences in $\delta^{13}C$-based estimates of past plant biomass composition. The present study evaluates the relationship of total Inorganic (TIC) and organic (OC) weight %C to $\delta^{13}C_{SOM}$ and $\delta^{13}C_{TIC}$ of 94 samples from a 15-meter sediment sequence deposited under an aeolian and fluvial depositional setting in the central Tapi River Valley, near Sakegaon, Maharashtra. Qualitative assessment through bivariate plots of elemental and isotopic composition parameters shows patterns of clusters of TIC vs $\delta^{13}C_{SOM}$ compositions and depositional environments, likely reflecting distinct floral habitat communities in different paleoclimatic and sedimentary settings during the Late Quaternary. Higher resolution analysis of this sequence is needed to characterize variation within environmental phases and rates of environmental change during transitions between phases.

Keywords: Tapi River Valley**,** Pedogenic carbonate, $\delta^{13}C_{SOM}$

STUDENT PRESENTATIONS

CARRIER PHASES OF RARE EARTH ELEMENTS IN BANDED IRON FORMATION FROM THE SINGHBHUM CRATON, INDIA

Achyuth Venugopal[1]*, Rakesh Kumar Rout[1], Gyana Ranjan Tripathy[1]

[1] *Department of Earth and Climate Science, Indian Institute of Science Education and Research Pune, Dr. Homi Bhabha Road, Pashan, Pune-411008, India*
*Corresponding author: venugopal.achyuth@students.iiserpune.ac.in

ABSTRACT

Elemental and isotopic distributions of Rare Earth elements (REEs) in Banded Iron formations (BIFs) have found frequent applications in constraining past ocean redox states, source of nutrients to oceans, and growth of continental crust. However, the exact phases associated with the authigenic, biogenic, and detrital components of these REEs remain less explored. In this contribution, the REE-Y abundances in BIF samples from the Singhbhum craton, India have been investigated. These elemental compositions have also been measured in different carrier phases, including moderately reducible Mn-Fe oxides, magnetite, aluminosilicate and biogenic silica (ABS). This preliminary report on REE phases does not include data for carbonate and complete Fe-oxide-associated phases. The total REE content (ΣREE) of the BIFs varies from 1.1 to 16.3 μg/g with an average concentration of 8 ± 6 μg/g. Average light (La-Nd; 5.2 μg/g), middle (Sm-Ho; 0.6 μg/g), and heavy (Er-Lu; 0.2 μg/g) REE concentrations show that the samples are light REE enriched. About half of these Rare Earths (~40%) are associated with aluminosilicates and biogenic silica (ABS) components of BIFs. The magnetite and moderately reducible Mn-Fe-oxide phases contribute only a minor fraction (~10%) of the total REEs. Most of these phases show elevated PAAS-normalized concentrations for Y and Eu, consistent with that reported for Precambrian BIFs from other global sections. The ABS component of selected samples shows minor depletion in PAAS-normalized Ce concentrations, similar to the modern-day seawater REE pattern. More investigations, including complete extraction of Fe-oxide and carbonate-associated phases, can provide better insights into the exact component that retains the signature for Archean ocean conditions.

COMPREHENSIVE SPECTRAL AND ISOTOPIC (C- AND O-) ISOTOPIC INVESTIGATION OF ULTRAMAFIC HOSTED MAGNESITES FROM SALEM, SOUTHERN INDIA

Haritha. A.[1*], Rajesh V.J.[1]

[1]*Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Valiamala P.O, Thiruvananthapuram 695 547, Kerala*
Corresponding author: harithaanil1994@gmail.com

ABSTRACT

Magnesite ($MgCO_3$), a carbonate mineral, can form through the alteration of magnesium-rich rocks in various geological settings. Magnesite deposits of southern India are mainly confined to the ultramafic complexes and occur as veins and stock work type of deposits. In the present study, we investigate the spectral and stable (C- and O-) isotopic characterization of the magnesite deposits of the Salem mafic-ultramafic Complex (SMUC). The dunite-hosted magnesite mineralization is confined mainly to major faults/joint planes in the complex. It occurs in two belts, i.e., the west hills – Jagir Ammapalayam (4 sq. km) on the south and the Karuppur-Red hills – Kurumbapatti- Chettichavadi Jagir (26 sq. km) in the north. The Chalk Hills Complex (CHC) or Sunambu Karadu, which is about 7 km NW of Salem city, is where the SMUC's notable magnesite occurrences are found. Magnesite vein-type occurrences predominate in the study area. The thickness ranges from a few centimeters to meters and restricted till 360m depth from surface. The spectral analyses of the magnesite samples were done using a combination of techniques such as XRD, hyperspectral, Laser Raman, and FTIR. The hyperspectral analysis showed characteristic absorption bands at 1.4µm, 1.9µm, and 2.3µm. These absorptions features are caused by the stretching and bending of the C-O bond in the CO32- ion. Laser Raman spectra showed the intensity peaks at 212cm-1, 327cm-1, 735cm-1, 1092cm-1 and 1445cm-1 which are attributed to the translational and liberational vibrations. The FTIR data showed the peaks at 1434cm-1, 880cm-1 and 747cm-1 corresponding to the Mg-O bond stretching and asymmetrical C-O stretching. The XRD spectra showed intensity peaks at 32.69°, 35.9°, 43.03°, 46.87°, and 53.92°. Stable isotope analysis of the magnesite samples yielded a δ13C value in the -2 to 6‰ range and δ18O value ranging from 24‰ to 26‰. According to stable isotope data, low-temperature (49 3.3 C) fluids enriched in carbon dioxide altered the ultramafic rocks, which led to the mineralization of magnesite in Salem. The genetic model we suggest implies that meteoric water penetrates the

ultramafic rocks through weak planes and fractures. This study also suggests that the decarboxylation or dissolution of marine limestone is the source of carbon for mineralizing fluid.

DISSOLVED SULFUR ISOTOPIC COMPOSITION OF THE MAHANADI RIVER, INDIA: SEASONALITY AND SULFATE SOURCES

Rakesh Kumar Rout[1*], Gyana Ranjan Tripathy[1]

[1]*Department of Earth and Climate Science, Indian Institute of Science Education and Research Pune, Dr. Homi Bhabha Road, Pune-411008, India*
*Corresponding author: rout.rakesh@students.iiserpune.ac.in

ABSTRACT

Sulfur isotopic ratio of river water have frequently been used to apportion their sulfate sources. Among these sources, sulfide oxidation (coupled with carbonate weathering) serves as an important source of atmospheric CO_2. Here, we present new major ions and sulfur isotopic data for a distributary of Mahanadi river (Paika river, Odisha, India) at a weekly interval for a duration of 15 months (August 2019 to October 2020). The major ions concentrations of the samples were analysed using an Ion chromatograph, and $\delta^{34}S$ in the $BaSO_4$ precipitates were measured using an IRMS instrument. The major ion chemistry of these samples show significant temporal variations, with relatively lower concentrations during the monsoon than the non-monsoon samples. The sulfate concentration varies from 36 to 132 µM with an average of 93 ± 24 µM (n = 65). The $\delta^{34}S$ values for the Mahanadi varies between 8.6 and 16.9 ‰ (average: 13 ± 2 ‰; n = 29). These $\delta^{34}S$ values, although compare well that reported for peninsular Indian rivers, are significantly enriched compared to global average $\delta^{34}S$ value reported for rivers (~4.4 ‰; [1]). The $\delta^{34}S$ values for the monsoon samples (~10 ‰; n = 8) are found depleted than the non-monsoon samples (~12 ‰; n = 8). Employing these seasonal $\delta^{34}S$ data to sulfide oxidation in the basin was tricky, mainly due to overlapping $\delta^{34}S$ values for the sedimentary pyrites and gypsum of this basin. Our preliminary results show that the sulfide oxidation in the Mahanadi basin is limited, despite of appreciable exposure of coal and shale deposits. The limited sulfide oxidation in this tropical river basin may be linked to the transport-limited weathering process in the basin.

WATER QUALITY PREDICTION USING MACHINE LEARNING TECHNIQUES: A REVIEW

Manisha S Babu[1*], Shaji E[1]

[1]*Department of Geology, University of Kerala, Kariavattom Campus, Trivandrum*
Corresponding author: manishababu9764@gmail.com

ABSTRACT

Water is the most significant resource of the Earth and is crucial for supporting life. The world's water reserve comes to about 1.4 billion. km^3, of which 35 million km^3 becomes freshwater resources, of which about 91,000 km^3 can be used for everyday consumption. More than 2.5 billion people on the globe rely on groundwater for drinking and providing high-quality drinking water has become one of the major challenges of human society. Water quality has a direct impact on public health and the environment. There are specific quality standards for ambient water bodies such as rivers, lakes, streams, and groundwater. However, humans and industrial processes can pollute such resources. Indeed, improved water quality decreases the cost of water treatment for drinking and industrial purposes while also boosting agricultural yield. Water demand increases due to population growth, intense agriculture, urbanization, and industrial activities. In the United Nations (UN) report, approximately 1.5 million people die every year from water-borne diseases. Water contamination is believed to cause 80% of all health problems in developing countries. Every year, there are five million fatalities and 2.5 billion illnesses reported. Since anthropogenic activities and natural pollution sources threaten the quality of water resources, water quality assessment and prediction using modern tools are necessary to assess its suitability for various uses. Water scarcity is dynamic and complex, emerging from the combined influences of climate change, basin-level water resources, over-exploitation of groundwater, and systems' adaptive capacities. Beyond conventional studies and responses, it is critical to also consider how modern tools like Artificial Intelligence and Machine Learning (ML) can help to mitigate or exacerbate water shortages. Accurate forecasting value will undoubtedly improve the management level of water resources.

This study analyses research articles based on the "Application of Machine Learning Algorithms in Water Quality Prediction" for the last twelve years. The results of this study would demonstrate the application of machine learning models for estimating water quality using factors that can be quickly and directly quantified. ANN, SVM, RF, and KNN are the important algorithms used in

water quality prediction. Most of the analyses have been done based on the water quality index and water quality class. Machine learning prediction models will enhance water quality control and assist farmers in managing irrigation water quality and administrators in managing drinking water quality. The analyses show that most of the ML studies are widely used in European and Asian countries, mainly in China. Based on this theme, very few studies have been done in India. Since ML can be used to anticipate water quality, improve resource allocation, manage resource shortages, etc., it has been widely adopted as a powerful tool to address difficulties in the water environment. This study encourages interdisciplinary talent expertise in multiple domains to create more sophisticated machine learning methods.

PYTHON PROGRAMMING IN QUANTITATIVE EARTH SCIENCES

Pragnyadipta Sen[1*]

[1]*TerraPy Education*
**Corresponding author: terrapyeducation@gmail.com*

ABSTRACT

The increasing demand of predictive mathematical and computational modeling in earth sciences is driven by the mining industry and the environmental agencies. Mathematical and statistical models of ore bodies or pollutant dispersal based on ground data are critical in developing predictive models for future exploration, mining, pollutant treatment plan. The predictive models and the model visualization/s have a direct impact on the health of human lives and the economy of a country. The solutions of the mathematical models and predictive statistical models typically involve solving complex mathematical and statistical equations analytically or numerically that are tedious to perform by hand. Computer programs are instead written to solve the models and visualize the results. In the late twentieth century, geoscientist started using the FORTRAN, PASCAL, and C programming languages to solve the modeling problems. FORTRAN ad C though extremely fast at performing computation have a number of challenges like (i) program compiles before execution of code thereby de-bugging or error finding in the code is very challenging, (ii) has a steep learning curve, especially C, (iii) lack of any visualization package or library.

In 1991, Guido von Rossum released the first version of the Python programming language – a high-level, general purpose programming language available for free to everyone. Python was developed to be an easy-to-understand programming language loosely following a human

conversation style logic. In 2000, Python 2.0 was released which was succeeded by Python 3.0 in 2008 where each major version contained several improvements in capability in computational techniques. Computer scientists quickly determined that Python is extremely easy to learn due to its programming principle that follows a human conversational style. Although in the early days of Python, the programming language was not intended for heavy quantitative analysis, the modular nature of Python programming language allowed the python developers to use legacy FORTRAN and C numeric code mixed with python code to develop libraries that could perform heavy-duty mathematical, statistical calculations and high-quality visualizations. Some of the advantage of using FORTRAN and C legacy numeric codes with python are as follows: (i) the numerical calculations are faster than if they were written in pure python, (ii) usage of mature numerical and statistical code used by many scientists in the field of basic sciences like Physics, Mathematics, Engineering, (iii) alleviating the need to re-write well-established code by scientists who want to apply the mathematical procedures, (iv) the opportunity for anyone to rewrite legacy code in python if they so desire with the caveat that their code will run slower than the FORTRAN or C version but they would know every assumption, condition they put in their code.

Around the time Python 2.0 was launched in 2000, earth scientists in academia were getting interested in the Python programming language due to the ease of learning, the modular nature, and the availability of several libraries that performed specific earth science calculations. Since 2000, a large number of python libraries have been developed that addresses numerous numerical methods required by earth scientists and that trend continues to grow. The factors that have contributed to making Python a preferred language for earth scientists are (i) Python is FREE compared to commercial earth science software, (ii) the code for all python libraries are freely available for anyone to modify and improve compared to the encrypted closed proprietary codes in commercial software, (iii) an active development team, (iv) numerous active forums where help can be sought, (v) a large collection python examples, (vi) easy to understand syntax of Python. In the recent years, research groups have started to convert to the open-source Python programming so that they can publish their code freely which can be easily replicated. Given the demand of the industry, in the near future all earth scientists must be able to perform quantitative computation and the Python programming language will be at the forefront of the programming language of choice.

BENTHIC FORAMINIFERA FROM ONSHORE PIT SAMPLES FROM THE LOCATIONS OF KANNUR DISTRICT, KERALA: IMPLICATIONS FOR PALEOSEALEVEL CHANGES

Adarsh P[1*], Anandasabari K[2], Rajeshwara Rao N[3]

[1]*Department of Geology, University of Calicut, Kerala*
[2]*National Institute of Ocean Technology, Chennai*
[3]*Department of Applied Geology, University of Madras, Chennai*
*Corresponding author: adarshprakrithy@gmail.com

ABSTRACT

In this study, a relative investigation of onshore samples from the two sites of Kannur District, Kerala yielded 20 species of foraminifera belonging to 15 genera and 4 suborders. Rotaliids dominate the assemblage overwhelmingly, with Ammonia beccarii accounting for at least 50% of the assemblage and other taxa associated with A. beccarii reveal that this region of Northern Kerala was typically a mid-tidal to shallow tidal, sheltered, near-normal environment connected to the Arabian Sea, also corroborated by the presence of few tests of planktonic foraminifera. Pit profiles from the study sites reveals that, variation in the sediment deposition structures and benthic foraminiferal occurrence in the certain depth, which is a result of greater overpressure from terrigenous and Marine input at study sites of KizhakkeKandangaliParappa (KK Parappa) and Marayikode region. Subsequently, foraminifera local assemblages, population density and species diversity suggest that most promising high-energy events in the study region of marshes, lakes, lagoons or shallow marine areas. The results of two pits sediment samples and shells ^{14}C dates were 4600±100 yrs BP; 4900±130 yrs BP; and 5100 ± 100 yrs BP from Thalody and sediment samples and shells ^{14}C dates were 5760±120 yrs BP; 5340±80 yrs BP; and 5500±80 yrs BP from Kunnaru-Thekkebhagam. These results exhibit the sediment characteristics and shell debris layers available below the present surface, which indicates an instinctive marine influence with terrestrial margin. Similarly, the sedimentation rate is considerably controlled by the river and terrestrial input because the rate of sedimentation is higher in transition time compared to the Mid –late Holocene period.

