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UNIVERSITY OF KERALA
कर्मणि व्यज्यते प्रज्ञा

First National

Multi-disciplinary Annual Research Conference (MARC 2015)

CURRENT TRENDS IN EARTH AND ENVIRONMENTAL RESEARCH

17 DECEMBER 2015

SCHOOL OF EARTH SYSTEM SCIENCES
Department of Geology
&
Department of Environmental Sciences

ABSTRACT VOLUME

MARC 2015

MARC 2015

ABOUT MARC

The maiden MARC 2015 of the University of Kerala was blossomed at a time when this Mother University of Kerala was re-accredited with NAAC 'A' grade. Presently, the university has been bestowed with the first Chancellor's Trophy for the best university in the state. This conference is organized by the Internal Quality Assurance Cell (IQAC) and various Schools of the University of Kerala. The aim of this conference is to promote multi-disciplinary studies, which is the need of the hour, among different departments.

The first MARC of the School of Earth System Sciences will provide a platform for researchers to present their work before an audience of environmental scientists and geologists. This will be a perfect venue to get a glimpse of the vitality of research in these two closely related disciples and could probably lead to more collaborative and synergistic research. Environmental Science is an interdisciplinary science and covers various aspects of geo- and bio-sciences, while geology controls the natural processes that define life on the Earth. The natural environment includes the biosphere, hydrosphere, pedosphere, lithosphere and atmosphere. A multi-disciplinary approach is essential to gain momentum in geo-environmental research.

FROM THE DIRECTOR'S DESK

Each conference is a formal meeting of people with a shared interest. Multi-disciplinary Annual Research Conference (MARC, 2015) is such a gathering of faculty, students and researchers of the constituent departments of each School in the University of Kerala. This conference, which is a landmark in the history of our University, is the first major platform created for the students and researchers in the Departments of the University to present their findings to a larger and varied audience. Today it is felt that multi-disciplinary and inter-disciplinary research has wider acceptance and better utility for the society. The Earth System Sciences give plenty of opportunities for such research. Such studies will make this planet a better place to live. I am sure that the students will also get to know the nature of research going on in other departments of the university. This also gives an opportunity for students in bettering their organizational and leadership skills.

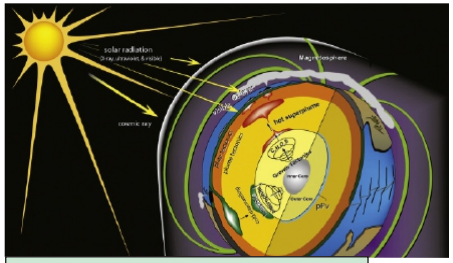
I wish MARC 2015- 'Current Trends in Earth and Environmental Research'- of the School of Earth System Sciences all success.

Dr. S.N. Kumar
Director, School of Earth System Sciences
University of Kerala

The Department of Geology and Department of Environmental Sciences, the constituent departments of the School of Earth System Sciences are organizing the Multi-disciplinary Annual Research Conference (MARC 2015) on the theme

CURRENT TRENDS IN EARTH AND ENVIRONMENTAL SCIENCE RESEARCH

17 December 2015 (10:00 to 17:00)
at
Department of Geology, University of Kerala
(Re-accredited with A-grade by NAAC) .



Interested in participating?
Send abstracts to one of the Organizing Secretaries

Dr AP Pradeepkumar
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geo.pradeep@gmail.com

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Mob: 9895 82 2161
jayvijayds@gmail.com

- Precambrian plate tectonics and its imprints in the Southern Granulite Terrain
- Environmental pollution, Environmental biochemistry, Environmental toxicology & Health
- Mineralization in the tectonic blocks of South India
- Environmental Microbiology, Microbial bio-geochemistry
- Groundwater scenario in Kerala: availability, pollution
- Hydrogeochemistry, Environmental geology
- GIS in land and water management
- Influence of climate, topography, vegetation and human impacts on various mass-energy cycles
- Mars: analogue studies and characterization
- Biogeochemistry of terrestrial and aquatic ecosystems
- Mega-volcanic eruptions and ash dispersal
- Environmental modelling
- Impact cratering in India: characterisation and mechanisms
- Participatory GIS and environmental planning
- Granites and pegmatite mineralization
- Critical zone research
- Shear zone kinematics

