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SECTION OF EARTH SYSTEM SCIENCES

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PART II
SECTION OF
EARTH SYSTEM SCIENCES

President: Prof. Atul Kumar Varma

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NEW PARADIGMS IN ORGANIC PETROLOGY REALMS FOR ENERGY DEVELOPMENT UNDER CLIMATE CHANGE FRAMEWORK

Atul Kumar Varma

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Abstract

The author presents development of organic matter in coal and shale under various geological settings resulting in changes in physical, chemical and technological properties. Here, author has assessed hydrocarbon generation potential of coal and shales. The micropore evolution is also exhibited through various degrees of coalification. it has been seen that igneous intrusive has played significant role in shaping of organic maturity and generating hydrocarbons for gas play analogs. The Rock Eval pyrolysis and TOC content exhibit that the larger obtained present day hydrogen index (HI or HI_{PD}) in coal samples with higher TOC results in negative value of conversion factor (*f*) which may be due to undercount of sub-microscopic reactive macerals, enhancement of inertinite reactivity, increase in reactivity of vitrinite as well as entrapment of expelled hydrocarbons in organic/mineral matrix. The FTIR analysis of heat-affected coal and shale samples indicates that heat supplied by intrusive causes disordering of kaolinite along with lowering of aliphatic peak which is an indication of expulsion of short chained hydrocarbons. The information regarding coal shaping quality including organo-petrographic constituents may be utilised for coal bed methane, shale gas, coal liquefaction, microstructural manoeuvring for coke making, carbon dioxide sequestration etc.

Keywords: Organic petrology, hydrocarbon generation, microstructural manoeuvring, CO_2 sequestration.

Introduction

Coal is a complex combustible sedimentary rock, composed largely of helophytic (±aquatic) plant debris and plant derivatives. Originally deposited primarily as peat, secondarily as mud, it transits to coal through physical and chemical processes brought about by compaction and heat with prolonged burial at depths of up to several kilometers and over periods of up to several hundred million years (O'Keefe et al., 2013).Coal is physically and chemically a heterogeneous copolymer which mainly consists of organic material made up of large, complex molecules containing mostly cross-linked aromatic ring structures plus varying amounts of inorganic and organically bound sulfur (<1 to 6%), nitrogen (<1 to 2%) and oxygen as structural components. Raw coal also contains moisture and solid particles of mineral matter (Vasireddy et al., 2010).Coal rank: The extent of diagenetic/metamorphic transformation in the macerals and minerals, reflecting the maximum temperature to which the coal has been exposed and the time it was held at that temperature and, to a lesser degree, the pressure regime through the latter time and temperature (O'Keefe et al., 2013).The geochemical process that transforms plant material into coal is called coalification and the degree of maturation of coal is termed as coal rank. This may be illustrated as below:

Peat – Lignite – Sub-bituminous – Bituminous – Semi-bituminous – Semi-anthracite – Anthracite – Meta- anthracite

Chemically, these transformations can be viewed as combinations of deoxygenation, dehydrogenation, aromatization and oligomerization (Vasireddy et al., 2010).

Organo-petrographic constituents

Lithotype: Physically distinct and mechanically separable megascopic bands of hard coals.4 types of lithotypes: Vitrain (brightest band), Clarain, Durain and Fusian (silky lustre and soils hand)

Maceral: Microscopic homogeneous organo-petrographic entities of coal and coal bearing rocks.

Maceral groups: Vitrinite, Liptinite and Inertinite

Vitrnite: Collotelinite, telinite, corpo-gelinite, gelinite, vitrodetrinite

Liptinite: Alginite, sporinite, resinite, cutinite, chlorophyllinite, suberinite,

exsudatinite, bituminite, liptodetrinite

Inertinite: Fusinite, semi-fusinite, macrinite, macrinite, funginite, secretinite, inertodetrinite

Microlithotype: Naturally occurring maceral or association of macerals or association of macerals and minerals with a minimum layer width of 50 µm such as vitrite, liptite, inertite, clarite, durite, vitrinertite, trimacerite, carbominerite, minerite.

Rank

Coal rank in tectonically undisturbed basin or in the basin devoid of any igneous intrusive bodies may increase in response to increasing geothermal gradient and burial or lithostatic pressure. Igneous intrusions like dolerite dykes, lamprophyre sills and dykes may enhance the coal rank in a local scale and bring about microstructural alterations. Intense tectonic activities like multiple thrusting episodes may also accelerate the physico-chemical modifications in the coal microstructure and thereby, may enhance the rank of the coal in the tectonically deformed terrains. Coal rank is a concept and is usually documented by mean random vitrinite reflectance (R_r; ISO 11760:2005) apart from other parameters like moisture content, volatile matter yield, fuel ratio etc. In the undisturbed basin, the mean random vitrinite reflectance measured under non-polarized light is the primary parameter to tell about the coal rank as the vitrinite grains do not develop prominent optical anisotropy. In the coal samples affected by igneous intrusions and the thrusting events the vitrinite grains develop optical anisotropy due to sudden exposure to high thermal and tectonic stress, respectively. In these samples, rank is preferably reported by maximum (R_{max}) and minimum (R_{min}) reflectance values under polarized light. In anthracite rank, the vitrinite reflectance anisotropy is reflected by an ellipsoid called 'Reflectance Indicating Surface (RIS)' .