Keywords: Sea level changes, Benthic foraminifera, Sedimentology, ^{14}C Dating.

LATE QUATERNARY INDIAN MONSOON VARIABILITY RECORD FROM BAY OF BENGAL BASED ON PLANKTIC FORAMINIFERAL RECORDS

Komal Shinde[1]* and Mohan K[2]

[1]*School of Advanced Sciences, Vellore Institute of Technology, Chennai-600127, India*
[2]*School of Civil Engineering, Vellore Institute of Technology, Chennai-600127, India*
*Corresponding author: komalshinde360@gmail.com

ABSTRACT

We report a high-resolution planktic foraminiferal record from the western side of the OMZ, located off the coast of Visakhapatnam in the Bay of Bengal (SK 336 GC-2, water depth; 814 m). These results show a significant monsoonal variability for the last 33 kyr as changes observed from *Globigerinoides ruber* (40 %), *Globigerina bulloides* (36 %), *Neogloboquadrina dutertrei* (27 %), *Globorotalia menardii* (26 %), and *Globoturborotalia rubescens* (22 %) and ecological preferences of these species will help to reconstruct paleoclimate and oceanographic conditions of Bay of Bengal. The relative abundance records of foraminifera show substantial change during the most recent glacial, deglacial, and Holocene periods. An increase in the relative abundance of *G. bulloides* and *N. dutertrei* suggests enhanced upwelling and productivity and *G. ruber* and *T. sacculifer* is attributed to strong stratification and nutrient poor water. *G. bulloides* show significance results during the Last glacial maximum and cold Younger Dryas. *G. ruber* abundances are correlated with a high influence of warm, oligotrophic tropical water, which occurs (~15 and 13 ka), coinciding with a warm Bolling/Allerod (B/A) and early Holocene (~9-6 ka) is indicates enhanced SW monsoon precipitation and freshwater flux to the Bay of Bengal. Overall, these results suggest that changes in the pattern of SW and NE monsoon precipitation in the Bay of Bengal regulate surface hydrography and productivity.

RESPONSE OF LIVING BENTHIC FORAMINIFERA TO ENVIRONMENTAL VARIABLES IN THE ANCHUTHENGU ESTUARY, KERALA

Jeshma P [1*], Suresh Gandhi[2], Tharun R[3], A. Nallapa Reddy[4]

[1]Department of Geology, Sahrdaya College of Advanced Studies, Thrissur
[2]Department of Geology, University of Madras, Chennai
[3]Department of Geology and Environmental Science, Christ College, Irinjalakuda, Thrissur-
[4]Majestic shore, Choolaimedu High Road, Chennai
*Corresponding author: jeshma111@gmail.com

ABSTRACT

The spatial distribution, total foraminifer number (TFN), and species richness (S) of living benthic foraminiferal assemblages were investigated in 20 surficial sediment samples collected in two seasons (premonsoon-May 12,2017 and monsoon-Aug, 14,2017) from the Anchuthengu Estuary to understand its ecological significance. The patterns of foraminifer distribution, total foraminifer number, and species richness were correlated with environmental variables such as salinity, pH, and DO. The study reveals that the estuary sustains low to moderate TFN and low species richness of benthic foraminifera. There are 20 species of foraminifer taxa in the premonsoon and 19 taxa in the monsoon. In both seasons, Ammonia beccarii, A. tepida are persistent and dominant, while A. convexa, Elphidium norvangi, Hanzawaia conccentrica, Nonionoides elongatus and Pararotalia nipponica are sparse and low in abundance. Ecological variables like pH and salinity appear to have a relatively positive relationship with TFN and S, while DO has no such association. The premonsoon standing crop is #4311, which is higher than the monsoon standing crop of #1910, and this correlates to the average OM values. Low species richness and low to moderate but highly fluctuating TFN suggest that ecologically stressed conditions were prevalent in the Anchuthengu estuary during the study period.

Keywords: Benthic foraminifera, Environmental Variables Anchuthengu Estuary

CARAPACE BEHAVIOUR OF BAIRDOPPILATA (BAIRDOPPILATA) ALCYONICOLA (OSTRACODA) TO EPMA FROM CORE SAMPLES OF VISAKHAPATNAM OFFSHORE, BAY OF BENGAL, INDIA

Mohammed Noohu Nazeer[1*], S.M. Hussain[2], and N. Mohammed Nishath[2]

[1]*Department of Marine Geology and Geophysics, CUSAT, 682016*
[2]*Department of Geology, University of Madras, School of Earth and Atmospheric Sciences, Chennai, 600025*
Corresponding author: geonoohu@gmail.com

ABSTRACT

Mg/Ca partitioning in Ostracoda valves to decipher the paleotemperature fluctuations is the core objective of the present work. Incorporating EPMA studies a minute level check on the Ostracoda valves for paleoenvironment has been done for the present study. Two short cores having a length of 31 cm (MC 39) and 36cm (MC 41) respectively was collected from the innershelf off Visakhapatnam, Andhra Pradesh, South Central coast of India, using a multicorer during the ORV Sagar Kanya cruise SK 308 Leg 1 fieldwork, from their respective water depths 29 and 72 metres. Ostracod species *Bairdoppilata (Bairdoppilata) alcyonicola* were retrieved from the core sediment samples using standard micropaleontological procedures. The cross check on the Ostracod valves indicates that the same shells are possessing fluctuations in Mg/Ca values. Alternate bandings has been observed in the exoskeleton of the adult Ostracod from the area and it may be of the ecdysis in the Ostracod shells, rather than the paleotemperature fluctuations. The EDS results also accounts for a variation in Mg/Ca partitioning in Ostracod valves. Points were taken randomly in on the shell edge of Ostracod focusing a particular area, indicates that a strong variation in Mg/Ca ratio. It is evident from the studies that even after carapace shedding, the process of ecdysis has an imprint on the Ostracod shell. For paleoenvironmental studies using Ostracoda analysis the total shell has to be considered, rather than a particular point of focus inorder to get near accurate results.

Keywords: Ostracod, Mg/Ca partitioning, EPMA, EDS, Paleotemperature, Bay of Bengal.

PALEOECOLOGICAL SIGNIFICANCES OF BENTHIC FORAMINIFERA DURING THE EOCENE- OLIGOCENE CLIMATE TRANSITION FROM EAST EQUATORIAL PACIFIC OCEAN

K. Shitha[1*] and K. Mohan [2]

[1]School of Advanced Sciences, Vellore Institute of Technology, Chennai-600127, India
[2]School of Civil Engineering, Vellore Institute of Technology, Chennai-600127, India
*Corresponding author: shithapremaraj96@gmail.com

ABSTRACT

Eocene- Oligocene climate transition (EOT) recognized as one of the important climate transition in the Earth which brought about dynamical changes globally and marked the first appearance of ice sheets on Antarctica. This study attempts to understand the paleoecological shifts that happened ~ 34 Ma and the paleoceanographic reconstructions at East Equatorial Pacific (EEP) Ocean during ~ 42 to 31 Ma. Benthic foraminiferal census records and Total Organic Carbon (TOC) measurements from a continuous succession of sediment core of ODP Hole 1218 A (water depth 4828 m) were analysed. The cluster analysis depicts the three main group of species, with *Cibicides* species serving as the main shared habitat. Along with this, *Globocassidulina spp*., *Gyroidinoides spp*., *Oridorsalis umbonatus, Nuttallides umbonifera*, *Pleurostomella spp*., *Pullenia subcarinata, Siphonodosaria abyssorum, Spiropectammina spectabilis, Stilostomellinella subspinosa* and various forms of dentalinids/nodosarids generally show higher abundances in the studied interval. The presence of *Cibicidoides* and other epifaunal species like *Gyroidinoides*, *Epistominella*, and *Oridorsalis* points to an oligotrophic, well-oxygenated habitat during the EOT. The infaunal genus *Stilostomellina* indicates a moderate to high flux of organic food, as well as intermediate seasonality, which suggests lesser oxygenation conditions in the interval. *Cibicides havanensis*, *C. grimsdalei*, and *C. praemundulus* are frequently found in abyssal paleodepths but were also indicators of lower bathyal and abyssal palaeoenvironments. The TOC records, which from this period show a peak value of 3.21% and a lowest value of 0.05%, also demonstrate a minimal organic carbon flux. This progresses our understanding of East Equatorial Pacific paleoproductivity, which in turn gives the Eocene-Oligocene climate shift more significance.

Keywords: Paleoecology, paleoproductivity, Eocene-Oligocene climate transition, East Equatorial Pacific Ocean, Epifaunal- Infaunal species.

A LATE HOLOCENE PALEOCLIMATIC RECORD USING A SEDIMENTARY SEQUENCE FROM A COASTAL LAKE IN SOUTHERN INDIA

Yamuna Sali, A.S.[1], Warrier, A.K.[1], Powravi Sai[1]

[1]Department of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education, Manipal, Karnataka-576104, India
Corresponding author: yamuna.sali@learner.manipal.edu

ABSTRACT

There is only a limited number of high-resolution paleoclimatic records from southern India. This study aims to reconstruct the past changes in climate in southern India during the Late Holocene. Grain size analysis, Loss-on-ignition and Fourier transform infrared spectroscopy (FTIR) coupled with Principal Component Analysis (PCA) were done on a 154 cm long sediment core collected from a small coastal lake, Lake Ramasamudra (RSL) which lies in the Udupi district of Karnataka. The AMS ^{14}C dating ascribes an age of 1550 years to the core which spans from 2000 cal yr BP to 450 cal yr BP. The percentage of Total Organic Carbon (TOC) is uniformly high, which indicates a general humid climate in the study area. From the multiproxy data generated, three climatic phases were identified: Phase I (2000 cal yr BP to 1100 cal yr BP), Phase II (1100 cal yr BP- 600 cal yr BP) and Phase III (600 cal yr BP to 439 cal yr BP). The percent values of sand are high and show less variability in Phase I. It suggests a less humid climate and a weakened hydrodynamic condition in the region and a low lake level. From the FTIR data, representation by the clay and feldspar minerals in sediments is also the lowest in this phase. The percent sand value decreases and there is a concordant increase in the clay and feldspar minerals and are highly variable in Phase II. It explains a high lake level and high precipitation, due to which the finer particles get deposited far from the shore within the lake, where the hydrodynamic conditions are weak. There is an anomalous increase in the percent sand and TOC values in the Phase III. The concentration of carbonate minerals and quartz is also the highest in this phase. This is suspected to be due to the agricultural practices near the catchment or due to some other anthropogenic activities in the region during the recent past.

Keywords: Grain size, Fourier transform infrared spectroscopy, lake sediments, precipitation, lake-level, southern India.

APPLICATION OF MAGNETO-TELLURICS IN FOUNDATION ENGINEERING: A CASE STUDY

Biju Longhinos [1], Anand S P[2], Jishma R Jayan[3]

[1] *University College, Trivandrum*
[2] *Indian Institute of Geomagnetism, Panvel, Navi Mumbai*
[3] *Government Engineering College Barton Hill, Trivandrum*
*Corresponding author: biju.longhinos@gmail.com

ABSTRACT

The "geological anomalies/surprises'' are becoming the evident causative factors for the failures of engineering /civilian constructions and the surface environment because of the lack of proper knowledge about the nearer subsurface. Characteristics of the shallow subsurface is one of the major determinative factors which decides the technology, the design, and the execution of any engineering construction to maintain the existing equilibrium of the subsurface.

Environmental geophysics is a new approach of geophysics which deals with the physical properties of the earth's shallow subsurface (up to 500m geologically) using non-invasive geophysical instruments and has got wider range of application which includes the construction application in civil engineering. The use of magneto-telluric investigation method for characterizing the nearer subsurface is getting more attention for its quick, cheap, and ergonomic results.

This study concerns the strata characterization of the terrain having garnet biotite gneissic rock gullies exposure, by magneto-telluric scanning up to 300m in Kollam, Kerala. The detailed scanning at the proposed site with 6 transects was conducted and followed by the geological study. The resulting 2D profiles gave insight to the extent of the rock intactness and fracture zones up to the 300m depth. The details of this work will be presented.

Keywords: Environmental geophysics-magneto telluric investigation –strata characterization

MICROPLASTIC DISTRIBUTION IN MULCHED AND UNMULCHED FARMLAND SOILS OF MATTU, UDUPI DISTRICT, KARNATAKA

Ashwathi C.[1*], Krishna Prasad A. A.[2], and Anish Kumar Warrier[1,3]

[1]*Department of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education, Manipal, Karnataka, India.*
[2]*Department of Sciences, Manipal Academy of Higher Education, Manipal, Karnataka, India.*
[3]*Centre for Climate Studies, Manipal Academy of Higher Education, Manipal Karnataka, India.*
*Corresponding author: ashwathi.c@learner.manipal.edu

ABSTRACT

Microplastics (MPs) are ubiquitous, and the exposure risk to humans is unresolved. The MPs range in size from 1 µm to 5000 µm and have been reported from all the spheres of our planet. The MP pollution levels in farmland soils are very high nowadays. However, a research gap exists in the literature involving the distribution and comparison of microplastics in the mulched and unmulched soils of farmlands in India. In the present study, we explore the presence of microplastics in soil samples, which include mulched samples (n = 4), unmulched samples (n = 2), and a mulched and unmulched mix sample (n = 1) from Mattu in the Udupi district of Karnataka. The total MP abundance of the seven soil samples is 3626 items/kg, with a mean (± standard deviation) value of 517.95 (± 708.51). The mean abundance of mulched soil samples is 659.39 (± 958.24) pieces/kg, and unmulched soil samples is 222.68 (± 47.73)0 pieces/kg. The lone sample of a mixture of mulched and unmulched soil samples registered an MP abundance of 542.73 pieces/kg. The abundance of smaller MPs was significantly higher, with the 0.1–0.3-mm-sized MPs contributing 52.33% and the 0.3–1-mm-sized MPs contributing 42.36%. The larger MPs (1–5 mm) accounted for a mere 5.31%. The types of MPs present in the samples were films, fibres, and fragments. Out of which, films (70.81%) were the most dominant, followed by fibres (28.06%) and fragments. Black-coloured MPs are more abundant, followed by grey and white. The increased abundance and the dominant colours (black and grey) indicate that they are mainly derived from the mulching sheets, which are available in the same colours. Plastic mulching is primarily done for selective crops (watermelon and brinjal) to avoid soil erosion, weed cultivation, etc. Fibres were the most abundant MP in non-mulched soils, while films were the most abundant in mulched soils. The film concentration in the MS2 field is comparatively much higher than the other fields. This field has been mulched for more than 6 years, and the field is near the road and residual houses. In addition, the degraded plastic litter from the surrounding regions and MPs from the road dust can be deposited in the fields through surface runoff. This preliminary data is

important for figuring out how MP pollution affects farmland soils and how crops might take in microplastics and nanoplastics at different stages of growth.