INVITED LECTURES

Prof. (Dr.) M. Santosh
'Plates, plumes and continental dynamics'
University of Adelaide, Australia &
School of Earth Sciences and Resources,
Beijing, China

Dr. R C Pandalai
'Silvicultural Options to Enhance Forest Plantation Biodiversity'
Kerala Forest Research Institute
Peechi, Thrissur

PhD GUEST TALK

Shan-Shan Li
School of Earth Sciences and Resources, China University of Geosciences Beijing, China
'Neoarchean subduction tectonics in the North China'

SCHEDULE

17.12.2015

9.30 am onwards	Registration
10.00 to 10.05 am	Prayer
10.05 to 10.10 am	Welcome Address ***Dr. Sajinkumar K.S.**, Assistant Professor* *Department of Geology, University of Kerala*
10.10 to 10.20 am	Presidential Address ***Dr. S.N. Kumar**, Director* *School of Earth System Sciences, University of Kerala*
10.20 to 10.25 am	Introducing Prof. (Dr.) M. Santosh ***Dr. Shaji E.**, Assistant Professor* *Department of Geology, University of Kerala*
10.25 to 11.15 am	Invited Lecture 1: **'Plates, Plumes and Continental Dynamics'** ***Prof. (Dr.) M. Santosh*** *Editor-in-Chief, Gondwana Research;* *Faculty, University of Adelaide, Australia &,* *China University of Geosciences, Beijing, China*
11.15 to 11.30 am	Tea break
11.30 to 11.35 am	Introducing Dr. R.C. Pandalai ***Dr. Jaya D.S.**, Associate Professor & Head* *Department of Environmental Sciences* *University of Kerala*
11.35 am to 12.30 pm	Invited Lecture 2*:* **'Silvicultural Options to Enhance Forest Plantation Biodiversity'** ***Dr. R.C. Pandalai*** *Scientist F, Kerala Forest Research Institute, Peechi*
12.30 to 1.30 pm	Lunch Break
1.30 to 4.55 pm	Technical Session *Chaired by* **1. Dr. V. Salom Gnana Thanga** *Associate Professor* *Department of Environmental Sciences* *University of Kerala* **2. Dr. Sajinkumar K.S.** *Assistant Professor, Department of Geology* *University of Kerala*
4.55 to 5.00 pm	*Vote of Thanks* ***Dr. Sabu Joseph**, Associate Professor* *Department of Environmental Sciences* *University of Kerala*

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ABSTRACT VOLUME

Hydro-geo-environment of Sasthamkotta Lake, Kerala

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Sasthamkotta Lake is one of the fresh water lakes in Kerala. The lake occupies 440 hectares and the catchment area of the lake is 1269 sq km. The main aquifer units in the study area are laterite and alluvium. The occurrence and movement of groundwater in laterite is mainly controlled by the topography. Laterite and sandstone form potential aquifers along the hills surrounding the lake and valleys and topographic lows. The groundwater from the wells flow towards the lake. As the water level lowers in the lake the groundwater level also declines. That is why there are many dry wells in the area. Depth to water map of the area has been prepared. It is observed that the dry wells are located in the southern part of the lake. Groundwater recharge from rainfall is not sufficient in those areas. North western part of the lake becomes marshy area; this indicates the shrinkage of lake. Eastern part of the lake has a bund which divides the lake water. The water level in the lake is gradually decreasing and the groundwater from the surrounding region reaches the lake. The lake itself has a base flow and water flows through the eastern side of the lake. Heavy soil erosion is also noticed in the area. A geospatial comparison of the lake between 2015 and 1988 was attempted. The area of the lake during 1988 was 3.6723 sq km. and presently it is reduced to 2.91759 sq km. That means around 0.7541 sq km area has been reclaimed/covered over the years.