Functional groups

The principal oxygen functional groups in bituminous coals are presented as phenolic or etheric groups with lesser amounts of carboxylic acids or esters along with carbonyls, while lignite and subbituminous coals contain carboxylic groups predominantly. Ionic bonds between the carboxylic groups and di and trivalent metals, in particular calcium, magnesium, and iron, are considered to contribute to the cross-linking in such low rank coals. Nitrogen and sulfur are mainly located in heterocyclic compounds. Organic sulfur in coal can occur as four basic types of structure: thiols, sulfides, disulfides and thiophenes. It was concluded that in low-rank coals there are significant amounts of aliphatic sulfur (dialkyl sulfides) and

that levels of aromatic sulfur (thiophenes and diaryl sulfides) increase directly as a function of increasing rank. Nitrogen in coals is originated mainly from the amides, amines, porphyrin groups, chlorophyll, proteins, amino acids and is mostly represented by the pyrrolic (N-5), pyridinic (N-6), cyclazine (N-Q1), pyridinic nitrogen linked with oxygen atom (N-Q2), and R = N–O–R (N-X) functionalities, where nitrogen atom is bonded to carbon (R) and one oxygen atom (Anwita et al., 2020; Boudou et al., 2008; Valentim et al., 2011). At the boundary between diagenesis and catagenesis, amides in peat convert into N-5 and N-6 due to thermal stress and consequent cyclization. Further, at the lignite phase, amide and amines convert to N-6 and N-Q1. Progressively, after the bituminous rank and anchizonal metamorphism, PAHs encapsulate the organic nitrogen released from the reactive N-5 and N-6 and enhance the abundance of the inert and thermochemically stable N-Q1. In this study, the bituminous coal samples (R_r = 0.67–1.11%) from the Jharia Basin, India, are researched through XPS and FTIR spectral techniques to furnish the relations between the nitrogen geochemistry, thermal maturity, and the rheology of organic matter. The XPS reveals the dominance of N-6 (398.8 eV) in all the coals, which marks the thermal maturity related to the Oil Window. At the Oil Window, the N-5 and N-Q1 groups become thermodynamically unstable, resulting in the cyclization of N-5, and deprotonation of N-Q1 (Valentim et al., 2011), which enhance the N-6 abundance. Besides, in N-5 (400.6 eV), the N atom replaces one C atom and is linked to one H atom in the plane of aromatic ring, which make the N-5 structure highly mobile and reactive (π-electron excessive heterocycle) to any substitution reactions. So, despite the N-6 dominance at the Oil Window, the N-5 imparts significant mobility in coal rheology at the bituminous rank. The presence of N-5 in these coals is supplemented by the 3330–3470 cm^{-1} wavenumber region of the FTIR spectra. Influence of the N-5 on coal rheological mobility is confirmed by its strong positive correlation (r = 0.87) with the Crucible swelling number (1 - 3), used to estimate the coking ability of coals (Sen et al., 2022). This strong correlation may further mark the N-5 moiety as the source of transferrable hydrogen, which plays crucial role in coal carbonization. During coal carbonization, depolymerization leads to homolytic cleavage of the aliphatic bridge bonds resulting in the formation of free radicals. which are required to be stabilized by the hydrogen transfer.

Microstructural characteristics

The interrelation between the Reflectance Indicating Surface (RIS) main axes, i.e., $R_{MAX} > R_{INT} > > R_{MIN}$, indicates the biaxial negative optical property of the vitrinite grains.

This is, further confirmed by the strong positive correlation between the Optical Sign Index (OSI) and RIS-style (R_{st}) parameters. This biaxial negative vitrinite maceral is the feature of the coals affected by folds and faults under high differential stress produced by intense tectonic activity. The acceleration of R_{MAX} with sharp decrease in R_{MIN} values had enhanced the bireflectance (B_w) values and may point towards the onset of pregraphitization phase. The higher values of heterogeneity coefficient (Ht) of the textural classes relative to heterogeneity coefficient calculated for textural classes containing>10% of total reflectance values (H10) may be indicative of a higher magnitude of heterogeneity existing in the microtexture of the samples.

Raman Spectroscopic Investigations

The lower intensity of D than the G band in the bituminous coal samples would suggest the burial transformations within their microstructure. Contrastingly, in the high rank A samples, the anchizonal metamorphism is manifested by smaller and thinner G band comparative to the D band. Further, the shift of the G band towards lower wavenumber coupled with its thinning in the anthracite A samples may suggest the increase in microstructural crystallinity towards the graphitic structure. The anchizonal metamorphism in the high rank A samples, perhaps, resulted in the marked disappearance of the surficial –OH stretching vibrations of weaker hydrogen bond energy, possibly, because of dehydroxylation. The polar functional groups were preferentially lost from the aromatic rings due to high thermal maturity and would have lowered the dipole moment and, consequently, limited the aromatic C=C stretching modes to absorb infrared spectra in the high rank A samples. On the other hand, the weakening of the hydrogen bonding in the anthracite A samples might have enhanced the frequency of C=O stretching vibrations of the ester group. Noteworthy, the combined effect of both phenomena would have raised the $C{=}O/C_{ar}$ ratio in the high rank A samples, which was hardly reported and hence, a crucial finding in this study in terms of coal metamorphism. Further, the thinning of C-C peak along with the lowering of C-O peak intensity with increase in coal rank may indicate improvement of the microstructural ordering in the anthracite A samples.