Nitrate Pollution in Groundwater of Puducherry region, India with special insights on Human Health Risk Assessment using Monte Carlo simulation

M. Sridharan, D[1*]. Senthil Nathan[1] and R. Ram Prasath[1]

[1]Department of Earth Sciences, Pondicherry University, Puducherry-605014.
*Corresponding Author: msridharansri@gmail.com

ABSTRACT

Throughout the globe nitrate (NO_3^-) pollution in groundwater is rising and are of great concern due to its adverse effect on human health. In the present study, detailed investigation was carried out to understand the impact of high nitrate concentration in groundwater on human health among the various age groups of people in Puducherry region. Geochemical study revealed that Na^+ and Cl^- are the dominant cation and anion in the groundwater samples respectively. From the Chadha's plot, it is inferred that rock-water interaction and ion exchange process are the dominant processes controlling chemistry of groundwater in the study area. Based on WQI calculation it is found that 96% of samples are excellent for drinking purpose. In about 4% and 25% of samples nitrate concentration was higher than the permissible and desirable limit respectively. Nitrogen Pollution Index and Human Health Risk Assessment depicts that 5% of samples are highly polluted and are not suitable for all the age group people. PCA and other NO_3^-/Cl vs. Cl^- plots signify that sewage and chemical fertilizers are the dominant sources for nitrate release in groundwater. Based on scatterplot of TDS vs. $(NO_3^-+Cl^-)/HCO_3^-$, it is inferred that anoxic biodegradation of organic matter; hydration of chemical fertilizers and nitrification of ammonia are the major processes controlling release of nitrate in groundwater of study area.

BENTHIC FORAMINIFERA AS BIO-INDICATOR OF MARINE POLLUTION FROM THE SHELF PART OF SOUTHEAST COAST OF INDIA

Harikrishnan Sadanandan1*, Senthil Nathan Dharmalingam[1], Mouttoucomarassamy Sridharan[1]

[1]*Department of Earth Sciences, Pondicherry University, Puducherry, India-605014*
Corresponding Author: harikallambalam16@gmail.com

ABSTRACT

The benthic foraminiferal community is used as an excellent bio-indicator of pollution in coastal and marginal marine settings. Their abundance, diversity and its relationship with environmental parameters viz, grain size, organic carbon (C_{org}) and trace metals concentration, in the surface sediment layer from shelf part of southeast coast of India have been used to understand the marine pollution in this study. Statistical analyses such as correlation matrix; PCA (principal component analysis) and Cluster Analysis show that the foraminiferal species composition is significantly influenced by the Organic Carbon (C_{org}), Co, Pb, Zn, Cr, and Ni concentrations. Dominance of stress tolerant species viz. *Ammonia beccarii*, *Ammonia tepida*, *Nonion faba*, *Bulimina marginata*, *Bolivina robusta*, *Elphidium craticulatum* and *Elphidium advenum,* and less species diversity demonstrate environmental pollution due to elevated C_{org} and trace metals concentrations.

Keywords: *Benthic foraminifera, Trace metals, Organic Carbon, Marine pollution, Shelf sediments, Bay of Bengal*

MICROPLASTICS IN SEDIMENTS AND SURFACE WATER FROM THE AKKULAM-VELI LAKE, KERALA, INDIA

Reshma S.R[1, *], M.A. Mohammed-Aslam[1] and Anish Kumar Warrier[2]

[1]*Department of Geology, School of Earth Sciences, Central University of Karnataka, Kalaburagi, India*
[2]*Centre for Climate Studies, Department of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education, Manipal, India*
[*]*Corresponding Author: reshmasr@cuk.ac.in*

ABSTRACT

This study aims to identify the occurrence, characteristics, and distribution of microplastic pollutants in both surface water and sediment samples of Akkulam-Veli Lake basin, Thiruvananthapuram, Kerala. To examine the occurrence of microplastics in the basin, 12 surface water samples and 3 sediment samples were collected in the month of November 2020 and processed for microplastic extraction through density separation. Identification of the polymer components of microplastics was done using FTIR spectroscopy. Microplastics were recovered from all water and sediment samples, indicating their extensive distribution in the basin. The concentration of total microplastics was found to be lower in the source region (65 pieces/m^3) and found to be highest in the lake water body (300 pieces/m^3). Fibre and fragment are the major types of microplastics observed in the study area. FTIR spectroscopy analyses showed the presence of Polypropylene (PP), Polyethylene (PE), Polyethylene Terephthalate (PET), High-Density Polyethylene (HDPE), Low-Density Polyethylene (LDPE), Polystyrene (PS), Polyurethane (PU), Polyvinyl Chloride (PVC) and Polystyrene Sulfonate (PSS). The scanning electron microscopic-energy dispersive spectroscopy analysis revealed that the microplastics have differential surface morphology and nickel, lead, manganese, iron, arsenic, copper, cadmium and chromium are the heavy metals accumulated in the surface of microplastics. Among the size classifications, 0.3-1 mm size ranges were found to be widely distributed in the samples. The differences in the concentration of microplastics could be caused by microplastics that build up in densely populated urban areas near the sink regions.

Keywords: Microplastics, Fibre, Fragment, Pollution, Lake basin, Heavy metals, Polymer.

PARAGLACIAL RESPONSE TO RECENT CLIMATE CHANGE IN UPPER GANGA CATCHMENT

Maria Asim[1], Subhendu Pradhan[1,2], Shubhra Sharma[2]*

[1] Department of Geography, Institute of Science, Banaras Hindu University, Varanasi-221005
[2] Geosciences Division, Physical Research Laboratory, Ahmedabad – 38005
*Corresponding author: shubhra@prl.res.in

ABSTRACT

Paraglacial zones are indirectly conditioned by glaciers and glacial processes and are ecologically and geologically unstable. Multiple phases of glacier advances/recessions have left an enormous quantity of unconsolidated sediments in the form of moraines, talus/ scree fans, and outwash gravel terraces (collectively known as paraglacial sediment). Thus, the paraglacial zones are transport-limited and not sediment-limited. Small triggers such as an extreme rainfall event or rain on snow may lead to significant sediment mobilization in form of debris avalanches/debris flows inflicting severe damage to life and infrastructures. Therefore, it is pertinent to have a real-time assessment of paraglacial sediments locked in valleys vacated by glaciers in the recent geological past. So that in case of their mobilization during an extreme hydro-metrological condition, a downstream threat perception can be assessed, and the vital infrastructures are protected. With this objective, the present study attempts to estimate the amount of paraglacial sediments stored in the two key tributary river valleys– Dhauli Ganga and Mandakini, in the upper Ganga catchment. Also, locations that can act as natural damming sites for force amplification in case of sediment mobilization during extreme weather events are demarcated. Using the published literature supported by remote sensing techniques, it has been observed, that the Dhauli Ganga and Mandakini valley has stored ~1467×10^6 m³ paraglacial sediment making these valleys extremely vulnerable to extreme weather events. The study cautions that with global warming as a reality, where frequencies and magnitude of extreme weather events are predicted to increase, extreme caution is required while planning and executing the infrastructure developmental projects particularly, the hydropower projects in these valleys.

PREDICTING RUN-OUT OF LANDSLIDES FOR SUSTAINABLE DEVELOPMENT

Rajaneesh A[1], Krishna Priya VK[1], AP. Pradeepkumar[1], Sajinkumar. KS[1,2]

[1]Department of Geology, University of Kerala, Thiruvananthapuram-695 581, Kerala, India
[2] Department of Geological & Mining Engineering & Sciences, Michigan Technological University, 1400 Townsend Drive, Houghton, Michigan 49931, USA
Corresponding author: rajaneesh@keralauniversity.ac.in

ABSTRACT

The Western Ghats characterised steep slopes and thus, prone to intense landslides. The tropical climate of the Western Ghats is the main trigger of landslides. These landslides have caused severe destruction to life and properties for the last couple of years. Severe landslide activity happened in August 2018 on the Western Ghats. Around 2800 debris flows were triggered in this extreme climatic event. These debris flows possess long run-outs that hazardously effects on the population and environment through its path. Landslide inventory was created for the Western Ghats by mapping using high-resolution Google earth imageries, Planet scope imageries and Sentinel-2 imageries. The landslides in the inventory are debris flows with long runouts, and that caused severe damages. The runout characteristics and effect of these landslides can be studied by numerical run out modelling methods with the help of topographical data. The runout lengths, lateral spreads, flow height and flow velocity obtained from the runout modelling helps in assessing the damage caused by such long-runout landslides. Sustainable developmental and building planning in an environmentally fragile area such as the Western Ghats needs a better landslides susceptible map rather than a slope stability map, which lacks the runout area of landslides in stable slopes. Studying the runout trends and adding it to slope stability maps results a better hazard map.

Keywords: Landslides, Long run-out, Western Ghats, Sustainable development, RAMMS

LANDSLIDE SUSCEPTIBILITY MAPPING OF WAYANAD PLATEAU, KERALA THROUGH WEIGHTED, STATISTICAL AND MACHINE LEARNING ALGORITHMS USING REMOTE SENSING AND GIS TECHNIQUES

Midhuna Vinayan [1*] and Gurugnanam Balasubramanian [2]

[1]*Centre for Applied Geology, The Gandhigram Rural Institute Deemed to be University, Gandhigram, Dindigul, Tamil Nadu, India*
[2]*Centre for Applied Geology, The Gandhigram Rural Institute Deemed to be University, Gandhigram, Dindigul, Tamil Nadu, India*
[*]*Corresponding author: midhunavinayan123@gmail.com*

ABSTRACT

Landslides are a frequent type of natural disaster in mountainous regions. The landslide Susceptibility Map (LSM) is helpful in planning and managing landslide-prone areas. The present study aims to identify the landslide susceptibility zones (LSZs) of Wayanad district, Kerala, South India. The current research is aimed at comparing five models, i.e., Analytical Hierarchy Process (AHP), Frequency Ratio (FR), Shannon's Entropy (SE), Logistic Regression (LR), and Support Vector Machine (SVM), by implementing them for the generation of Landslide Susceptibility Maps (LSMs) with the help of Remote Sensing (RS) data and Geographical Information Systems (GIS). The landslide inventory containing 332 landslide points was developed by visual interpretation of satellite images, Google Earth imagery, previous literature, and field survey. Four influencing factors have been selected for the study: slope, land use/land cover (LU/LC), drainage density, and distance from the road. The LSMs were then categorized into four classes, namely, low, moderate, high, and very high susceptibility to landslide occurrence. The results of our study were validated using the receiver operating characteristic (ROC) curve. The area under the curve (AUC) values of the AHP, FR, SE, LR, and SVM methods are 83%, 84%, 82%, and 90%, respectively. As per the results of the validation method, the Machine learning (LR and SVM) models are more accurate than the other collection models. The outcomes of this research are helpful and essential for the government, planners, decision-makers, researchers, and general land-use planners in the study area.

LANDSLIDE SUSCEPTIBILITY STUDY OF KOKKAYAR SUB-BASIN OF MANIMALA RIVER OF CENTRAL KERALA USING THE FREQUENCY RATIO (FR) METHOD

Tania Mathew[1*] Sreelakshmi S[1] Suraj P R[2]

[1]*Government College Kottayam Kerala*
[2]*Government College Kasargod*
[*]*Corresponding author: taniamathew280@gmail.com*

ABSTRACT

The objective of the current study is to assess the susceptibility of landslides of the Kokkayar sub-basin of the Manimala river of central Kerala. This is done using satellite imaging, digital data, and geographic information system while utilizing a statistical technique known as the Frequency Ratio method. The 12 geo-environmental parameters examined in the study are elevation, slope angle, slope aspect, planar curvature, profile curvature, geology, NDVI, lineament density, drainage density, TWI, distance from the road, and LULC. The spatial relationship between these environmental parameters and landslide occurrences in the study area was analyzed and a Landslide susceptibility map (LSM) is prepared. The study reveals that more than 8.5 % of the total study area comes under the critical landside susceptible zone, such as the area around Meloram and Urumbikkara. Very-high susceptible class of the study area is 18.5 % of the total study area. The places like Peruvanthanam, Chuzhuppu, Pullupara, Kaduvappara, and Kochunadukkar are very-high susceptible zone for landslides. The validation of the study was carried out using the Relative landslide index or R-Index method, which shows a positive correlation between the landslide susceptibility class and the R-Index value. The study gives an indication of the unscientific slope modifications and Land use land cover patterns that trigger landslides in the Western Ghats. The findings from this assessment can assist local citizens, Land use developers, urban planners, and engineers in proper slope management and Land use patterns to reduce landslide risk in the study area.

Keywords: Landslide Susceptibility, Frequency Ratio, Geo-environmental factors, Relative landslide index (R-Index)

IDENTIFICATION OF ARTIFICIAL RECHARGE ZONES IN UPPER KODAVANR RIVER BASIN USING GEOSPATIAL TECHNOLOGIES

M. Lavanya[1*], M. Muthukumar[1]

[1]*Centre for Geoinformatics, Gandhigram Rural Institute (Deemed to be University)*
Gandhigram-624302, Dindigul District, TamilNadu, India
[*]*Corresponding author: m.muthu.m@gmail.com*

ABSTRACT

The long-term viability of groundwater resources depends on artificial recharge. As a result of helping to preserve surface runoff, artificial recharge zones help to lessen the likelihood of flooding. The excessive groundwater extraction that stems from urban population increase and persists may have negative environmental effects. In order to address the needs of the water-related issues in the Upper Kodavanar river basin, Dindigul District, Tamil Nadu, India, using integrated Remote Sensing (RS), Geographic Information Systems (GIS), and Analytical Hierarchy Process (AHP) methodologies, this study suggests a methodology for defining artificial recharge zones and locating the best artificial recharge sites. The study analyzed various thematic layers such as, geomorphology, geology, drainage density, slope, lineament, rainfall, water level, and soil. Using Saaty's Analytic Hierarchy Process (AHP), normalized weights were determined for several themes and their classes based on their respective contributions to groundwater recharge in the region. Based on the assigned weights obtained from the AHP analysis using the weighted overlay analysis tool, these thematic layers were combined to create a map of the artificial recharge zones for the study area using the ArcGIS environment. The recharge zones have been categorized into five classes: "very poor suitable zone," "poor suitable zone," "moderately suitable zone," "highly suitable zone," and "very high suitable zone" based on their suitability for artificial groundwater recharge.