Hydrochemistry of Karamana river, Kerala, with emphasis on nutrient status: a multivariate statistical approach

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Nutrient status studies of rivers and estuaries are important as they provide signatures relating to the influence of natural and man-made activities. The Karamana river basin – KRB, a small tropical river basin in Thiruvananthapuram district, Kerala, India, originates in the southern Western Ghats and flows SSW, and finally debouches into the Arabian sea. Towards the downstream end, a major tributary, Killiyar, carrying heavy load of pollutants from a number of non-point and point sources mainly from the Thiruvananthapuram city joins KRB. The river bank near Poonthura estuary is a major tourist zone.

This study was carried out during premonsoon (PRM) and monsoon (MON) of 2013 to assess the variability and sourcing of hydrochemical attributes and nutrients in the river. Water samples (24 nos) were collected, and a comprehensive study using 29 key variables demonstrates that water quality is better upstream than downstream. Cations like Ca, Mg, Cl and K are found to be high in the downstream. Na and total phosphorus (TP) are high in downstream during MON. The content of Na, TP and ammonia are lower in PRM than MON.

The attributes like EC, TDS, TH, Ca, Mg, Cl, alkalinity, NO_3, NO_2 exhibit an increasing trend from upstream to estuary. In the Piper diagram, majority of samples belongs to CaCl type during PRM and NaCl type during MON. The chloro-alkaline indices reveal base-exchange phenomenon during PRM and chloro-alkaline disequilibrium or cation–anion exchange during MON. Positive loadings of ammonia, nitrate, nitrite and TP along with Ca, Mg, Cl, K and salinity is observed in factor analysis. Further, SO_4 and IP (inorganic phosphorous) shows positive loading and is mainly from agriculture runoff. Another important factor is the HCO_3 and CO_3 factor. Based on correlation and factor analysis, sea water intrusion and marine spray plays a major role in the chemical composition of water in downstream region. The study helps understand the relationship between human activities and pollutant loads, and further helps in decision making .

INVITED LECTURE 1

Plates, plumes and continental dynamics

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2-School of Earth Sciences and Resources, China University of Geosciences Beijing, China
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Planet Earth was born dry before it was bombarded by hydrous meteorites from the outer asteroid belt, or water-bearing planetesimals around the Earth's orbit accreted to the planet. Water as the lubricant started the plate tectonic engine. By analogy with the primordial anorthositic crust on the Moon, and based on the common features shared by the Earth-Moon system at the birth stage, it is possible to envisage that the Hadean Earth might have been covered by anorthositic continents. The initiation of plate tectonics on Earth marked the destruction of the primordial crust through vigorous convection and their deep burial at the core-mantle boundary as 'lost continents', in contrast to Moon where the primordial continents were preserved due to the small size of the planet and absence of plate tectonic activity. Archean plate tectonics operated over a double-layered convecting mantle with a large number of small-sized lithospheric plates with multiple but short-lived subduction systems, as compared to the modern Earth with large but less number of lithospheric plates and long-lived subduction history. Tectonic erosion along convergent margins and destruction of continental crust resulted in the accumulation of radiogenic element enriched 'continental' detritus in the mantle transition zone. The preserved continental crust on the globe might be only a small fraction of the total volume that now lies buried in the two boundary layers of deep Earth, the mantle transition zone and the core-mantle boundary. Plumes rising from both these zones act as pipes for material transfer, and also serve as the forces that disrupt large continental masses, driving them to reassemble in various configurations through Earth history marking supercontinent tectonics. Continental dynamics is intrinsically linked with the core-mantle system and has potential implications and impact on surface processes and life evolution in our planet.