Impact of functional group chemistry on caking property

The regression analyses between the crucible swelling number (dependent variable) and the chain length, pyrrolic–NH and (Cofg/Car = A1650-1800/A1490-1620) parameters may indicate that the caking property intensifies with the increase in the aromatic pyrrolic–NH structures, but

declination in the chain length and oxygenated functional group concentration. With the increase in the aliphatic branching (shorter chain length) and consequent bridge bonds, the amounts of free radicals escalate due to the thermal homolytic rupture of these bonds. These free radicals are stabilized by the transferrable hydrogen sourced from the pyrrolic–NH group and other hydroaromatic moieties to form the metaplast. The formation of plastic mass and its fluidity are essential to build a good quality coke. Hence, the pyrrolic–NH moieties and the aliphatic branching may induce positive influences on the caking ability of the coals. On the other hand, lowering of oxygenated functional groups may lead to lessening of hydrogen scavenging and, therefore, augment the availability of transferrable hydrogen to stabilize the free radicals, which may in turn help to form the plastic mass and enhance its fluidity. Hence, these correlations lead to the proposition of new empirical equations that depict the compound influences of these functional groups on the caking ability of the coals. Further comprehensive studies from other sophisticated techniques may be conducted to delve deep into the integrated influences of various functional groups and their chemistry on caking behaviour of coals with a plausible objective of converting non-coking coals to coking coals economically.

Combustion

The inability to produce heat up to the desired level by many coal fired thermal power plants can mainly be due to the weak combustion of coal. To understand the role of petrographic characteristics in combustion behavior, inertinite rich feed coal and fly ashes were collected power plants in India. The technological characteristics, petrographic make up (maceral – and microlithotype composition) and vitrinite reflectance of the feed coals were studied in details. The variation in char types were identified in the various fly ashes. The chars from different feed coals were prepared under controlled laboratory conditions. The burn out level and the unburnt carbon amount in fly ash seem to be controlled by rank and inertinite content. The good correlation between the high-density chars and inertinite dominated microlithotype suggests that high-density chars are mainly derived from these related microlithotypes. The presence of a new type of char, named vitrosphere is reported. The fly ash with little unburnt carbon is predominantly comprised of plerospheres.

Gross Calorific Value may be considered as a primary rank parameter and a good parameter for evaluation of char. Lower Barakar Formation seams are marked by pronounced aromatic C-H stretch due to the presence of higher carbon content in these samples causing increase in rank relative to other samples. Geochemical indicators K_2O, CaO and

K_2O/CaO ratio differentiate the Lower Barakar and Upper Barakar Formation. Inertinite dominated microlithotypes is responsible for formation of various organopetrographic constituents of char. Silica to Alumina ratio (SiO_2/Al_2O_3) and silica ratio point towards the condition for formation of HDC (high density char) due to increase in viscosity. Increase in temperature of critical velocity is unfavourable for formation of HDC.

Coal Bed Methane and Shale Gas

The CBM generation takes place in three stages:

(i) Biochemical coalification

(ii) Physicochemical coalification

(iii) Post coalification

To generate base level data on Coal Bed Methane (CBM), GSI has started Gas desorption tests in some of the boreholes in selected coalfields. Field level desorption tests are being carried out for some selected coal seams at different depth level using temperature controlled canister. Desorption test is generally carried out by collection of coal/lignite core samples. Samples are to be collected as early as possible (within few minutes) after reaching the coal core sample at surface by wire line drilling.

Following equations were used to determine fraction of conversion:

$$HI_O = \frac{(\%\ \text{type I} \times 750)}{100} + \frac{(\%\ \text{type II} \times 450)}{100} + \frac{(\%\ \text{type III} \times 125)}{100} + \frac{(\%\ \text{type IV} \times 50)}{100}$$

$$f = 1 - \frac{HI_{PD}\{1200 - [HI_O/(1 - PI_O)]\}}{HI_O\{1200 - [HI_{PD}/(1 - PI_{PD})]\}}$$

$$TOC_O = \frac{83.33(HI_{PD})TOC_{PD}}{[HI_O\,(1-f)(83.33 - TOC_{PD}) + HI_{PD}(TOC_{PD})]}$$

TOC content and Rock Eval Pyrolysis data indicates that shales from Barakar Formation has very good to good hydrocarbon generation potential and can be the target formations for shale gas exploration. The shales of Barren Measures Formation may be a horizon of interest for shale gas exploration. Igneous intrusion of dykes and sills in the Formations occurring in and around the areas of Sitarampur and Kulti might have resulted in cooking of the shales, increasing their maturities.