Keywords: Artificial Recharge Zones, Weighted Overlay Analysis, AHP Technique, GIS and Remote Sensing.

GEOCHEMICAL AND ENVIRONMENTAL ISOTOPIC CHARACTERISATION OF THE AQUIFER SYSTEM OF ALAPPUZHA DISTRICT, INDIA

N. Saleena Vahid[1], J. Noble[2], E. Shaji[1], R.B Binoj Kumar[1]

[1]Department of Geology, University of Kerala, Thiruvananthapuram, India
[2]Isotope and Radiation Application Division, Bhabha Atomic Research Centre, Mumbai, India
[*]Corresponding author: saleenav.n@gmail.com

ABSTRACT

An isotope hydrogeochemical investigation was carried out to characterise the multi-aquifers of the Alappuzha area, Kerala. The multi-aquifer system is composed of Quaternary alluvium, followed by Tertiary aquifers of Warkalai, Quilon and Vaikom in succession. The Alluvial aquifer is in phreatic condition whereas the Tertiary aquifers are in confined condition within the study area. The Warkalai aquifer is extensively developed in and around the Alappuzha district. For the present study, Water samples were collected from dug wells, tube wells, surface water bodies etc, during the southwest monsoon season (July 2021) and pre-monsoon season (April 2022) for chemical and isotopic analyses. Physico-chemical parameters such as temperature, pH, Electrical conductivity(EC) and Total Dissolved Solids (TDS) were measured insitu, whereas major ions like calcium, magnesium, sodium, potassium, bicarbonate, sulphate, chloride, nitrate and fluoride were analysed in the lab adopting standard procedures. These parameters were used to assess the suitability of groundwater for the domestic purpose by comparing them with the WHO and Indian standards. TDS, Sodium Adsorption Ratio (SAR), and permeability index were used for irrigation suitability assessment. The hydrochemical data analysis reveals that the groundwater is not entirely fit for drinking with respect to EC, Ca^2, Mg^2, Na, Cl^- and F^-. The samples collected during the monsoon and pre-monsoon seasons showed that the (EC is <2180 μS/cm and <3150 μS/cm,) and contaminants like fluoride is (<2mg/L and <2.5 mg/L) and nitrate is (<3.5 mg/L and<3.7mg/L, respectively). In some of the collected samples, the concentrations of these parameters exceeded the permissible limits of WHO and ISI standards.

This paper also describes the inferences obtained from the interpretation of environmental isotope ($\delta^{18}O$) data. The $\delta^{18}O$ data of groundwater alluvial aquifer varies from - 0.4‰ to -0.76‰, and -0.4‰ to 0.30 ‰, during monsoon and pre-monsoon, respectively. The $\delta^{18}O$ of groundwater from the Tertiary aquifer varies from -2.25‰ to -2.01‰ and -1.59‰ to -1.10‰, during monsoon and pre-monsoon, respectively. The $\delta^{18}O$ of surface water bodies varies from -3.3‰ to 0.63‰ in

pre-monsoon. The spatial distribution of δ¹⁸O of the groundwater in the alluvial aquifer indicated that it is mainly recharged by precipitation (similar to the rainwater value) and by surface waters (relatively enriched value) in the areas close to their proximity. The distinct δ¹⁸O values of shallow and deeper aquifer system probably indicated that they are not vertically connected.

DELINEATION OF GROUNDWATER RECHARGE POTENTIAL ZONES IN PALLIMAN WATERSHED, SOUTH KERALA, INDIA USING GIS AND AHP TECHNIQUES

Sreeja I S [1]*, Rajesh Reghunath[1,2], Binoj Kumar R B[1], Aju C D[1]

[1]*Department of Geology, University of Kerala, Thiruvananthapuram, Kerala, India*
[2]*International and Inter-University Centre for Natural Resources Management, University of Kerala, Thiruvananthapuram, Kerala, India*
Corresponding author: sreesivageo18@gmail.com

ABSTRACT

Artificial recharging of aquifers is being practised as a management tool around the world for the sustainable management of groundwater resources, since it can incrementally enhance the depleted and deteriorated groundwater resources. The present study tries to identify suitable and potential sites for recharging the aquifers by way of artificial means in the Palliman Watershed (PWS), Kollam district. Palliman Watershed is a major tributary of Ithikkra river basin which drains through the Kollam district of Kerala State. Various spatial data sets were generated in GIS platform and analysed by analytic hierarchy process (AHP) techniques. The spatial data set include those of geology, geomorphology, slope angle, available space for recharge, soil infiltration rate, land use/land cover, lineament density, sand percentage and drainage density. It is found that factors such as geology, geomorphology, slope and the available space have more influence in taming an area for artificial recharging. The identified suitable and potential sites were reassessed for few site-specific recharge methods such as rainwater infiltration pits, percolation ponds, injection wells and pond-cum-injection wells using a rule-based approach. In general, western and north western portions of the basin are found to be suitable for the construction of rainwater infiltration pits and percolation ponds, whereas the central portions are more suitable for injection wells and pond-cum injection wells. The outcome of this study can be used for the planning of sustainable groundwater development and regional management of the river basin.

EFFECT OF SOIL VENTILATION ON HYDRAULIC PROPERTIES IN THE UNSATURATED ZONE

V.K. Haritha[1]* and L. Elango[1]

[1]Department of Geology, Anna University, Chennai 600025, India
*Corresponding author: haritha.v.kuttan@gmail.com

ABSTRACT

Flow in the unsaturated zone (USZ) is variable and is highly sensitive to the variations in hydraulic properties of the subsurface. Air entrapment in USZ during infiltration is a common phenomenon especially when the water is flooded which affects the unsaturated hydraulic properties and thereby the infiltration rate. This study aims to investigate the feasibility and effect of soil ventilation to overcome the effects of air entrapment, improve the water content and hydraulic conductivity $[K(\Theta)]$ in the USZ. The impact of multiple soil vents of different dimensions on soil water content and in turn $K(\Theta)$ was studied in the laboratory through 43 ponded infiltration experiments. The provision of vents has improved the $K(\Theta)$ up to 66% and this study confirms that a simple technique of soil ventilation can be beneficial in improving the $K(\Theta)$. This method of soil ventilation is cheap and easily adaptable, with less operational and maintenance efforts, can be adopted by individuals or agencies who intends to improve the hydraulic properties, especially during flooding conditions.

Key Words: Unsaturated zone, Entrapped air, soil ventilation

EVALUATION OF HEAVY METAL POLLUTION INDEX (HPI) OF GROUNDWATER IN CHALIYAR RIVER BASIN

Nikitha P Bhaskar [1*], V.J Rajesh [2], Rajesh Reghunath[3], Arunkumar K.S[1*]

[1] Department of PG Studies & Research in Geology MES Ponnani College, University of Calicut, Ponnani, Kerala, India
[2] Department of Earth and Space Sciences , Indian Institute of Space Science and Technology , Valiyamala, Kerala, India
[3] Department of Geology, University of Kerala, Karyavattom Campus, Trivandrum, Kerala, India
* Corresponding author: nikithapbhaskar@gmail.com

ABSTRACT

Heavy metal pollution index (HPI) is defined as a rating reflecting the composite influence of different dissolved heavy metals. HPI is calculated from a point of view of the suitability of ground water for human consumption with respect to metal contamination. HPI is a powerful tool for ranking amalgamated influence of individual heavy metal on the overall water quality and a view of the suitability of ground water for human consumption. The critical pollution index value for drinking water should be less than100. Another index is the general metal index (MI) for drinking water, which takes into account possible additive effect of heavy metals on human health that help to quickly evaluate the overall quality of drinking water. The higher the concentration of metals with respective to MAC (Maximum Allowed Concentration) value which makes the worse quality of the water. The heavy metal pollution index (HPI) and metal index (MI) for open well water samples of Chaliar river basin were determined. The concentration of 19 eco-toxic heavy metals such as Li, Be, Sr, V, Ti, Fe, Co, Ni, Mo, Se, TI, Hg As, Mn, Zn, Cd, Cr, Cu and Pb have been analyzed for 15 ground water sampling stations in the Chaliyar river basin by atomic absorption spectrometer. The concentrations of heavy metals have been found to below the permissible limit of drinking water quality standards. The data have been used for the calculation of Heavy-metal Pollution Index (HPI) and Metal Index (MI). The mean HPI values of ground water in Chaliyar river basin are 23.2 and 6.4 respectively. The results indicated that mean HPI values were found to be below the critical pollution index value of 100. HPI results showed that, all sampling sites Chaliyar river were found lower than the critical pollution index 100. The mean MI values of ground water at Chaliyar river basin is 0.07. These results of MI were used to ascertain the heavy metal toxicity among the sampling sites.

GEOGENIC IRON CONTAMINATION IN THE GROUNDWATER RESOURCES OF KERALA

Raicy Mani Christy1[*], Priju P Chungath P[1], Arun P R[1]

[1]*Hydrology and Climatology Research Group, Centre for Water Resources Development and Management, Kunnamangalam, Calicut, Kerala, India*
* Corresponding author: raicymc@cwrdm.org

ABSTRACT

The Kerala is endowed with plenty of surface water resources such as rivers, tanks, and ponds and considerably less consumed groundwater resources with an average annual rainfall of nearly 3000mm. However, the groundwater quality varies from place to place based on several factors, and the state has witnessed geogenic groundwater contamination in many parts. In the deeper aquifers, iron, nitrate, and fluoride contamination have been reported, while the groundwater in phreatic aquifers is mostly fresh and suitable for domestic consumption. Northern Kerala is also reeling under similar conditions, where iron contamination in groundwaters due to the impact of geochemical processes has become one of the most discussed issues nowadays. Although iron in drinking water is safe to ingest, the iron sediments may contain trace impurities or harbor bacteria that can be harmful. Chronic ingestion of excess iron can lead to a severe disease damaging the body organs. The aim of this study is to understand the interrelation among various parameters favoring the release of iron into groundwater. As part of the study, secondary data including the depth of wells, concentration of iron, rainfall availability, geology etc were collected to understand the mutual information among the variables using statistical codes. In 2020, the highest iron concentration in the state is reported in the Malappuram district with the highest concentration of 28.5 mg/L (CGWB report, 2021). Most of the shallow wells are dominated by the water soluble Fe^{2+} ions and deeper wells and wells in fractured aquifers are dominated by Fe^{3+} ions. The form of Iron, however, may be altered as a result of oxidation or reduction or due to the growth of bacteria in the sample during storage. The major source of iron in groundwater of most parts of the state is the lateritic soil, which covers more than sixty percent of the state and functions as a cap rock covering numerous crystalline rocks, particularly in the midlands. Laterites contributes nearly 90-100% Fe into groundwater when in contact in water.

TREND ANALYSIS AND FORECASTING OF GROUNDWATER LEVELDISTRICTSFOR 13 SELECTED DISTRICT OF JHARKHAND STATE, INDIA

Seemab Akhtar[1*]

[1]M.Tech (Mineral Exploration), Indian Institute of Technology (IIT), Indian School of Mines (ISM), Dhanbad, India
*Corresponding author: akhtariitdhn@gmail.com

ABSTRACT

This study aims to analyze the trends in ground water levels and correspondingly predict the same in selected 13 districts of Jharkhand state, India namely Ranchi, Gumla, Dhanbad, Hazaribagh, Khunti, Koderma, Godda, Pakur, Gumla, Deoghar, Jamtara, Latehar and Chatra. Modeling study involves a twofold objective. First, it estimates and evaluates trends variations in groundwater level (GW) using Mann-Kendall non parametric test. The second objective is forecasting modeling of GW and this was achieved by using ARIMA (Auto Regressive Integration Moving Average) modelling. Parameters of cross-validation of modeling studies are optimum, acceptable, and support the hypothesis of ARIMA modeling. Significantly increasing trends were expressed by districts Chattra, Dhanbad, Deoghar, Godda, Latehar, Pakur and Palamau, for the pre-monsoon period while in the monsoon period Deoghar, Godda, Gumla and Palamau districts were exhibited an upward trend. For the post-monsoon (Rabi), only four districts Pakur, Palamau, Deoghar and Godda were reported upward trends, whereas for post-monsoon (Kharif) districts Chattra, Dhanbad, Deoghar, Jamtara, Latehar and Palamau districts were showed an increasing trend. Moreover, a forecast of ground water levels in all combine districts was done for the years 2018 to 2027. Study revealed that the groundwater level decreased through the years 2018 to 2024 and then remain almost at a constant level in the pre-monsoon phase, whereas it is expected to increase through 2018 to 2019 for the post-monsoon phase (Rabi & Kharif). Besides these studies it is observed that soil moisture is decreasing from periphery to central part of the study area and maximum groundwater level (MSL) was observed at the central parts of the study area. Overall studies clarified that trend modeling is a valuable tool for monitoring the groundwater levels.

Keywords: ARIMA modelling, Mann-Kendall Test, Forecasting, Soil Moisture.

CALCAREOUS DINOFLAGELLATE CYST RECORDS FROM THE EASTERN ARABIAN SEA DURING THE HOLOCENE

Prem Raj Uddandam[1]

[1]*Birbal Sahni Institute of Palaeosciences, 53 University Road, Lucknow, Uttar Pradesh, India-226007.*
Corresponding author Email ID: premraj@bsip.res.in

ABSTRACT

Arabian Sea (AS) primary productivity records are crucial for understanding past changes in the Indian monsoon dynamics. However, biotic proxies other than foraminifera have received less attention for primary productivity reconstruction from the Arabian Sea. A calcareous dinoflagellate cyst (dinocyst) record from the Off-Goa (SC-26; (14.47° N; 73.23° E, water depth 240 m,), eastern Arabian Sea during the Holocene is generated. Coccoides of *Thoracosphaera heimii*, *Leonella granifera* shows the dominance of 82-92% in the total assemblage suggesting eutrophic environment throughout studied period. The relative percentage of the dominant species *T. heimii* and *L. granifera* shows an opposite trend. The high relative abundance of *Calcidinellum* species during the early Holocene (prior to 10.7 ka BP) indicates a comparatively low productive environment than the late Holocene. A strengthening trend in the monsoon during the early to mid-Holocene is reflected by the gradual increase in the *L. granifera* which is a runoff/terrestrial nutrient indicator. A decrease in the runoff-related nutrients is reflected during the mid-Holocene (~6 - 5 ka BP) by a decrease in the *L. granifera*. A reduction in the calcareous dinocyst concentration between ~ 6 and 5 ka clearly indicate the mid-Holocene weakening in the monsoon and its effect on decreased productivity in the south-eastern Arabian Sea.