INVITED LECTURE 2

Silvicultural options to enhance forest plantation biodiversity

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Silviculture is the manipulation of forest structure and dynamics at the stand level with a specific intention of producing certain goods and services. In simpler terms, it is the art and science of cultivating forest crops. Silvicultural systems are guidelines which operate for regenerating, tending and harvesting of forest tree species/crops growing in forests/plantations. Productivity, thus depends on the judicious execution of these procedures with modifications, if needed.

Plantations are mainly established for the production of wood products such as timber, pulp and charcoal. In addition, plantations also serve as areas for carbon sequestration, erosion control, water regulation and biodiversity conservation. These ecosystem services through plantations has also been integrated in most of the community forestry programmes and it helps considerably in reducing pressure on natural forests. As the extend of natural forests declines, ecosystem goods and services provided by these plantations become more important as a substitute for services of natural forests.

Biodiversity can be defined as the variety of life on earth and the natural patterns it forms. It not only maintains the ecosystem functioning, but provides conditions to support diverse species of wild plants/animals and microorganisms. Forest plantations sustain and enhance biodiversity by providing the habitat or habitat components, enabling the corridor functions and connectivity and buffering the native ecosystems. The issue now is, knowing that the silvicultural measures/ interventions can enhance the biodiversity, even without substantial losses in timber production rates, how to go about doing this?

Evaluation of drinking and irrigational quality of groundwater resources of Nemom Block, Trivandrum, Kerala, India

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2-Department of Geology, University of Kerala, Trivandrum - 695 581, Kerala, India
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An attempt for the assessment of the suitability of water for domestic and agricultural needs has been carried out for the groundwater resources of Nemom block, Trivandrum district, Kerala. Groundwater is the major source for domestic and agricultural activity in this area. Groundwater samples were collected from 40 open wells during pre-monsoon season. Acidic nature of groundwater is the major quality problem encountered in the study area. The lateritised aquifers present in the study area is the prime reason for the acidic trend. The continuous interaction of the lateritic aquifer with the groundwater system is the reason for the lower pH values. Suitability of groundwater for irrigation was evaluated based on various indices like Sodium Percent, Sodium Adsorption Ratio and Residual Sodium Carbonate. Most of the groundwater samples are found to be suitable for agricultural purposes.

Discriminant Analysis using Principal Components for vegetation classification using remote sensing techniques – a study in Peppara Wildlife Sanctuary, South Kerala, India

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The Peppara Wildlife Sanctuary located on the Western slopes of the Western Ghats along the South East corner of Kerala is selected as the study area owing to its diversified wealth of floral characteristics, especially at the landscape level. The present study aims to develop a new function for deriving vegetation map of the study area based on a number of vegetation and terrain parameters. This endeavour also seeks to compare the accuracy of supervised and unsupervised vegetation classification from remote sensing images. Landsat ETM+ images (8 bands), SRTM filled, and finished DEM data were used for this study. Vegetation indices like SR, DVI, NDVI, SAVI, EVI, NDMI, NDWI, brightness, greenness, wetness and terrain parameters like slope, aspect, curvatures, solar illumination Index, distance to stream, potential solar insolation, radiations were used. Vegetation cover map was prepared using supervised classification. Indices were extracted corresponding to each vegetation type and statistical analysis involving Principal Component Analysis and Linear Discriminate Analysis were carried out to develop the discriminate functions, from which the principal predictive parameters were determined. The Statistical Data Analysis produced three significant discriminant functions which explains 99.9% of the information given by the original Principal Components. Scope of further study on generation of vegetation cover map from the PCA analysis exists which can be further checked for accuracy. In the context of the Kasturirangan Committee report on the Western Ghats (2013), the study area has special significance, as it falls under the ESA (Ecologically Sensitive Area) category in Kerala, as envisaged in the report. The results obtained from the study will prove to be immensely useful in both assessment and monitoring of the floral biodiversity in the area at the vegetation class level.