Coal liquefaction

Inertinite-rich coal samples (inertinite content >30 vol%, mmf) of different ranks and belonging to different sedimentary facies were selected. The maceral group compositions, mean reflectance of vitrinite in oil (R^o_m,) and proximate analysis of coal samples were determined. For hydrogenation, the coal samples were crushed to ~0.1 mm. Anthracene oil was hydrogenated before being used as a solvent. The hydrogenated anthracene oil (HAO) was analysed .HA0 (1500 g) and 500 g of each coal sample were taken separately. Each coal sample was thoroughly mixed with part of the HA0 to form a coal-oil paste which was placed in a vessel and heated. The remainder of the HA0 was introduced. into a 4 litre agitated autoclave and heated to 450°C. The coal-oil paste was then introduced, without addition of any catalysts ; the pressure of hydrogen was maintained at 20 MPa and the duration of reaction for each coal sample was 60 min. The flow of hydrogen during the reaction was about 201 mini. At the end of the reaction the hydrogenated products were transferred to a cooled pressure receiver through the cooling system and then to a receiver without pressure. The amount of raw hydrogenated product (RHP) was determined. Solvent analysis of RHP was done in tetrahydrofuran (THF). The THF insoluble components (THF-I) were obtained by filtration and the amount of THF-I was determined. The scheme‴ of hydrogenation. The degree of conversion of organic constituents of coal, and the amount of THF-I were calculated.

Mean reflectance of vitroplast ($R^o_{m\ vtp}$) is an approximate indicator of undesirable MS which creates operating problems. This indicator may help in choosing raw material (coal) and in finding the optimal conditions for coal liquefaction, i.e. temperature, pressure, time, solvent (with good hydrogen donating capacity) and rapidity of stirring the mixture. Most of the MS is formed from vitroplasts. The course of formation seems to be: low reflecting vitroplast (asphaltene) →high reflecting vitroplast (preasphaltene) →mesophase → semicoke. The formation of MS seems to be inversely related to the formation of DOI.

Coke making

Medium-rank inertinite-rich coal samples were ccalculatedollected for study from limnic and paralic facies. The microlithotypes seem to control the content of the mosaic textures. It also appears that carbominerites favor the formation of pyrolytic carbons. The coke obtained from poorly pyrofusinitized, homogeneous, limnic coal has higher mechanical strength with larger and thicker cell walls, and is les's porous than those derived from highly pyrofusinitized, heterogenous paralic ones. The

microstructure of the cokes appears to be controlled by different amounts of fibers and coarse mosaics.

PCR = (RtA) /(RnVM) where, PCR = petrographical caking ratio; *R,* is the content of reactive microlithotypes, which includes vitrite, clarite, vitrinerite, duroclarite, vitrinertoliptite and other trimacerite; *A* is the ash yield

Carbon Nanomaterial

CNTs and CNBs are synthesized through MCL (molten caustic leaching) method from coal samples belonging to Ib valley Basin,Odisha, India. HRTEM (High-Resolution Transmitted Electron Microscopy), FTIR (Fourier Transform Infrared) spectroscopy and XRD (X-ray Diffraction) analyses appraised the presence of carbon nano-particles with varied sizes in the MCL products. The nanoballs are in the range of 52-64 nm and the nanotubes are within the range of 7-15 nm in diameter. The petrographic parameters viz. various macerals and rank, as well as a measure of aliphatic bonds, have a significant impact on the amount of yield, purity, and quality of CNTs/CNBs.

CO_2 Sequestration

The amount of CO_2 has increased many times in recent years. The geological storage of CO_2 is a very important option to mitigate CO_2 emissions particularly developing countries like India which targets for very high economic growth rate depending on fossil fuels for the next several decades. These require providing assurance of long-term storage security and establishing standardized site guidelines for policy makers, regulators and industry. This may be accomplished by conservation and improved efficiency of energy generating systems, as well as by the recovery of industrial CO_2 and its sequestration in geological formations and oceans. The Geological Storage of CO_2 (GS- CO_2)—a final step of the Capture and Sequestration of Carbon is certainly the technological option most widely considered for an application at the industrial level in the nearby future, *i.e.*, during at least a couple of decades. The depleted oil and gas fields, saline aquifers and unmineable coal seams are taken into consideration by various countries but the location of sedimentary formations is still a virgin and significant site for CO_2 storage. Here authors want to investigate about the merits and demerits of mitigation of CO_2 from atmosphere. Sedimentary rocks like sandstone, shale, coal and clay because of their petro-physical properties like porosity in sandstones, micro-pore, cleat, and fractures in coal and clay sheet structure are important sedimentary rocks/formations are evaluated for carbon dioxide storage. Sedimentary rocks include mainly sandstone, shale and coal.

Sedimentary rocks are classified into three groups. These groups are clastic, chemical precipitate and biochemical (or biogenic).

Conclusions

The organo-petrographic constituents provide key role in various aspects of coal conversion. It may be significant for geological capture and storage of carbon dioxide.