Keywords: Calcareous dinoflagellate cysts; Eastern Arabian Sea; Monsoon; Palaeo-environment.

GENESIS OF VEIN TYPE BARITE DEPOSIT IN VEMPALLE FORMATION, CUDDAPAH BASIN, INDIA: CONSTRAINTS FROM PETROGRAPHIC, GEOCHEMICAL AND ISOTOPE STUDIES

Devika D S[1], Megha Chandran P[1], and Pandian M S[1]

[1]Department of Earth Sciences, Pondicherry University, Puducherry, India
*Corresponding author: *devikadev296@gmail.com*

ABSTRACT

Mafic dykes intruding into Vempalle Formation in the southern part of the Cuddapah basin host barite mineralization in the form of fracture fill and breccia fill veins. The mineralized mafic dykes have undergone extensive alteration due to fluid-rock reactions and consist of clinochlore, epidote, albite, calcite and quartz as the major minerals. It is inferred that alteration of primary calcic plagioclase to albite and clinopyroxene to clinochlore released Ca^{2+} which was used for the formation of epidote and calcite. Though large in size, Ba^{2+} is accommodated in the site of Ca^{2+} in plagioclase at high temperatures [1] but is expelled during the fluid-rock reaction. Trace element data of mafic rocks in the Vempalle Formation [2–4], exhibit a wide variation in the concentration of Ba, from a few ppm to a few thousand ppm, which indicates the mobilization of Ba^{2+} during the alteration of mafic rocks. These evidences clearly show that the mafic rocks emplaced within Vempalle Formation are the source of barium for barite mineralization. Sulphur isotope analysis of the barite has yielded $\delta^{34}S$ values ranging from 16.89 to 23.24‰ and averages at 20.75 ‰. This is comparable to the $\delta^{34}S$ values estimated for the Proterozoic seawater. Study of fluid inclusions in barite shows five distinct types: Type Ⅰ aqueous monophase liquid inclusions; Type Ⅱ aqueous monophase vapour inclusions; Type Ⅲ aqueous biphase ($L_{H2O}+V_{H2O}$) inclusions; Type Ⅳ polyphase (S+L+V) inclusions; and Type Ⅴ aqueous-carbonic inclusions. Three or more of these inclusion types occur together in clusters, with diverse phase proportions implying heterogeneous conditions of the fluid during barite mineralization. Co-existing monophase, biphase and polyphase inclusions suggest fluid mixing as one of the causes of barite mineralization.

Keywords: Barite, Vempalle Formation, Sulphur isotope analysis, aqueous monophase

PETROLOGY AND GEOCHEMISTRY OF A DIABASIC INTRUSION WITHIN THE ANGADIMOGAR ALKALINE PLUTON, NORTHERN KERALA: IMPLICATIONS FOR PLUME MAGMATISM

Nandu M R[1,2], Sreejith C[1]

[1]Department of PG Studies and Research in Geology, MES Ponnani College (University of Calicut), Kerala–679 586, India
[2]Department of Geology, University of Kerala, Trivandrum, Kerala–695 581, India
Corresponding author: mrnandugeo97@gmail.com

ABSTRACT

The processes responsible for intraplate magmatic activity are more enigmatic than those at plate margins since there are no obvious mechanisms, we can tie to the plate tectonic paradigm. The emplacement of Oceanic Island Basalt (OIBs) in the continental crust provides valuable clues for understanding this unique geological process. Here, we report for the first time a diabasic intrusion from the Angadimogar alkaline pluton and infer its origin in relation to the Cretaceous plume activity. The Angadimogar Diabasic Intrusion (ADI) is emplaced to the Neo-Proterozoic Angadimogar alkaline pluton, Kasargod District, occurs in the periphery of Coorg block within the northern part of the southern Indian Granulite Terrain (SGT). The ADI is less altered and shows multi-storied, partially developed columnar-like joints. The samples are essentially composed of augite and plagioclase and display ophitic or sub-ophitic textures. Plagioclase occurs both as phenocryst and groundmass and shows compositional zoning and exsolution lamellae, suggesting fractional crystallization of the parental magma before eruption. Geochemical data show low to moderate MgO (5.43 to 7.23 wt.%) and Al_2O_3 (11.97 to 16.9 wt.%) contents with SiO_2 ranging between 47.17 and 49.1 wt %. The ADI is typically enriched in Fe with 11.13–16.8 wt% of FeO, with a narrow range for CaO contents (8.7–11.04 wt.%). The K_2O content ranges from 0.12 to 1.02 wt.% and in terms of SiO_2 *vs.* K_2O, the ADI follow low-K sub-alkaline tholeiite and sub-alkaline tholeiite trends. Moderate to high TiO_2 (1.9–3.41) is noticed in the ADI, comparing them with plume-related basalts around the world erupted in both continental and oceanic environments [1,2]. Characteristic depletion in compatible elements such as Ni (74–108 ppm) and Cr (84–200ppm), lower than that of primary mantle melts indicating that the parental mafic magma does not have the Cr and Ni contents expected for partial melts of peridotites. In the meantime, it shows relatively lower Rb (14–23 ppm) and Sr (209–355 ppm) as compared to the OIBs. Ba/Rb *vs.* Rb/Sr variations suggests an amphibole and mica (phlogopite) bearing source or protolith [3]. Low K_2O/P_2O_5 (avg. 1.9), high TiO_2/P_2O_5 (8.2–12.2) and marked depletion of Rb reflect minimum

contamination by granitic continental crust. The Zr/Ba ratios ranging from 0.6 to 1.2 indicating the involvement of asthenospheric mantle sources in the melting process [4]. Overall, the geochemical compositions of the ADI attest to their mantle plume origin [5]. The tectonic discriminations of the samples show clear indications of within-plate magmatism. A petrogenetic model utilizing Zr and Zr/Y with calculated partial melting curves suggest partial melting of a garnet-bearing protolith and a relatively deeper mantle origin [6]. The petrological and geochemical characteristics of the ADI thus suggest a late-stage magmatic event possibly induced by a cretaceous plume activity.

Keywords: Geochemistry, Diabasic Intrusion, Plume Magmatism

A GEOCHEMICAL COMPARISON OF THE PLAGIOGRANITES OF NIDAR, NAGA-MANIPUR, AND ANDAMAN OPHIOLITES

Naga Santosh Sree Bhuvan Gandrapu[1,2]*, Jyotiranjan S. Ray[2,3], Rajneesh Bhutani[1]

[1] *Department of Earth Sciences, Pondicherry University, Puducherry 605014, India*
[2] *Geosciences Division, Physical Research Laboratory, Navrangpura, Ahmedabad 380009, India*
[3] *National Centre for Earth Science Studies, Akkulam, Thiruvananthapuram 695011 India*
* Corresponding author: sreebhuvan7@gmail.com

ABSTRACT

Plagiogranites are the ubiquitous felsic component of the oceanic crust, found at both present day mid-oceanic ridges and ophiolites. Their compositional similarity with the Archean TTGs makes them a suitable proxy to understand the generation of the oldest felsic crust. Most authors attribute the genesis of plagiogranite to the melting of an altered oceanic crust (gabbro), but those related to fractional crystallization of a low-K tholeiite melt and partial melting of sheeted dykes are also reported worldwide. In this work, we compare the field associations and geochemical characteristics of the plagiogranites found in the Nidar, Naga-Manipur and Andaman ophiolites and comment on the tectonic setting of these rocks. Major and trace element analyses were performed on 5 plagiogranite samples collected from the Andaman ophiolite. Published data for plagiogranites from Andaman, Nidar and Naga-Manipur were used for comparison. In all the three ophiolites, plagiogranites occur as intrusive bodies in the gabbros. In addition, they are also intrusive into mantle section of the Naga-Manipur and Andaman ophiolites. On the normative Ab-An-Or and QAP diagrams, most of the plagiogranites of all the three ophiolites are classified as tonalites and trondhjemites, while a few are classified as diorites and quartz diorites on the QAP

diagram. On the AFM diagram, most plagiogranites plot in the calc-alkaline field while a few samples plot in tholeiite field due to the higher TiO_2 and FeO^t contents owing to the occurrence of Fe-Ti bearing phases. On chondrite normalized REE plots, the plagiogranites of Naga-Manipur exhibit the highest variability having both LREE depleted and enriched patterns, whereas those from Nidar and Andaman exhibit a narrow range of values, hinting that the effect of fractionation on the evolution of plagiogranite parent magma in Naga-Manipur is higher than the other two ophiolites. On primitive mantle normalized spider diagram, Nidar plagiogranites show patterns like N-MORB, Andaman plagiogranites are characterized by negative Nb-Ta anomaly, while those from Naga-Manipur have a dichotomy: a few samples have negative Nb-Ta anomaly whereas those with higher TiO_2 and FeO^t show an OIB like signature. We suggest that this enrichment in Nb-Ta could be related to the accumulation of ilmenite, which has a higher mineral-melt partition coefficient for the said elements. Although the three ophiolites are related in formation to the closure of Tethyan ocean, the influence of subduction is only evident in the plagiogranites of Andaman and a few samples of Naga-Manipur, while the presence of Nb-Ta bearing phases possibly buffered the subduction signature from the rocks of Nidar and the rest of the samples from Naga-Manipur.

Keywords: Andaman ophiolite, Nb-Ta, plagiogranites

EXSOLUTION MICRO-TEXTURES IN CR-V-TI MAGNETITE (LODESTONES) OF SOUTHERN INDIA; REMNANTS OF COMPLEX MAGMATIC PROCESSES

V. Deepchand[1*], V. J. Rajesh[2], A. Haritha[2], R. B. Binoj Kumar[1]

[1]*Department of Geology, University of Kerala, Thiruvananthapuram-695581*
[2]*Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Thiruvananthapuram-695547*
Corresponding author: deepchandgeology@gmail.com

ABSTRACT

Lodestones are naturally magnetised bodies that exhibit magnetic polarity, commonly occurring as lenses or bands in mafic-ultramafic rocks. The present work focuses on the high-resolution reflected light microscopic analysis of lodestone samples from the Kanthampara region of northern Kerala. According to prior studies, lodestone is formed in the early stages of crystallization from a mafic magma related to a layered complex in the present study area [1]. The lodestone layers

occur within the lateritised host rock, where metamorphosed ultramafic intrusions and charnockites mark the in the basement. The present samples consist mostly of titanomagnetite and ilmenite with a minor amount of hematite, pleonaste, and ulvöspinel. Ti-magnetite is characterised by developing a wide range of micro intergrowths of ulvospinel, pleonaste and ilmenite. Ulvospinel exsolutions are present in the characteristic form of cloth texture. Spinel exsolutions in Ti-magnetite occur in blebs/lenses or internal granules. Lenses of pleonaste are concentrated within the central part of the Ti-magnetite and have a length of 10-200 µm. Blebs occur in very small dots or are often found as chains of blebs aligned in three different crystallographic directions. Ilmenite occurs either as exsolution lamellae in titanomagnetite or as granular ilmenite. Ilmenite exsolutions are developed as i. trellis type texture, ii. sandwich-type texture, and iii. elongated lath forms, and iv. symplectite textures. Granular ilmenite grain boundaries are mostly serrated, indicating the development of spineliferous ilmenite rims. Coarse-grained granular ilmenite consists of a variety of hematite intergrowths. In ilmeno-hematite intergrowth, ilmenite consists of a few lensoidal lamellae of hematite. Lodestones of the Kanthampara region show variety of primary and secondary ore textures resulting from primary crystallisation followed by oxidation. These exsolution phases resulted from the oxidation of magnetite-ulvöspinel at different levels of subsolidus compositions and conditions of oxygen fugacities [2]. Oxy-exsolution occurs during the cooling of titanomagnetite. As a result of this reaction, ulvöspinel is converted to ilmenite and magnetite: $6Fe_2TiO_2 + O_2 \leftrightarrow 6FeTiO_3 + 2Fe_3O_4$. Ulvospinel intergrowths are interpreted as the result due to the exsolution of a magnetite-ulvospinel solid-solution under relatively low oxygen fugacity [3]. Pleonaste usually exsolves at a higher temperature than ulvospinel at an earlier stage. The spineliferous ilmenite rims are caused by the continued solid-state growth of ilmenite crystals during subsolidus cooling due to external granule exsolution. Titanomagnetite also shows alteration to secondary martite and goethite due to the low-temperature oxidation and hydration during weathering. Micro-ore textures in the present sample may have resulted from a complex magmatic process at various crystallisation temperatures, compositions, and oxygen fugacity levels. Moreover, they are useful proxy indicators of paragenetic evidences, magmatic cooling histories, and rock magnetism.

Keywords: Exsolution, Micro-Textures, ilmeno-hematite

PETROGRAPHY OF REEF QUARTZ FROM CHERLOPALLY DOME, RAMAGIRI GREENSTONE BELT, ANANTAPUR DT., ANDHRA PRADESH

Pothuri Ramesh Chandra Phani[1]

[1]*Mining & Natural Resources, Cyient Limited, Hyderabad, India.*
Corresponding author: phaniprc@gmail.com

ABSTRACT

The Ramagiri Greenstone Belt (RGB) forms a part of Eastern Dharwar Craton (EDC), is popular for gold (Au) mineralization in blue quartz veins for past more than 90 years. The RGB contains domal structures, among which Cherlopally dome (CD) lies on the eastern flank of the belt. The CD chiefly comprises banded gneisses, metabasalt with ultramafic bands, acid volcanics and quart bands. with banded iron formation (BIF) in center. Base metal mineralization is reported from quartz reefs of CD at Cherlopally and Kanaganapalli areas in the northern part. The present study focuses on petrography of quartz from quartz reefs of CD. For this purpose, three types of quartz from reefs namely smoky quartz, reddish quartz veins and the milky quartz veins have been sampled and studied under petrological microscope. The reddish quartz is brown to reddish brown due to iron oxide disseminations. The third variety, milky quartz is white, with iron oxide as fracture fillings and also Mn dendrites on fracture planes. Smoky quartz is greyish, transparent, sometimes contain inclusions visible with a hand lens. The smoky quartz shows undulatory extinction, recrystallisation, and stretching. The minor mineral phases include, calcite, biotite, muscovite. The minerals tourmaline and apatite occur as tiny needles. In polished ore sections, the smoky quartz is observed to have sulphide minerals like pyrite, marcasite, chalcopyrite, malachite along with magnetite. The magnetite appears to be altered to martite along cleavage planes. Magnetite occurs in association with sulphide specks. Among all sulphide minerals present in smoky quartz, pyrite and chalcopyrite occupy 80-90%. The other two types of quartz namely, reddish quartz and milky quartz are barren. The reddish quartz clearly shows opaque iron oxides in thin section. The milky quartz shows wavy extinction with occasional iron oxide impurities. The mineral assemblages in the smoky quartz show that the quartz veins are derived from a late stage metal rich hydrothermal source. The presence of tourmaline reflects boron-bearing fluids. Sulphide disseminations occurring in smoky quartz veins traversing both host rocks, chlorite schist and altered granite gneiss and absence of ore phases in the matrix portion of the two lithounits indicate that source of the sulphide mineralization is hydrothermal.