Neoarchean subduction tectonics in the North China Craton: evidence from Yishui complex

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Archean tectonic history of the North China Craton (NCC) involved complex processes of amalgamation of microcontinents along multiple subduction zones prior to the consolidation of the major crustal blocks and their assembly into unified cratonic architecture. Here we evaluate the granitoids, diabase, metabasalts, volcanic tuff, banded iron formations and quartzite from the Yishui Complex along the southern margin of the Jiaoliao microblock within the Eastern Block of the NCC. The geochemical features of the magmatic suite are calc-alkaline magmatism in a convergent margin setting consistent with IAB, MORB and OIB affinities showing typical of rocks formed in an arc-related subduction environment. Zircon $^{207}Pb/^{206}Pb$ ages of magmatic zircons show 2504±19 Ma for the volcanic tuff, 2581±21 Ma for the granitoid, 2501±19 Ma for the metavolcanics, 2537±38 Ma for the pyroxenite, and 2506±13 Ma for the diabase. Metamorphism is constrained from the 2451±18 Ma and 2466±23 Ma age groups in the metavolcanics and (meta) pyroxenites. Zircons from BIF show multiple population with the oldest showing a spot age of 2503 Ma, followed by a number of distinct groups of Paleoproterozoic zircons corresponding to later thermal events. The oldest population of magmatic zircons from the quartzite shows $^{207}Pb/^{206}Pb$ mean age of 2495±24 Ma. The dominantly positive εHf(t) values of the magmatic zircons from the Yishui suite are broadly consistent with a depleted mantle source with only minor input of crustal components. Their Hf crustal residence ages (T^{C}_{DM}) range from 2586 to 3181 Ma and Hf depleted mantle model ages (T_{DM}) are in the range of 2548-2927 Ma. The data indicate that magma production involved Meso- to Neoarchean juvenile sources within a continental arc setting. The continuity of a Neoarchean subduction system along the western and southern margins of the Jiaoliao microblock is traced, marking active subduction-accretion-collision during the Archean-Proterozoic transition.

Terrestrial biogeochemical cycles: understanding the complexity by the synergistic use of modeling, measurements and remote sensing at multiple scales

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The terrestrial biogeochemical processes are perhaps the most dynamic and complex component of the Earth's climate system. The fluxes of heat and mass at the biosphere-atmosphere interface are controlled by a variety of processes that are tightly interlinked and scale-dependant. To better understand these complexities, the synergistic use of process-based modeling, remote sensing and measurements at multiple scales is warranted. Also, within the models, hydrological, ecophysiological and biogeochemical processes should be tightly coupled to better understand the non-linear interactions and feedback mechanisms. In this spirit, a synthesis of the research activities conducted by the author during the past several years is presented.

First of all, process-intensive simulation of Carbon (C), Water (W) and Nitrogen (N) cycles in two distinct ecohydrological settings are presented using the STEPS model: [1] a pristine boreal landscape in Eastern Canada and, [2] a managed forest-crop landscape in SW France. Secondly, long-term modeling of C cycle under changes in climate, atmospheric chemistry and disturbances, at landscape (Quebec, Canada) and regional (Oregon, USA) scales are presented and some numerical experiments using the InTEC model are discussed.

In the remaining part of the presentation, some recent works done at the global-scale are discussed. The spatiotemporal trends in global vegetation dynamics and soil moisture are discussed using remotely sensed data (AVHRR and SMOS, respectively). A strategy for refining the global estimates of terrestrial gross primary productivity using remote sensing techniques is also briefly explained.

Rare Earth Element, C- and O-isotope signatures of carbonatite from Munnar, South India: evidence for hydrothermal recrystallization

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Carbonatites are igneous rock with more that 50% of modal CaO, usually associated with alkaline complexes and emplaced within continental rift environment. Carbonatite and alkaline intrusive complexes, as well as their weathering products, are the primary sources of REE. Munnar carbonatites occur in the Western Madurai Domain of the Southern Granuite Terrain. Based on major element chemistry most of the samples shows calcio-carbonatite character while one sample exhibits ferro-carbonatite nature. Major element chemistry also gives the indication of fluid-rock interaction which is substantiated by the close association of biotite and quartz. C and O isotope values gives evidence of hydrothermal recrystallisation, and interaction with a carbon dioxide rich fluids under a reducing condition. The source of this carbon dioxide is identified as metamorphic and the alteration associated with them can be correlated with the formation of incipient charnockites in the surrounding area. Stable isotope values are used to classify Munnar carbonatites in Indian context which also favours a hydrothermal alteration. REE plots shows weak negative Ce anomaly indicating an alteration favoured condition and the strongly negative Eu anomaly gives the indication of reducing environment during their crystallisation. The enriched LREE content throws light upon the low degree of partial melting during the carbonatite formation.