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II
ABSTRACTS OF
PLATINUM JUBILEE LECTURES

INTEGRATING STRUCTURAL GEOMETRY OF ROCK MASS, GEO-MECHANICAL SLOPE CLASSIFICATION AND PROPERTIES OF CLAYS TO PREDICT HILLY LANDSLIDES: A NOVEL APPROACH TO TRANSPORT DESIGN IN HILLY AREAS

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Abstract

Highways in hilly areas are frequently prone to disastrous landslides and slope failures that create loss of life and properties of national importance. Structural geometry of the rock mass associated with highway slopes indicate geometric relationships of orientations of planes and lines of structural elements for example, faults, joints, bedding or compositional surfaces, axial planar cleavages, shear zones with mylonitic foliations, mineral and stretching lineations, etc. in relation to slope orientation and slope height that are favorable for slope failures. Kinematic analysis of these planes characterizes the intact slopes in the above locations to possess conditions of planar, wedge, toppling and circular modes of failure, either single or in combinations. Rock microstructural study in oriented thin sections in foliated rocks frequently reveals the development of strong preferred dimensional orientation of phyllosilicates, quartz, calcite and other mineral grains to define a penetrative foliation that evidently serves as avenues of groundwater percolation and seepage and therefore indicate the potential of failure along water-soaked foliation planes that 'day-light' on the road-cut slopes.

Geo-mechanical classification of slopes uses slope mass rating as a weighted rating system of several parameters that represent different conditions of the rock and the discontinuities associated with a Highway slope cut. These parameters are: (1) Unconfined Compressive Strength of intact rock, (2) Rock Quality Designation, (3) spacing between discontinuities, (4) condition of discontinuities, (5) groundwater, (6) slope height, (7) adjustment factors depending upon parallelism of strike of discontinuity or penetrative planes and strike of slope, dip of joints or plunge of line of intersection of two intersecting planes, dip of slopes and method of excavation of slopes. Slope Mass rating is a strong indicator of probability of slope failure in highway cut sections. Geo-mechanical classification of a slope is the categorization of slopes based on its degree of stability.

Important physical properties of clays that exert a strong control on the modes of slope failures in landslides, are the Liquid limit, Plasticity index, Shear strength parameters (Cohesive strength, Friction angle), void ratio, effective porosity, water content, specific gravity and saturated unit weight. Clay sensitivity, mineral Chemistry, Physico-mechanical properties and mineralogy of clays are inter-related and can be a significant contributing factor in landslides along road sections during heavy rainfall. Therefore, clays need to be documented, studied and analyzed, in detail, in slopes overlooking highways.

Integration of structural geometry of rock masses, geo-mechanical classification of slopes, and clay properties can lead to development of hazard zonation indices that will help to design highways in hilly areas with various methods of protection and mitigation measures.

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III
ABSTRACTS

01

PARAGENESIS OF TREMOLITE IN THE DOLOMITIC MARBLE OF BICHUA FORMATION, SAUSAR GROUP, CENTRAL INDIA

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Abstract

The dolomitic marble of Koradi belonging to Bichua Formation hosts tremolite as a mineral qualifier. The mineral study was restricted to general geology and was not previously studied in details. Therefore, the present study is based on the characterization, chemical analyses and paragenesis of tremolite amphibole occurring within the dolomitic marble in and around Koradi - Mahadula areas. From the characterization study, it was known that a mineral is stout-prismatic, radiating white needle shaped. Chemical analysis study stated that the mineral belongs to the tremolite amphibole with higher silica and magnesia content. By the use of empirical methods ~0.35 Kbar or ~35 MPa pressure; 610℃ temperature and = -15 MPa oxygen fugacity was estimated for the formation of the mineral in Koradi area. Moreover, tremolite is formed due to regional dynamo-thermal metamorphism of siliceous limestone, or infiltration of silica-rich aqueous fluid through dolomitic marble, with or without involving magnesite; although involvement of serpentine (talc-chlorite analogue) is demonstrable at Koradi.

Keywords : Dolomitic marble, Amphibole, Tremolite, dynamo-thermal metamorphism, Koradi

02

MINERAL CHEMISTRY AND GEOTHERMOBAROMETRY OF THE CHLORITE OCCURRING IN THE DOLOMITIC MARBLE OF KOLAR RIVER SECTION, KORADI AREA, NAGPUR DISTRICT, MAHARASHTRA

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Abstract

The dolomitic marbles belonging to Bichua Formation of the Mesoproterozoic Sausar Group of rocks in Centra India, have been exposed in the Koradi area, Nagpur district of Maharashtra. The dolomitic marble hosts patches of well-developed and aesthetically attractive aggregates of green colored mica. Some attention has been paid to the minerals and their host rocks of the Koradi and adjoining areas in the recent past; however, the green-mica was not studied in any details. Several varieties of green micas are available, most common among those are dioctahedral micas, such as, chromian muscovite (fuchsite; K(Al,Cr)3Si3O10(OH)2), Roscoelite (K(V3+,Al)2(AlSi3O10)(OH)2), or chlorites such as clinochlore (Mg5Al(AlSi3O10)(OH)8). During the present study, the mineral chemistry of the green mica was carried out using electron probe microanalyzer. The chemical analysis showed that the green micaceous mineral is the clinochlore variety of chlorites having high magnesian, and very low Fe# ~ 0.05. Several empirical methods were used for estimating the temperature and pressure of the chlorites, which indicated a temperature of 283°C for the formation of Koradi chlorites. These chlorites do not show significant FeMg-1 (FM) substitution, although there is some Tschermakite (TK) and dioctahedral (AM) substitutions present. It is inferred that the Koradi marbles were formed due to green-schist facies metamorphism of the impure dolomite or dolomitic limestone.