VARIATIONS IN THE PETROPHYSICAL CHARACTERISTICS OF SHALES FROM KACHCHH AND KALADGI BASIN

Sagar Thakurdas[1*], Dhanajay Meshram[2], Bhawanisingh G Desai[3]

[1]Department of Geology and Petroleum Technology, Nowrosjee Wadia College, Pune, Maharashtra, India.
[2]Department of Geology, Savitribai Phule Pune University, Pune, Maharashtra, India.
[3]Pandit Deendayal Energy University, Gandhinagar, Gujrat, India.
* Corresponding author: sagarthakurdas@gmail.com

ABSTRACT

Shale gas being an unconventional resource of petroleum has become an interesting topic of research and development for the oil and gas industry around the world. The production of petroleum from unconventional resources needs improvement in the techniques as well as greater insight into the reservoir rock and its petrophysical properties (Siswandani et al. 2015). As per EIA (2014) report, the global natural gas consumption is likely to escalate by 50%, by 2035, and one third of this demand is expected to be satisfied by the unconventional sources. It also states that the technically recoverable global shale gas resources stand at approximately 7299 Tcf spanning over 137 shale formations in 95 basins and 41 countries. The Shales are inherently anisotropic and composed of clay-sized particles approx. < 1/256 mm (4 μ in diameter) (Sondhi, 2011). Porosity in shales is mostly associated with clay particles and the organic matter preserved within. The pore throats are usually present in microscale (5nm) (Loucks et al.2009). Different types of microscale pores are present in organic matter, within clay mineral matrix, within pyrite framboids, within the preserved fossils and in the form of microcracks (Sondergeld et al., 2010). The study was aimed at understanding the effect of geological age on the petrophysical properties of shales from Kachchh and Kaladgi Basins. The Kachchh shale is Mesozoic while shale from Kaladgi basin is much older belonging to Meso-Proterozoic age. The samples were characterized with the help of optical study, X-ray diffraction and N_2 gas adsorption method. Representative samples from different locations were analyzed by applying BET (Brunauer–Emmett–Teller) and BJH (Barrett–Joyner–Halenda) theory for determination of surface area, pore size distribution, type and shape of pores. Our observations suggests that both the sample sets (Kachchh basin and Kaladgi basin) exhibit Bi-modal pore size distribution with peaks between certain nano meter pore throat sizes.

The comparison of differential pore volume suggests that porosity is very low in Kaladgi samples, and it is evident from the hand specimen as well. Study indicates abundance of micro pores in the organic matter, presence of OM in both the samples is supported by thin sections.

Key Words: Shale Gas, Pore size, Pore throat, BET and BJH method, Organic Matter, Pore volume.

PROVENANCE OF THE SAND DUNES OF THAR DESERT, WESTERN INDIA

Anagha V[1,2] and Bivin G. George[1]*

[1]*National Centre for Earth Science Studies, Akkulam, Thiruvananthapuram 695011, India*
[2]*Department of Marine Geology and Geophysics, Cochin University of Science and Technology, Kochi 682016, India*
*Corresponding author: bg.george@ncess.gov.in

ABSTRACT

The sedimentation history of Thar, India's largest desert, spans nearly 200 k.y. However, the origin and possible depositional pathways of these huge deposits of sand are equivocal. There exist several hypotheses for their origin which include its derivation from the Arabian Sea coast, local alluvium and basement rocks, sub-Himalayan plains, and the faraway Himalayas. We studied the mineralogy and major oxide compositions of the sand dunes across the Thar to decipher the provenance of its sediments, and tectonic setting and weathering intensity of the source area. Thar dune sands are fine grained litharenites and show limited grain size variation ranging from 2.4 to 2.8 phi. Quartz grains make 75 - 92 percent whereas feldspars make up 0.4 - 4 percent, and lithic fragments 6 - 23 percent. A few accessory minerals such as hornblende, garnet, zircon and apatite too are present. Modal mineralogical composition suggests that the sediments are likely derived from a 'Recycled Orogen' tectonic setting. The SiO_2 content of the dune sand varies from 80 - 83 percent which is higher than the Upper Continental Crust (UCC) value whereas all other major oxide contents are lower than UCC compositions. These values do not change significantly with the type of the dune or with geography. Thar sands are compositionally immature and had undergone low degree of recycling as demonstrated by their high ICV (1.1 - 1.3) values. The dune sands show very low values of CIA (46 - 49), PIA (45 - 48), CIW (51 - 54), and WIP (37 - 42), all indicators of the degree of chemical weathering, suggesting that chemical weathering is limited and physical weathering dominates the area from which the sediments are derived. Results of

modal mineralogy and major oxide composition indicate that the primary source of sand to the Thar dune system is likely the Himalayas. The sediments are transported by the westward flowing Himalayan rivers like Indus, Sutlej and other Punjab rivers, and are either deposited directly and recycled to form the dunes, or likely taken up from their deltas by the monsoonal winds, recycled, and deposited as dunes.

Keywords: Thar, sedimentation, physical weathering

RECONSTRUCTION OF SUMMER MONSOON VARIABILITY OVER THE PAST 15,000 YEARS: PLANKTIC FORAMINIFERAL EVIDENCE FROM THE ARABIAN SEA

Sruthy Rose Baby[1] and Mohan K[2]

[1.] *School of Advanced Science, Vellore Institute of Technology, Chennai.*
[2.] *School of Civil Engineering, Vellore Institute of Technology, Chennai.*
Corresponding author:mohan.kuppusamy@vit.ac.in

ABSTRACT

The Arabian Sea and the Bay of Bengal play a significant role in determining the climate of the Indian subcontinent. The Arabian Sea's sediments are frequently utilised to reconstruct historical Indian Summer Monsoon (ISM) and coastal upwelling variations. We used core samples SK240/473 with 4.30 m from off the Saurashtra coast with a water depth of 121 m for the current study. The ratio of *G. bulloides/G.ruber* and relative abundances of the planktonic foraminifera *Globigerina bulloides* were used to determine how the ISM in response to intensification and weakening of climate forces during the late Quaternary. The asymbiotic species *G.bulloides* is frequently found in transitional to polar environments, but it is particularly distinctive in nutrient-rich upwelling regions. The ratio varies from 0.1 to 2.5, and the relative abundance of *G.bulloides* ranges from 35% to 4%. The abundance of *G.bulloides* and the ratio of *G.ruber* demonstrate a positive link, with the abundance of *G.bulloides* indicating high productivity in the area. A period of strong upwelling with a high benthic percentage is indicated by the high value of *G.bulloides/G.ruber* in two points (~13099 yrs and ~13345 yrs). Low *G.bulloides/G.ruber* ratios in section would imply reduced productivity and the impact of warm, oligotrophic water. A period of high productivity and the influence of cold, nutrient-rich water are indicated by the age range of ~6500 yrs to ~15,145 yrs. The results allow us to infer that this site has a low production period up to ~6500 yrs, following which the rate of terrestrial input and upwelling doubles.

Keywords: *Globigerina bulloides,* ISM, Arabian Sea

MICROBIAL PROFILING OF ANCIENT SEDIMENT: CHALLENGES AND OPPORTUNITIES IN METHODOLOGIES OF EXTRACTING METAGENOMIC DNA

Kruti Mistry[1]*, Anoop Markande[2], Prabhin Sukumaran[3]

[1,2] *Department of Biological Sciences, Charotar University of Science and Technology, Changa, Gujarat, India*
[3] *Dr. K C Patel Research and Development Centre, Charotar University of Science and Technology, Changa, Gujarat, India*
* *Corresponding author: mistrykruti97@yahoo.com*

ABSTRACT

Extracting DNA from ancient sediment is a challenging and expensive task. Though, standard protocols and soil DNA extractions kits are available today for extracting DNA from modern soil samples, DNA extraction from ancient sediments (older than Holocene) are more challenging. DNA preserved in ancient soil are usually highly fragmented <100 base pair (bp) in size, degraded, and present only in minute amounts. Though the ancient soil contains large amounts of organic matter (that are potential reservoirs for DNA), DNA recovery from these sediments has been difficult and insufficient because organic matter such as humic acid and DNA protected into nanopores have a strong affinity with each other [1]. As a result, DNA co-extracted with humic acids and prevent DNA amplification by inhibiting the enzyme activity of PCR [2]. The commercial kits available in the market involve bead beating-which mechanically disrupts the soil aggregates and microbial cells along with various extraction reagents; but they are unable to produce sufficient DNA yield concentration and purity [3]. Here, we evaluated the usefulness of different commercial kits, based on bead beating and column-based DNA extraction, and kit which extracts DNA through nanoparticles. The paper also presents the possible reasons for the failure of extraction of ancient DNA using the standard kits. A pure and sufficient DNA extracted from the soil will be necessary for further applications in the downstream processing such as 16s PCR-based amplicon sequencing. Therefore, it requires to develop an efficient method that carried out proper lysis of sediments along with the removal of humic acid and PCR inhibitors for the downstream process which further plays a role to study the evolutionary trajectories of microbial community, which is an unexplored area in the field of quaternary research.

Keywords: soil DNA extractions, PCR, amplicon sequencing

CARBON ISOTOPE ANALYSIS OF A LATE QUATERNARY FLUVIAL, AEOLIAN AND PALEOSOL SEDIMENTARY SEQUENCE FROM THE CENTRAL TAPI RIVER VALLEY

Prabhin Sukumaran[1], Stanley H Ambrose[2] and Parth R Chauhan[3]

[1] *Dr. K C Patel Research and Development Centre, Charotar University of Science and Technology, Changa, Gujarat, India*
[2] *Department of Anthropology, University of Illinois, Urbana, USA*
[3] *Department of Humanities and Social Sciences, IISER-Mohali, Punjab, India*
* Corresponding author: prabhinsukumaran.cv@charusat.ac.in

ABSTRACT

Plants that follow the C_4 photosynthetic pathway, mainly tropical grasses and herbs adapted to strong sunlight, have $\delta^{13}C$ values averaging -12‰. Carbon isotope analysis of soil organic matter ($\delta^{13}C_{SOM}$) can be used to reconstruct proportions of tree and grass biomass in tropical savanna ecosystems. The carbon isotope composition of pedogenic carbonate ($CaCO_3$) primarily depends on the isotopic composition of soil CO_2, which reflects that of plant root and soil microbial respiration. The $\delta^{13}C$ values of pedogenic carbonates can also be used to estimate the proportion of trees to grasses in the past environment [1-5]. Organic and carbonate $\delta^{13}C$ should provide closely similar estimates of C_3 and C_4 biomass. However, they often differ significantly [6]. Soil carbonate forms at variable depths below the soil surface that provides the root-respired plant CO_2, so carbonates may form at the same levels as older organic carbon that had formed in environments with different proportions of C_3 and C_4 plants. Diagenesis of organic or carbonate fractions, and assimilation of air CO_2 in carbonates formed close to the surface, may also contribute to differences in $\delta^{13}C$-based estimates of past plant biomass composition. The present study evaluates the relationship of total Inorganic (TIC) and organic (OC) weight %C to $\delta^{13}C_{SOM}$ and $\delta^{13}C_{TIC}$ of 94 samples from a 15-meter sediment sequence deposited under an aeolian and fluvial depositional setting in the central Tapi River Valley, near Sakegaon, Maharashtra. Qualitative assessment through bivariate plots of elemental and isotopic composition parameters shows patterns of clusters of TIC vs $\delta^{13}C_{SOM}$ compositions and depositional environments, likely reflecting distinct floral habitat communities in different paleoclimatic and sedimentary settings during the Late Quaternary. Higher resolution analysis of this sequence is needed to characterize variation within environmental phases and rates of environmental change during transitions between phases.

Keywords: Tapi River Valley, Pedogenic carbonate, $\delta^{13}C_{SOM}$

GEOARCHAEOLOGICAL EXPLORATION OF QUATERNARY LANDSCAPE AND MIDDLE PALAEOLITHIC ACTIVITY AREAS IN NORTH KARANPURA VALLEY, JHARKHAND.

Shubham Rajak[1] and Prabhin Sukumaran[2]

[1] *Department of A.I.H.C. and Archaeology, Deccan College Postgraduate and Research Institute (Deemed University), Pune, India.*
[2] *Dr K C Patel Research and Development Centre, Charotar University of Science and Technology, Changa, Anand, Gujarat, India.*
*Corresponding author: shubham.rajak@dcpune.ac.in

ABSTRACT

Quaternary valley fill deposits of Eastern India are one of the less explored areas having the potential to understand the human climate interaction throughout the Quaternary. The present paper discusses preliminary observations of prehistoric human activities, a relative chronology of the Quaternary deposits, palaeo-environment and geoarchaeology of North Karanpura Valley (NKV), situated North of upper Damodar basin, Jharkhand. The Middle Palaeolithic stone tools, associated with fine-grained uniform reddish sandy-silty deposits in NKV give us context on the prehistoric activity areas and palaeo-geography. The recent findings of prepared core technology and blade-scraper assemblage from Banwarniya (including three localities) prove that the Middle Palaeolithic culture of NKV is associated with fine-grained reddish sandy-silt resting on yellow sandstone bedrock of Gondwana Super Group. Regional mapping of these fine-grained uniform reddish sandy-silty deposits in the valley reveals that the deposits are preserved in foothill regions of the Northern Mahudi Pahar range (from Keredari to Sikri village) and North-Eastern Sathi range (at Banwarniya village). Thick, structureless deposits abutting the moderately steep bedrock suggest a wind-blown activity responsible for the deposit. Movement of such fine-grained sediments along the foothill can be an indication of less vegetation (not as forested as we have today) and maybe a grassland environment during the Middle Palaeolithic Culture (Late-Middle Pleistocene < 75 ka BP). Our hypothesis of the grass-land environment during the Middle Palaeolithic is also supported by the pictographic evidence of extinct species like *Rhinoceros unicornis*, *Bos Gaurus* or *Bos namadicus* and *Pangshura sylthensis* from Isko Rock Shelter (Rajak, 2019 and 2021). Moreover, the present research also found the first fossil evidence of *Bos namadicus* from the cemented gravel layer near Bundu village on the bank of the Damodar River. A hypothetic semi-dried grass-land environment at North Karanpura Valley, Jharkhand during Late-Middle Pleistocene opens the door for interdisciplinary scientific research for a better

understanding of prehistoric human life and the surrounding natural environment. Such studies will ultimately help us to trace the trajectories of modern human migration, human evolution research and its global connections.