Variability of dissolved ionic carbon in Meenachil River, Kerala, India– a proxy for regional catchment dynamics

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The present study in Meenachil river (L= 78 km, A = 1272 km^2), Kerala comprises of seven stations from upstream to downstream for pre-monsoon (PRM), monsoon (MON) and post-monsoon (POM). Season-wise study shows that Ca^{2+}, SO_4^{2-} Na^+, K^+, Cl^-, DIC and DOC showed a similar trend in most stations i.e., PRM>POM>MON. Significant rise of DIC and DOC at station (S7) during POM and PRM could explicate changes ensued in adjacent Vembanad lake system, which was also evident from HCA dendrogram. The factor analysis result exhibit high F1 loading during PRM (Ca^{2+}, Na^+, K^+, Cl^- and DOC), MON (Na^+, K^+, Cl^- and DIC) and POM (Na^+, K^+, Cl^-, DIC and DOC) respectively. DIC/DOC ratio clearly represents the variability of carbon ions with respect to their catchment type viz., Forest, Plantation, and Agricultural land. These ratios also highlight the ingress of saline lake water in downstream stations during PRM and POM. Hence, this study highlights the imperative role of dissolved carbon in riverine studies and serves as a proxy for the changes occurring in the catchment areas associated with it.

Geochemistry and tectonic significance of meta-ultramafics of Wayanad, southern India

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In the Meenangadi-Pulpulli-Sulthan Bathery area of Wayanad, several meta-ultramafic rocks occur as rafts and enclaves within the gneisses. The meta-ultramafics include websterite, talc-tremolite schist, peridotite and serpentinite. This study reports several new exposures of metamorphosed websterite and phlogopite-bearing ultramafic rocks. The rocks are fine to medium grained and associated with TTGs and charnockites. Mineralogically the rocks are distinct with mineral assemblages of phlogopite, muscovite, talc, clinopyroxenes, orthopyroxenes, needle shaped amphiboles and spinel. Whole-rock chemical analyses of the meta-ultramafic rocks show SiO_2 (43–53 wt%) and MgO (20-27 wt%) contents. REE pattern of these rocks exhibits negative-slope with enrichment of LREE over HREE and indicates the remnants of metasomatised mantle and subduction related tectonism. Hydrous fluids/liquids might have enriched the LREE into the host rocks. The rocks show varying TiO_2/Zr ratios, suggesting that they do not have a common or related origin. The high loss-on-ignition (LOI: 0.9–6.0 wt%) indicates that the samples were subjected to considerable alteration by either sea-water or metamorphic fluids. These rocks show negative Eu anomaly, which is evidence of plagioclase fractionation during their formation. Negative Ce anomaly is seen in the REE plots of the serpentinites, talc-tremolite schist and phlogopite and muscovite bearing ultramafites. The negative Ce anomalies are produced by the subduction of pelagic sediments + Sea Water Altered Basalts (SWAB) into the mantle. These rocks preserve evidences of mantle metasomatism. These meta-ultramafic rocks in association with the granulite sequences provide important information on convergent margin processes, including subduction-accretion-collision tectonics.

Geospatial decision support system in environmental planning in Digital India

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Efficient environmental planning requires the integration of scattered information from diverse sources and public participation in the decision-making process. While active stakeholder participation is important for the success of decision making, various conventional methods such as meetings or workshops are not effective because of space–time constraints, reluctance of people to speak out in public etc. Consequently, there is a need for a P-GIS tool that greatly overcomes the problems associated with these methods.