Keywords: Chlorite, Geothermometer, Dolomitic marble

03

FIBER OPTICS SENSORS APPLICATIONS IN GEOSCIENCE

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Abstract

Distributed Fibre Sensing (DFS) includes Distributed Acoustic Sensing (DAS) Distributed Vibration Sensing (DVS) seismometer, distributed stain sensor DSS and Distributed Temperature Sensing (DTS). DFS using fibre-optic cables, in the wellbore, DAS for the measurement of ground motion in a land surface seismic environment using trenched horizontal fibre-optic cables. The use of DFS in the downhole environment is an established technology particularly for VSPs Vertical seismic profiling and temperature measurements. The sensing probe of the fiber Bragg grating geophone is made up of Fiber Bragg Gating (FBG). The information which it collects is embodied in wavelength. The modulation- demodulation is accomplished by FBG geophone directly. Compared with traditional geophone, there are many advantages, such as higher resolution, wider bandwidth, higher accuracy and better immunity to electromagnetic interference, which meet the new needs in the seism probing field. The coupled mode equations are built by means of expanding perfect wave-guide modes, the relationships between the reflective spectrum characteristics of fiber Bragg gratings and their structural parameters (grating length, coupled coefficient) are obtained. The temperature, strain and pressure sensing mechanisms of fiber Bragg gratings are studied systematically. A high sensitive Fiber Bragg Grating(FBG) geophone/optical sensor is employed for seismic exploration and hydrocarbon production. Real Time Fiber Optic Casing Imager (RTCI) provides a three- dimensional image of the casing or sand control screens as they are stressed during production by shifting formations such as salt or unconsolidated sandstones. Distributed optical fiber temperature sensors adopting optical fiber scattering theory can overcome the shortcomings of traditional point electronic sensors that cannot work in environments of high temperature, high pressure, corrosion, strong geomagnetic disturbances, etc. Monitoring temperature data obtained by the distributed optical fiber temperature sensing monitoring system is inevitably adulterated with noise, thus affecting the accuracy of monitoring data. DTS signal is so weak that the signal is very difficult to be detected. The noise level in the acquired signal is very high, and the temperature error is not little. A wavelet transform is employed to decrease

the temperature error by signal denoising. A high sensitive Fiber Bragg Grating(FBG) geophone/optical sensor is employed for seismic exploration and hydrocarbon production. Fiber Bragg Grating Peak Wavelength Detection is done by Wavelet Analysis, discrete wavelet transform (DWT) for the demodulation, demultiplexing and denoising of sensor data, as well as in the detection, extraction and interpretation of measurand-induced change from an acquired sensor signal. Singular value decomposition SVD is used for FOS data analysis. Large data set terabyte data analysis is done by machine learning, deep learning, statistical learning. Artificial Neural Network ANN- time series data analysis-Recurrent Neural Network (RNN), CNN Convolutional Neural Network(images),DNN Deep Neural Network, ResNet Residual Neural Network, unsupervised and supervised machine learning, deeplearning, reinforcement learning for seismic imaging and inversion, seismic attributes ,seismic interpretation, reservoir characterization, geosciences data analytics, bigdata analytics,data assimilation modelling and simulation, etc. Physics Informed Neural Network PINN, greybox model [whitebox-physics, blackbox-data, black+white= grey], Graph Neural Network GNN machine learning for subsurface imaging and interpretation. FOS data full waveform inversion of seismic data, curvelet seismic wavefield for lithosphere subsurface imaging.

Keywords: fiber optics sensor, DAS, DTS, FBG, Data analysis, machine learning

04

TRI-HYBRID ELECTRICITY GENERATION METHOD FOR EV CHARGING STATION BY USING MFC, SOLAR AND WIND ENERGY

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Abstract

This paper reviews Microbial Fuel cell, Solar & Wind energy. First objective is to discuss microbial fuel cell. Second objective is to put forth various experiments done by me in generating electricity through microbial fuel cell. Till now majority of Microbial Fuel cell are using graphite as anode and cathode separated by Proton exchange membrane. I have used Graphite and Magnesium as electrodes for generating electricity in single chamber without any membrane. This MFC can be used for various applications. Also a new concept of generating electricity with solar panels and using the area beneath it for generating energy with MFCs, while at the same time a small wind turbine while be used as a third hybrid electricity generating partner. This technology can revolutionize the current energy production method. Also the reason behind bringing this technology into light is to show that it is green, free, hazard free, flexible, compact and unending availability. One can generate electricity at home for own consumption. This generated energy is going to be utilize for charging of Electrical vehicles at different places.

Microbial cell is a very easy and simple method to get energy from soil. This battery generates voltage of 1.5 to 1.8 volts. It is totally green and renewable. This energy can be used to turn on led lights, buzzers, calculators, digital watches etc. Tomorrow we may see this energy being used in many Gadgets (as energy requirement for electronics devices getting reduced day by day).

This paper is a result of 7 years of research and development, trial and error and infinite ideas.