Keywords: North Karanpura Valley (NKV), Palaeolithic stone tools, Quaternary deposits, palaeo-environment

POTENTIAL USE OF AIRBORNE HYPERSPECTRAL AVIRIS-NG DATA FOR MAPPING SITTAMPUNDI ULTRAMAFIC COMPLEX AND ASSOCIATED ROCKS IN SGT, INDIA

Monisha Mohan M[1*] and Muthukumar M [1]

[1]*Centre for Geoinformatics, The Gandhigram Rural Institute (Deemed to be University) Gandhigram-624302, Dindigul District, Tamil Nadu, India*
Corresponding author: monishamohan948@gmail.com

ABSTRACT

Airborne Visible InfraRed Imaging Spectrometer – Next Generation (AVIRIS-NG) data with high spectral and spatial resolutions are used for mapping Sittampundi Anorthosite Complex and associated Mafic-Ultramafic rocks in Southern Granulite Terrain (SGT) India. The study indicate the ability of AVIRIS – NG data for mapping mafic- ultramafic rocks and associated rocks from Sittampundi that are known more mineral deposits. Hyperspectral sensors with high spectral resolution can be used to identify specific minerals, which makes them a viable alternative to more conventional methods of mineral exploration including multispectral remote sensing and field-based methods. Airborne Hyperspectral data is used. Band combinations derived for identifying the rock deposits in various colours. Principle Component Analysis (PCA) and Minimum Noise Fraction (MNF) algorithm is used for the reduction of the dimensionality of data. Spectral signatures taken from the satellite images are used for the extraction of the endmembers. The spectral signatures belong to anorthosite, gabbro, pyroxene and chromite classes. Those endmember spectra are used for the different mapping algorithms i.e. LSU, SAM and SVM. Different mapping algorithms illustrate the occurrence of rock deposits. SAM produces superior outcomes compared to other methods. Additionally, other classifications separate the settlement from the mining zones. Then the laboratory spectral signatures collected from Spectrometer to identify the absorptions to knowing the compositions. This study was done to demonstrate the

AVIRIS-NG hyperspectral remote sensing data's capacity to locate mineral deposit zones with valuable mineral deposits.

Keywords: Airborne Hyperspectral Remote Sensing, AVIRIS-NG, PCA, MNF, LSU, SAM and SVM.

DELINEATION OF PALAEOCHANNELS USING GEOSPATIAL TECHNOLOGIES. A CASE STUDY OF THE KADUVAIYAR RIVER, TAMIL NADU, INDIA

Pasupathi Subramaniyan[1] and Muthukumar Meyyappan[1]*

[1] *Centre for Geoinformatics, The Gandhigram Rural Institute (Deemed to be University), Dindigul, Tamil Nadu, India*
* Corresponding author: m.muthu.m@gmail.com

ABSTRACT

The demand for groundwater is increasing in developing nations like India; therefore, it is important to delineation and identification of palaeochannels for groundwater. The Cauvery delta located in the southern part of India exhibits many palaeochannels due to the tectonics and morphometric change in Cauvery River. The present study concentrated on Kaduvaiyar river and its palaeochannel has identified from Landsat 8 OLI images (30m) and SRTM DEM (30 m) using various image processing techniques such as Principal Component Analysis (PCA), Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) using ArcGIS and ENVI software. The results shows that the Kaduvaiyar palaeochannel have originated from the Cauvery River due to their morpho-tectonic changes in the historical record and flow in meandering patterns toward the southeast direction. The study reveals that the optical data provides better information related to surface configurations while the SRTM DEM data portrays the surface features more effectively. The identification and geospatial distribution of Kaduvaiyar palaeochannel have been validated using surface expressions measured by the spatial profiling. Thus study, using the Landsat 8 OLI images coupled with SRTM DEM data can provide good information about the changes in the palaeo-landscape of the Kaduvaiyar Palaeochannel, which may have a significant impact on increasing groundwater storage and supplies in the Kaduvaiyar River and its surrounding region.

Keywords: Kaduvaiyar, Palaeochannels, NDVI, NDWI, PCA and Geospatial Technologies.

SHORELINE ANALYSIS AND COASTAL GEOMORPHOLOGY OF NORTHERN KERALA COAST, INDIA- A REMOTE SENSING BASED APPROACH.

Pranav Prakash [1]*, Rajesh Reghunath[1], Ajayakumar A[1]

[1] *Department of Geology, University of Kerala, Thiruvananthapuram, Kerala, India*
* Corresponding author: pranav@keralauniversity.ac.in

ABSTRACT

Earth has been subjected to tremendous changes in its environment throughout the geologic history. The vibrational and recurring changes that occurred during the Quaternary Period were the most noticeable, as they contributed to the formation of modern-day landforms. One of the major changes occurred during the quaternary period was the shoreline change, which in turn controlled the evolution of coastal landforms. Coastal landforms are hyper versatile in nature, changing all the time due to natural and human activities [1,3]. The northern Kerala coast in Southwest India has a diverse range of coastal landforms and sedimentary environments. The current study aims to assess the utility of satellite imagery in understanding coastal landforms and shoreline studies. LANDSAT imagery (30-meter resolution) and survey of India toposheets were used to extract shorelines. The Digital Shoreline Analysis System (DSAS) was used to calculate shoreline displacement rate after extracting shorelines from Landsat images. The DSAS tool developed by the United States Geological Society (USGS) has revolutionised the analysis of short- and long-term shoreline change around the world [2]. PLANET LAB imagery (3-meter resolution) is used for the delineation of landforms found in the study area. Visual interpretation techniques and GPS-based field surveys were used to identify various coastal landforms. The rise and decline of sea level during the quaternary period influenced the evolution of coastal landforms. The presence of parallel barrier islands, palaeo beach ridges, tidal flats, etc., identified in the study area indicates past sea-level changes. The present study reveals that recent eustatic changes played an important role in shaping the coastal geomorphological aspects of the study area.

Keywords: LANDSAT, Digital Shoreline Analysis System (DSAS), PLANET LAB imagery

LINEAMENTS AND VEGETATION LINK IN GROUNDWATER EXPLORATION: INFERENCES FROM EDC, KARNATAKA

Sharath Raj B[1] and Mohammed Aslam M A [1]

[1]Dept. of Geology, School of Earth Sciences, Central University of Karnataka, Aland Road, Kadaganchi, Kalaburagi-585367
* *Corresponding author*: *sharathgeocuk@gmail.com*

ABSTRACT

This study reports the possible linkage between lineament densities and vegetation indices observed in Dharwar Craton, a hard rock terrain in Karnataka. Lineament mapping was carried out by using landsat8 panchromatic band, landsat8 RGB bands and Sentinel2A RGBNIR bands with the help of line extraction tool algorithm in PCA Geometica software. Thus, generated lines were verified with already existing lineament maps, Google Earth and field verifications. Lineaments were then classified into micro (<1000m), meso (1000-2000m) and macro (>2000m) lineaments based on their length. Rose diagrams prepared for these classified lineaments shown that, micro lineaments are aligned in almost all directions and are mostly confined to clospet granites, probably by the development of mural joints in granites. Majority of the meso and macro lineaments were found to be aligned in NNW-SSE direction, which is similar to the regional trend of Dharwar craton. To understand the role of these lineaments (faults and fractures) in groundwater occurrence, vegetation indices of summer season (keeping in mind that, during summer, shallow depth groundwater is the only source of water for the growth of vegetation) were calculated. Correlation of vegetation indices such as Normalised Difference Vegetation Index (NDVI), Difference Vegetation Index (DVI), Green Difference Vegetation Index (GDVI), Ratio Vegetation Index (RVI), Green Ratio Vegetation Index (GRVI), and Soil Adjusted Vegetation Index (SAVI) with lineament density has shown that, there exists a positive correlation between these variables ($R^2= 0.9+$). Report concludes that, mapping of lineaments is effective using this integrated approach; Meso and macro lineaments might have formed well before micro lineaments and their significance in groundwater exploration is well understood.

Key words: Lineament tectonics, Vegetation indices, hard rock

REMOTE SENSING-BASED GEOMORPHOLOGICAL MAPPING OF GLACIAL AND PARAGLACIAL LANDFORMS FROM SEMI-ARID AND SUB-HUMID HIMALAYA

Subhendu Pradhan[1,2*], Shubhra Sharma[1]

[1]*Geoscience Division, Physical Research Laboratory, Ahmedabad, India-380009*
[2]*Department of Geography, Institute of Science, Banaras Hindu University, Varanasi, India-221005*
*Corresponding author: spradhan.geology@gmail.com

ABSTRACT

The present study maps and quantifies the paraglacial landforms preserved in the arid NW Himalaya (eastern Zanskar ranges: Sarchu plain) and the sub-humid Gangotri valley (central Himalaya). The two catchments that have contrasting climatic conditions are chosen to understand the changes in ice volume and sediment sequestration in the late Quaternary period. Using the satellite remote sensing data supported by Google Earth images, the study identifies multiple paraglacial features including the moraines, alluvial fans, scree fans, drumlins, talus cones, and outwash gravel terraces. The moraine stratigraphy is used for the estimation of temporal changes in the ice volume and paraglacial landforms are used to quantify the sediments sequestered in these two valleys. The study indicates that the sub-humid Gangotri valley had a significantly high ice volume since the Marine Isotopic Stage (MIS)-4 compared to the arid Sarchu plain, which is attributed to increased contribution from the combined moisture from the mid-latitude westerlies (MLW) and the Indian Summer Monsoon (ISM). Whereas, the amount of paraglacial sediment sequestered in the Sarchu plain far exceeds the Gangotri valley. Although preliminary in nature, the study suggests that the sub-humid Himalayan glaciers in the Himalayas contain larger ice volumes with the exception of the Siachen and Drang-Drung glaciers (largest and longest) in the north-west Himalayas. However, in terms of sequestered sediments, the Sarchu plain overwhelms the sub-humid paraglacial zone which could be due to the contribution from the alluvial fans and scree/talus cones.

Key words: Marine Isotopic Stage, mid-latitude westerlies (MLW), Indian Summer Monsoon (ISM).

THE GEOMORPHOLOGY OF AN UNNAMED CRATER IN XANTHE TERRA, MARS: INSIGHTS INTO THE SUBSURFACE PROCESSES OF THE LOW LATITUDINAL REGIONS

Asif Iqbal Kakkassery[1,2*], Najma Nujumudeen[3], V.J. Rajesh[1]

[1]Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Valiamala P.O, Thiruvananthapuram 695 547, Kerala
[2]Department of PG Studies and Research in Geology, Government College Kasaragod, Kasaragod 671123, Kerala
[3]Planning Building Environment, Technische Universität Berlin, Germany
* Corresponding author: kakkasseryasif@gmail.com

ABSTRACT

Impact craters on Mars provide valuable information about the geologic history of the planet's surface. These craters were created during a period of intense bombardment approximately 3.9 billion years ago and are well-preserved due to the lack of active erosion processes on Mars. In contrast, impact craters on Earth are subject to erosion, which can make it difficult to study the geologic history of the planet's surface. This research investigates the geomorphology, or physical features and geological processes, of an unnamed crater located in Xanthe Terra on Mars (3^0 S 52^0 W). The surrounding region of the unnamed crater, which is situated approximately 200 km northwest of the Ganges Chasma region of Valles Marineris, has a number of fluvial features such as interior layered deposits, lakes, alluvial fans, and outflow channels. Existence of these features hints subsurface fluvial or glacial processes that may have played a role in their formation. The study aims to determine the presence of fluvial or glacial features within the crater and to understand the subsurface processes that may have contributed to their formation. High-resolution imagery from the Context Camera and HiRISE instruments on the Mars Reconnaissance Orbiter, along with a digital elevation model produced by the Mars Orbiter Laser Altimeter, were used to analyze the crater. The results of the study showed that the crater is large, with an average diameter of 78 kilometers, and has a peak ring complex, terraced walls, and floor deposits. The floor of the crater also exhibits aeolian features such as transverse aeolian ridges and large dark dunes. In addition, the study found evidence of fluvial and glacial activity within the crater. The alluvial fans, that originated from the southern crater wall and spread out into the floor. Similar alluvial fans were also observed on the west wall and in the region between the central peak mound and the arc of the peak ring massif on the east side of the crater. Braided sinuous ridges were observed at the confluence of these alluvial fans, and bench-cut-like eroded platforms were seen at the terminus of the fans. Additionally, the study identified tongue-shaped flows on the hill slopes of

the peak ring complexes that were interpreted as glacial flows with lateral and end moraines. Large massive flows were also found on the north, west, and east crater walls, which were similar to massive glacial flows on Earth and were compared to those in the Taylor valley of McMurdo Dry Valleys in Antarctica. These flows were inferred to be gelifluction lobes. Small scale, overlapping viscous flow features with tongue-like shapes were observed on the troughs of the east and west crater walls. These features resembled debris covered glaciers in the Mullins glacier in Antarctica. Results of this study suggest that the crater has a complex geologic history involving diverse processes such as impact cratering, erosion, and possibly the presence of water or ice.

Keywords: Mars, Impact craters, Xanthe Terra, HiRISE instruments

COMPOSITIONAL, TOPOGRAPHICAL AND MORPHOLOGICAL STUDIES OF OPHIR CHASMA AND CANDOR CHASMA, VALLES MARINERIS, MARS USING MARTIAN REMOTE SENSING DATA

T. Sivasankari[1], S. Arivazhagan[1]

[1]*Centre for Applied Geology*, *The Gandhigram Rural Institute – Deemed to be University*
Gandhigram, Dindigul, Tamil nadu, India.
*Corresponding Author: sankari159@gmail.com

ABSTRACT

Ophir Chasma and Candor Chasma belongs to the central trough of the Valles Marineris Canyon System which is considered as the largest canyon of the Solar System. The data from Context Camera (CTX) and HiRISE (High Resolution Imaging Science Experiment) of Mars Reconnaissance Orbiter (MRO) were used to study detailed morphology of both chasmas. The Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) spectral data on board MRO is used for mapping the minerals. The topographical study is done with MOLA (Mars orbiter Laser Altimeter) data on board Mars Global Surveyor (MGS). Ophir Chasma trends west-northwest bordered by high-walled cliffs, spur-and-gully morphology. The floor of Ophir Chasma has Landslides, plateau and wall material, wall rock with spurs and gullies. This canyon continues southward into Candor Chasma which is divided as East and West Chasmal respectively. The floor of Candor Chasma has a variety of landforms, including layered deposits, dunes, landslide deposits and steep sided cliffs and mesas. In the present study, the landslide features and the various morphological features like yardangs, Impact craters, dunes, and chaotic terrains have been

identified and studied. The compositional analysis of Ophir Chasma reveals the presence of iron oxide, phyllosilicates (illite, kaolinite and smectite). The compositional analysis of Candor Chasma shows presence of sulphates (jarosite), carbonates (ankerite) and phyllosilicates (illite, smectite and palagonite). The presence of phyllosilicates, sulphates and carbonates indicate the low-temperature chemical weathering and aqueous environment respectively. The topographical analysis shows that Ophir Chasma has elevation ranges from 4000m to -4500m whereas for Candor Chasma, it ranges from 5000m to -4800m depicting both the Chasma has highly rugged and complex topography. The origin and evolution of both the Chasma are discussed in detail based on the compositional, morphological and topographical analysis.