This paper explores the possibility of using a Web-based spatial decision support tool that can be used by stakeholders and policy makers. Thus, the problems which have spatial dimension can be discussed over a map-based discussion forum. With a Web-based system, stakeholders can easily contribute to a discussion anonymously, which is an advantage for people who are shy or reluctant to speak out in public. In this paper, the author discusses the use of such a tool for the rural environmental sector. The author proposes to develop a Web-based participatory Geographic Information System (PGIS) tool called Geospatial FarmChat a simple, easy to understand, user-friendly map-based discussion tool. The GeospatialFarmChat, will explicitly link one's opinion with a georeferenced location. By using this tool, planners and other stakeholders can create individualized strategies and requirements, and then "discuss" these individual solutions within the context of a community-based management approach.

Groundwater chemistry of phreatic and deep hardrock aquifers of Trivandrum district

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Hydrochemistry of groundwater in phreatic and deeper hardrock aquifers of Trivandrum district has been studied. The samples have been collected from Vamanapuram, Neyyar and Karamana basins. Major rock types in the study area are khondalites and charnockites. Groundwater occurs in unconfined to semiconfined conditions in the weathered and fractured crystalline rocks. The maximum depth of wells in the phreatic aquifers is 20 m and in deeper aquifers the depth is greater than 30 m. The chemical analysis shows that the hydrochemistry of these two aquifers are slightly different. In general, the chemical constituents in dug well samples show higher concentration than that of bore well samples except in Amboori. ln Amboori the parameters like EC, TDS, salinity and magnesium are higher in bore well samples than that of the dug well samples. In most of the areas magnesium concentration in bore well water samples are more than that of the dug well water samples. Calcium concentration is more in the bore well water samples from the areas such as Parakkottukonam, Kovilloor and Amboori. Bicarbonate is more in the bore well samples from Parakkottukonam and Palayamkunnu and sulphate is more in the bore well samples of Amboori and Kovilloor. Carbonates are present in the bore well samples of locations Parakkottukonam and Vamanapuram and it is absent in the dug well samples. The groundwater chemistry in the area depends upon the weathering of rocks and the rock types present in the area. The chemical analysis indicates that all the parameters are within the limit in both dug well and bore well water samples. The increase in magnesium and calcium concentrations in the bore well samples indicates the hardness of water and this is due to the excess rock-water interaction in the bore wells.

Physio-biochemical characteristics of tomato plants cultivated in soils amended with fly ash

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Fly Ash (FA), a coal combustion residue, has been regarded as a problematic solid waste all over the world. Disposal of huge amount of fly ash from coal burning industries absorbs large amounts of water, energy and land area (in the form of ash ponds). Since energy demands are growing, various environmental, economic and social problems associated with the disposal of fly ash would continue to increase. Therefore, flyash management would remain a great concern of the century. For the present study, flyash was collected from Hindustan Newsprint Ltd., Kottayam. In this industry, the process of paper making uses raw materials including water, energy, chemicals and wood chips. Coal is used as the energy source in paper mills. This study was carried out to analyse the physio-biochemical characteristics of Lycopersicum esculentum (tomato plant) cultivated in soils amended with flyash and to assess the physico-chemical changes in the soil. In this experimental study, the flyash is amended in three different concentrations to the potting mixture and a control was also maintained without flyash. After 75 days, the mature plants were uprooted, and both the plant and soil characteristics were determined. From the study, it was found that flyash amended plants showed changes in morphological characteristics. The availability of nutrients (N, P, Na and K) was increased due to the addition of flyash. The activity of antioxidant enzymes in test plants showed higher value than that in control because of the stress induced by fly ash. The study also revealed the presence of heavy metals like lead and chromium in the test group plants. Flyash can be used as a potential nutrient supplement for degraded soil thereby solving the solid waste disposal problem to some extent. However, the bioaccumulation of toxic heavy metals and their critical levels for human health in plant parts should be investigated.