Keywords: Microbial fuel cell, Renewable energy, Free energy, perpetual energy, non-conventional energy, EVCS Electrical Vehicle Charging Station

05

THE PALACE OF GEOGRAPHICAL IMPORTANCE "JHUNJHUNWA HILLS" LOCATED AT PAWAI VILLAGE AURANGABAD DISTRICT IN BIHAR WITH A SPECIFIC ROCK METALIC TONE

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Abstract

The Pawai hills rock with on earth surface near punpun river. Iti hills a natural landform that extends. Above the surrounding terrain, It is less than 984 to 1968 feet and less step so comparatively of mountain easier to climbs. There are several reasons that triggers the occurrence of a hill some of the reason include. Falting (constant movement of rocks beneath the earth surface) Melting and shifting of glaciers Land erosion. Deposits of varied minerds The India under Bihar state Pawai hills as less than 1000" However the general features of this hills are Having a rounded summit or a not well defined submit with reals metalic sound. Having a low altitude and elevation usually less than 984 – 1968 feet (300 – 600 meters) Hence earth geography is a landmarks with numerous variation due to varied geography phenomena. Pawai hills stones produced eco sound like metalic sound to any small stones throw on rock by any person.

Keywords : Metalic sound, Geographical, Terrain, Occurrence, land mark, rock.

06

Importance of Spatial Autocorrelation in Geospatial Analysis, Modeling, and Mapping of Geophysical Variables

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Abstract

One of the most commonly encountered properties of many geophysical variables, often overlooked or assumed as trivial in the geospatial analysis, is spatial autocorrelation. The presence of systematic spatial variation in a variable with distance or direction, known as spatial autocorrelation, is often in a concealed state or unheeded by geoscientists in generating statistics, modeling, or mapping. In a variety of fields, including hydrogeology, mineral deposit modeling, mining, geochemical analysis, and meteorological and climate studies, the function and significance of spatial auto-correlation in geospatial mapping will be highlighted. A Variable's geospatial modeling must incorporate spatial autocorrelation property for accurate estimates and projections.

Keywords: Spatial autocorrelation, geospatial analysis, modeling, environmental impact analysis (EIA)

07

TITLE : GEOSTATISTICS IN MINERAL EXPLORATION

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Abstract

Geostatistics aims at providing quantitative descriptions of regionalized variables distributed in space or in time and space. Over the years, the subject of geostatistics has progressed from linear, nonlinear, non-parametric, conditional simulation, multi-point to machine learning. From 1960 to the present, two key issues that influenced the progress of geostatistics in mineral exploration includes clarification and dissemination of geostatistical concepts and theories to the practitioners; and identification and definition of unsolved problems in evolving geo-mathematical modelling techniques. It may be emphasized that deposit geology suitably integrated with appropriate geostatistical procedure provides an improved understanding of the mineralization type and specifics.

Keywords: Regionalised variable, Semi-variogram, Kriging, Exploration

08

ENSURING THE SUPPLY CHAIN OF NUCLEAR FUEL MINERALS AND CRITICAL ELEMENTS FOR ACHIEVING NET ZERO BY 2070 – THE INDIAN PERSPECTIVE

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Abstract

At the 26th UN Climate Change Conference (COP26) in Glasgow, the first two elements of the '*Panchamrit*' pledged by India as its contribution to climate action, relate to the energy sector i.e. to reach 500 GW of non – fossil energy capacity and meet fifty percent of its energy requirements from renewable energy by 2030. These are crucial factors to attain the fifth element – Net Zero by 2070. Expansion of nuclear energy capacity along with enhanced production of critical elements (Li, REE, Sc, Y, Nb, Ta, Si, Al, Cu, Cr, Co, Ni, Mo, V, Ti, Pb, Zn, Ag, In, etc.), which are essential for clean and green energy technologies, will play a key role in achieving these targets. Although India has adequate resources of nuclear fuel minerals (U and Th), considering the three-stage Nuclear Power Programme (NPP), increased production of nuclear fuel and construction of nuclear power plants in fleet mode is the need of the hour. On the other hand, while some of the critical elements may have to be acquired through foreign assets, the country must focus on building a resilient supply chain from available indigenous resources as well as developing the value chain industry. The Indian community of Earth Scientists, especially Economic Geologists, have the challenging task in defining the way forward for these key endeavours.

Keywords: Renewable, Nuclear, Fuel mineral, Critical elements, Energy.

09

AN INTEGRATED INVESTIGATION FOR NEOTECTONIC RELATIONSHIP BETWEEN CHAMBAL-MAHI BELT (CMB) AND NARMADA RIFT SYSTEM (NRS)

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Abstract

The Chambal-Mahi Belt (CMB) is a significant zone between the Himalayan Thrust System (HTS) and the Narmada Rift System (NRS). Even a cursory look on the satellite image reveals that the Chambal and Mahi Rivers follow lines of predefined weakness which in general, can be traced all along the course of these rivers. All three, the HTS, NRS and CMB indicate recent tectonic activities.