Keywords: Mineralogy; Morphology; Ophir Chasma; Candor Chasma; Weathering; Aqueous environment

EXPLORING THE FROZEN LANDSCAPES OF ADAMAS LABYRINTHUS: UNCOVERING WATER ICE DEPOSITS ON MID LATITUDINAL MARS

Asif Iqbal Kakkassery[1,2], Srojish S M[3*], Rajesh V J[1,] Girish Gopinath[3]

[1]*Department of Earth and Space Sciences, Indian Institute of Space Science and Technology, Valiamala, Thiruvananthapuram, Kerala 695 547, India*
[2]*Department of PG studies and Research in Geology, Government College Kasaragod, Vidyanagar, Kasaragod, Kerala 671 121, India*
[3]*Department of Climate Variability and Aquatic Ecosystems, Kerala University of Fisheries and Ocean Studies, Panangad, Kochi, Kerala 682506*
*Corresponding author e-mail: srojish24@gmail.com

ABSTRACT

Water ice has always been a priority for the Mars science community because of its ability to provide a great grasp of the planet's climatic conditions. The astrobiological relevance of the ice-occurring region and surroundings can be determined from the detailed study of these terrains. Non-polar water ice research is rapidly progressing to gain a better understanding of the atmospheric conditions that led to the formation of near-surface and surface ice deposits. The Adamas Labyrinthus region, located in the northern lowlands of Mars, has received little attention in previous studies. In this research, we aimed to investigate the potential for water ice deposits in this area, which has an area of 343024 sq. km and a perimeter of 2342 km. We used high-resolution orbital data from the Context Camera (CTX), High-Resolution Imaging Science Experiment (HiRISE), and Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) to analyze the

region's morphology and surface composition. Our analysis revealed the presence of water ice in certain troughs of the region's polygonal terrains, as indicated by the blue-white tinted regions in HiRISE images and spectral signature curves that match those of water ice in the reference library. Additionally, we found evidence of glacial activity, such as brain terrain, concentric craters and chevron texture, in the area. Based on these findings, we propose that the cliffs of Adamas Labyrinthus may be a potential location for previously unexplored ice deposits on the mid-latitudes of Mars.

Keywords: Mars, Adamas Labyrinthus, water ice deposits, HiRISE,

COASTAL VULNERABILITY ASSESSMENT OF ERNAKULAM DISTRICT USING BAYESIAN BELIEF NETWORK AND GEOSPATIAL TECHNOLOGY

Sanju Eldhose[1], Achu A L[1], Girish Gopinath[1]

[1]*Department of Climate Variability and Aquatic Ecosystems, Kerala University of Fisheries and Ocean Studies (KUFOS), Kochi-682 508, Kerala, India.*
Corresponding author: ggkufos@gmail.com

ABSTRACT

Coastal vulnerability is a concept that identifies people and places susceptible to the disturbance caused by coastal hazards such as coastal storms and erosion. These hazards bring significant threats to physical, economic and social systems. In recent years Kerala coast is highly prone to coastal hazards, affects millions of people. In this context, the present study identified the coastal vulnerable areas in Ernakulam district of Kerala using Bayesian Belief Networks. Physical parameters like slope, lithology, and demographic parameters like the number of households, population density, literacy rate, female literacy rate, and primary workers rate is considered for modelling. Besides, shoreline change of last 30 years is extracted using satellite images and used for validating the coastal vulnerability. The study shows that about 19% area comes under very low vulnerable, 16% low vulnerable ,29% moderate vulnerable,18% in highly vulnerable and18% area in very highly vulnerable. The result of the present study can be utilized by policy makers for hazard mitigation.

Keywords: Coastal vulnerability, GIS, Bayesian Belief Network, Kerala

ANALYSIS OF SHORELINE CHANGES IN CENTRAL KERALA, INDIA: AN APPLICATION OF DIGITAL SHORELINE ANALYSIS SYSTEM (DSAS)

Samreena Mohammed[1] and Arunkumar K S[1]

[1]*Department of PG Studies & Research in Geology, MES Ponnani College (Calicut University) South Ponnani P.O, Malappuram-679586, Kerala, India*
Corresponding Author: samrinissar94@gmail.com

ABSTRACT

Coastline or Shoreline calculation is one of the important factors in the finding of coastal accretion and erosion and the study of coastal morphodynamic. Coastal areas are highly preferred habitat (80%) for human society while it is highly vulnerable towards natural disaster and climatic phenomenon. The current study was designed to evaluate the coastal vulnerability of of Central Kerala, India considering the high population density (819/km2) and susceptibility towards natural calamities. The study has been conducted along the coastal stretches of Thrissur and Malappuram districts (78 km) of Central Kerala with the help of multi-temporal satellite images of 1988, 1998, 2008, 2018, and 2022. The continuing coastal erosion and accretion rates have been calculated using the Digital Shoreline Analysis System (DSAS). Linear regression rate (LRR) and End Point Rate (EPR) are used for calculating shoreline change rate. It has been found that the maximum erosion rate is 2.70 m/year, and the highest accretion is 1.70 m/year. Based on calculations, the districts shoreline has been classified into six categories as high, medium and low (erosion/accretion). Out of 78 km, high erosion occupied 16.25 km of coast followed by medium erosion of 8.35 km and high accretion of 20.75 km. The outcome of study shows that erosion is prevailing in Munambam-Chavakkad (16.25km), Perinjanam-Munnakkal (6.85km), and Chavakkad-Engandiyur (9.35km) coastal stretches, whereas the coastal stretches of Engandiyur-Snehatheeram (8.35km) are accreting. The study could be used for further planning and development and also for disaster management authority in the decision-making process in the study area.

Key Words: Shoreline changes, Digital shoreline analysis system (DSAS), Erosion & accretion, Remote sensing and GIS.

RECONSTRUCTING A PALEO-DRAINAGE FROM THE PAMPA RIVER BASIN IN SOUTHERN INDIA USING AN INTEGRATED APPROACH

Sarath K.V[1], Deepchand V[1,] Sreevishnu K[1,2], Shaji E[1]*

[1]*Dept of Geology, University of Kerala, Kariavattom Campus, Thiruvananthapuram, India-695581*
[2]*Dept of Civil Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education, Manipal-576104, Karnataka, India 2*
* Corresponding author: sarathgeo123@gmail.com

ABSTRACT

In recent years numerous studies was carried out estimate ancient fluvial systems, particularly, their morphology and hydrology. Paleo drainage are early river channels filled with fluvial sediments. This old remanent channel is a potential site for economically valuable placer deposits. The ancient channels are broad erosion channels into a basement that underpins a system of depositional sequences, and they represent meandering peneplain streams. This is the report of a prominent Paleo-Channel delineated from the Pampa River Basin's using remote sensing, GIS, sedimentological analysis, and field studies. This study's multidisciplinary tactic demonstrated to be actual tools for understanding, mapping, and determining the precise dimensions of the paleochannel. The paleochannel, oxbow lake structures, paleo-depositional and erosional surfaces were delineated using geomorphological features and advanced technologies such as infrared Landsat images also mapped using a Digital Elevation Model and a normalised difference vegetation index. Morphological properties like channel width and sinuosity index were investigated. Sediment cores from the channel were taken for sedimentological analyses, and geobotanical evidence were collected. Sedimentological analysis of collected core samples aided in determining the type, mechanism of transfer, and deposition environment of sediments from the channel's various depths. Based on the data presented above, it is concluded that the identified paleochannel was a minor tributary of the Pamba River.

Keywords: Paleo-Channel, Geobotany, Remote Sensing (RS), Geographic Information System (GIS) and Sedimentology

GLACIO-GEOMORPHOLOGICAL STUDY IN PARTS OF EASTERN KARAKORAM: A CASE STUDY OF RONGDO BASIN, NUBRA VALLEY, LADAKH, INDIA

Quarshi, A H [1], Deshmukh, B[1] & Chandra, R[2],

[1]*School of Sciences, IGNOU, New-Delhi, [2]Department of Geology, University of Ladakh, Leh*
Corresponding author: rakeshchandra69@gmail.com

ABSTRACT

Glaciers are one of the key proxy indicators of contemporary climate in recent times, there has been a general trend of glacier retreat. However, the glacier's reaction to climate change is variable within the Himalaya, Hindu Kush and Karakoram regions. Considering the significance of these region's glaciers to water availability, changes in glacier dynamics, climate change impacts and their socio-economic impacts on the habitations living downstream, it becomes significant to evaluate the response of glaciers to climate change. The present study elucidates the response of glaciers of Rongdo Basin in the Eastern Karakoram to climate change, based on satellite data for the last five decades from 1964 to 2019 followed by field studies. Detail analysis of the CORONA, Landsat data series, topographic maps, and ASTER DEM has been carried out. Numbers of glaciers were delineated by using different image enhancement techniques like rationing, PCA, and thermal signatures of snow and glaciers. The present study reveals that the number of glaciers has increased and decreased over time, with total deglaciation of 10.39% over 55 years. However, there has been a state of expansion in the glacier cover that started somewhere between 1989 to 2000 and continued up to 2019 which confirms that the glaciers of eastern Karakoram show anomaly at a local level.

Keywords: Climate Change, Hindu Kush, Karakoram, Rongdo Basin, Glaciers

MORPHOLOGICAL CHARACTERISTICS OF SOUTHERN PART OF LYOT CRATER, MARS

Shabana Ebrahim[1] and Nithya Mullassery[1]

[1]*Department of PG Studies & Research in Geology, MES Ponnani College (University of Calicut), Ponnani South, Malappuram District, Kerala – 679586,*
Corresponding author: shabnaebrahim@gmail.com

ABSTRACT

Located close to the hemispheric dichotomy, Lyot is the largest and the deepest impact crater with a diameter ~220 km, in the northern lowlands of Mars. The impact would have almost certainly penetrated the cryosphere, exposing the groundwater beneath it. Landforms shaped by glacial, periglacial, and fluvial processes suggest that Lyot and the surrounding area record the action of ancient, recent groundwater and atmospheric precipitation. Wind-dominated features are prevalent on mars and are evolving over time. Large impact into the icy terrain that might hold the secret of an ancient ocean resulted in glaciation and melting that carved fluvial channels ensuing wind deposits. The main objective of the study is to map the features like fluvial channels, distal ridges, glacial like forms, dune-forms of various types etc. within the impact crater and have used a preliminary morphological mapping approach. Our work combines a study with processed CTX (5-6 m/pixel, 30 km swath) and HRSC (~12.5-50 m/pixel, 52 km swath) images, supported by higher resolution HiRISE (25-30 cm/pixel, ~6 km swath). Aeolian features are studied for the wind behaviour and topography, whereas studies of fluvial, glacial, and periglacial structures are valuable for studying water on Mars throughout its history. The data presented here are potential avenues for future work.

Keywords: Mars, Lyot, CTX, Morphology

PETROGEOCHEMISTRY OF THE GNEISSIC ROCKS EXPOSED IN AND AROUND THANA, DISTRICT-BHILWARA RAJASTHAN

Harel Thomas[1*], Haritabh Rana[1], Aman Soni[1], Jyoti Bidolya[1], Rishabh Batri[1]

[1]*Dr. Harisingh Gour Vishwvidyalaya, Sagar*
Corresponding author: harelthomas@gmail.com

ABSTRACT

Medium to high grade metamorphic gneisses covers about one third of Thana, Rajasthan. These gneisses are classified into ortho and para gneiss based on their origin and field relations. Ortho-gneiss consist quartz-K-feldspar-plagioclase-biotite-hornblende and iron-oxide, while the paragneiss consist mainly of sillimanite-kyanite-garnet-biotite-K-feldspar-plagioclase-quartz. The SiO_2 and Al_2O_3 contents fluctuate between 45.2% to 68.28 wt% and 13.10% to 25.2% wt% respectively in the paragneiss, while in the case of ortho-gneiss the SiO_2 and Al_2O_3 content varies between 51.02% to 71.05 wt% and 12.60% to 21.74 wt% respectively. The geochemical signature reflects that Al-rich paragneiss is of S-type and peraluminous in nature and protolith for these Al-rich paragneiss are shale or greywacke, while ortho-gneiss is metaluminous in nature and similar to I-Type granite which is chemically similar to continental arc granitoids.

SERPENTINISATION AND ASSOCIATED CHRYSOTILE MINERALISATION IN VEMPALLE FORMATION CUDDAPAH BASIN: CONSTRAINTS FROM PETROGRAPHIC, GEOCHEMICAL AND STABLE ISOTOPE STUDIES

Megha Chandran P[1*]., Devika D.S[1]., M.S.Pandian[1]

[1]Dept.of Earth Sciences, Pondicherry University
Corresponding author: meghanair096@gmail.com

ABSTRACT

The mafic sills intruding into the dolostones in the uppermost part of the Vempalle formation have caused extensive metasomatism in the dolostones resulting in serpentinisation and hydrothermal chrysotile mineralisation in the Pulivendla asbestos belt. There are three different coloured varieties of serpentine developed successively away from the mafic sill-dolostone contact - the black, green, and yellow serpentine respectively. The serpentines are massive, and occur in the form of bands, irregular replacement patches and stylolite fills in dolostone. Metasomatic

magnetite and pyrite are also common in serpentinised dolostone. Metasomatism of dolostone was followed by extensive fracturing and hydrothermal fluid flow, when some of the early formed serpentines got dissolved in hydrothermal fluid and precipitated as chrysotile filling fractures and stylolites.

Major and trace element data indicate the formation of black serpentine with greater contribution from the mafic sill and that of dolostone in the formation of yellow and green serpentine. Variation in the concentration of transition elements and the chromophores possibly demonstrate the development of various colours in serpentine.

$\delta^{34}S_{VCDT}$ values of the metasomatic stage pyrite range from -3.56‰ to -1.88‰ pointing towards a magmatic origin. Serpentinised dolostone commonly shows depletion in $\delta^{13}C_{VPDB}$ and $\delta^{18}O_{VPDB}$ values respectively ranging from -1.43‰ to -0.76‰ and -18.01‰ to -17.06‰, compared to the unaltered dolostone ($\delta^{13}C$ 0.88‰ to 0.97‰ and $\delta^{18}O$ -7.11‰ to -7.10‰). The depletion in C-O isotope values in the serpentinised dolostone is inferred to be caused by their decarbonation and interaction with the mafic magma.

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