Petrology and tectonic significance of syenite from Kasaragod, Kerala

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A series of unmetamorphosed alkaline magmatic intrusions occur along the northern margin of the SGT. This paper reports the petrology, geochemistry and tectonics of syenites from Angadimogar and Mundithadikam, Kasaragod district. The rock is medium to coarse-grained and is composed of alkali feldspar, greenish amphiboles, and minor pyroxene together with plagioclase, biotite and opaque minerals. The syenite body shows many compositional variations in different parts of Angadimogar quarry and preserves many mafic magmatic enclaves (MME). The mafic enclaves are seen as boudins, lensoids and irregular fragments with sharp contacts with the syenite. The enclaves show either sharp contact with the host syenite or occur as partially digested relics typically resembling those resulting from mixing and mingling of felsic and mafic magmas. The MME is composed of hornblende and biotite, with relict pyroxenes. Syenite often shows foliation with the alignment of minerals like biotite and hornblende. Geochemistry of the rocks matches typical alkali syenites reported from other parts of the SGT. In terms of aluminum saturation index, the syenites straddle between the peralkaline and metaluminous fields. When plotted in the Y+Nb *vs* Rb discrimination diagram of Pearce et al. (1984), the alkali syenites straddle the VAG (volcanic-arc granites) and WPG (within plate granites) fields with most samples confined to the VAG field. The alkali syenite samples exhibit more fractionated nature with La/Yb in the range of 27–265, whereas the MME samples display less fractionation, showing near flat patterns and this supports magma mingling and mixing process. The geochronology (Santosh et al., 2014) data shows that the age of the syenite is in the range of 781.8±3.8 Ma to 798±3.6 Ma based on $^{206}Pb/^{238}U$ ages of the magmatic zircons. Since the syenite plutons fall in the WPG field (Pearce et al., 1984), coupled with their positive Nb anomalies, it is infererd that the magma was generated in an extensional (continental rift) setting.

Long-term trends in the vegetation dynamics over Kerala

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Spatio-temporal patterns of the vegetation in Kerala were analyzed using the GIMMS NDVI data for the 25 year period (1982–2006) at 8 km resolution. To understand the interannual trends in vegetation dynamics, the pixel-specific Area under the Annual NDVI Time-series (AANT) was computed and mapped. In order to explore the interannual seasonal trends, the Season-specific Areas under NDVI Trajectories were also calculated. From our observation, the Wayanad district showed a positive trend in plant growth. The seasonal analysis indicated that this increased greening in Wayanad occurs during the months between March and August. Among the different districts, Wayanad, Kannur, and Kasargod showed highest positive trend whereas Allapuzha and Kottayam showed negative trend throughout the year.

Gypsum of Rann of Kachchh, India and Mawrth Vallis, Mars: evidence for prevalence of an evaporative process

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Gypsum, one of the most common evaporate minerals, is the first to precipitate during the evaporation of brine or saline water. Formation of gypsum indicates the dry climatic condition that prevailed in an area. The presence of $(OH)^-$ in its structure gives a particular spectral signature in the Near Infra Red (NIR) region. The space explorations in the recent decades revealed that gypsum is not only a part of Earth but it is very common in terrestrial planets like Mars. The regions in Mars like North Polar Region, Meridiani Planum, Gale Crater and Mawrth Vallis show the signature of gypsum. Here we attempt a correlation between the gypsum associated with the Rann of Kachchh (23.8261° N, 68.7769° E) in western India and the one seen in Mawrth Vallis (22.6°N 16.5°W). Both the gypsum has same spectral signatures characterized by absorbance peak between 1900 and 2000 nm and reflectance peak around 1600 nm. The associated clay minerals in both the locations also show comparable spectral signatures. XRD and SEM-EDX analysis of Kachchh gypsum reveal that they do not have any elemental impurities suggesting a pure evaporative process of formation and not by any other processes like hydrothermal reactions.