While movement of Indian plate is exerting northward compression in HTS, differential crustal movements (?) has generated several N-S trending lineaments between HTS and NRS. These N–S trending lineaments are distinctly observed over the rocks exposed between CMB and NRS (Deccan Basalts, Vindhyan rocks, older basement rocks etc). The area between NRS and CMB has a general northward ground slope (north flowing rivers with distinct neotectonic signatures) and, represents a zone of transition from compressional regime (the Aravalli thrust system) to extensional regime (the Narmada rift system). The two contrasting tectonic regimes are expected to exchange accumulated stress through the fracture systems developed in between. Since the result of movement of Indian plate is more as horizontal tectonics than the vertical tectonics, neotectonic manifestations of ongoing plate movement (vis-à-vis horizontal tectonics) are very much expected at surface/shallow surface level. Thus, measurement and monitoring of rock strain at surface/shallow surface level is expected to provide good quantum of information over the horizontal tectonics prevalent in the area.

A detailed morphometric and morphotectonic study is in progress using extracted digital elevation data including computation of various parameters indicating active tectonics in the area.

Traditional measurement of rock strain needs strain markers (viz. deformed pebbles, fossils, reduction spots etc.) which are rather uncommon in igneous and undeformed/less deformed sedimentary rocks. The Anisotropy of Magnetic Susceptibility (AMS) provides a good

approximation of rock strain in almost all rocks even with very low magnetic susceptibility. The Deccan Basalts and undeformed Vindhyan sedimentary rocks occupy the major part of the proposed area of investigation. Looking into the usefulness of the AMS technique in measurement and monitoring of rock strain in the identified area, an integrated study is being carried out in the identified geological terrain.

Keywords: Himalayan Thrust Systems, Chambal-Mahi Belt, Narmada Rift System, Active Tectonics

10

PAST CLIMATE CHANGES: GLEANING CLUES BEYOND INSTRUMENTAL AGE

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Abstract

Understanding past climate helps us to explain how current ecosystems came to be. For example, climate typically controls what types of vegetation grow in a particular area. Furthermore, paleoclimatology provides data that we can use to model and predict both current and future climate change scenarios. These proxy data are preserved physical characteristics of the environment that can stand in for direct measurements. Paleoclimatologists gather proxy data from natural recorders of climate variability such as corals, pollen, ice cores, tree rings, caves, pack rat middens, ocean and lake sediments, and historical data.

Paleoclimate proxy records are sources of data that tell us about past climates. They are especially useful in helping us to learn about climate during periods prior to human records. By analyzing records taken from these and other proxy sources, we can extend our understanding of climate far beyond the 140-year instrumental record. Historical Data: Historical documents also contain a treasure of information about the climates of the past. Various aspects of these proxies shall be detailed in this paper.

11

CLIMATE CHANGE ADAPTATIONS AND CAPACITY BUILDING FOR SUSTAINABLE LIVELIHOOD IN HIGH ALTITUDE COLD DESERT OF LEH- LADAKH, INDIA

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Abstract

Climate Change adaptation in a high altitudinal zone of the Himalaya is a need of the hour as the change in precipitation and temperature patterns is influencing the local life. Leh district is one of the most fragile and remote area in south Asia. Communities living here have adapted to the local conditions for many centuries but recent years have witnessed the changing climate and climate paradigms in the region. Here the human habitat is totally depended on glacial meltwater. High Range of temperature and climatic variability are affecting the precipitation pattern and glaciers-cover, which are generating the disastrous situation to survival in Leh-Ladakh region. The aim of this study is to observe the spatio-temporal trends of climate change and to assess the indigenously adopted adjustment methods and government initiatives against it, which will be helpful in inclusive development programs for mountain communities in Leh-Ladakh region. In this study, it has been found that the changing nature of the climate is affecting the local lifestyle and livelihood. The major source of livelihood has been agriculture, horticulture and animal rearing but in present days the changing paradigm of climate has brought in a difficult challenge of water scarcity. Due to this significant alteration, snowfall is decreasing and the rate of snow melting is increasing consistently. It has also been found that the seasonal availability of water is a very important aspect of daily life in this region. Therefore, local and government initiatives are particularly needed in terms of conservation and judicious use of water resources.

Keywords: Climate Change Adaptation; High altitude Cold Desert; Melting Glaciers; Sustainable Mountain livelihood; Mountain Communities; Capacity Building Policy

12

GEOLOGICAL AND GEOTECHNICAL STUDIES OF NUNGKAO LANDSLIDE ALONG IMPHAL-JIRIBAM NATIONAL HIGHWAY, NH-37, MANIPUR, INDIA

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Abstract

Slope collapses on a mountainous stretch of the National Highway are a serious concern because they hinder traffic. Human involvement in the form of large-scale excavation of the natural slope for expansion of the existing National Highway has significantly altered the slope mass's predisposing properties. Using rock mass characterizations and uniaxial compression strength tests, this research examines the rock mass's current geotechnical state and the types and locations of potential failures. In terms of slope mass rating (SMR), the portion is classified as "partially stable". Nungkao Landslide is unstable, according to kinematic study as well as field observations. Wedge collapses are prevalent. Factor of safety for rock under wedge failure mode has indicated stable condition. Preventive measures have been suggested to improve slope stability.

Keywords: Slope mass rating (SMR), Kinematic analysis, Uniaxial compressive strength (UCS), Factor of safety, Nungkao.

13

GEOCHEMICAL DISTRIBUTION AND FORMS OF PHOSPHORUS IN THE SURFACE SEDIMENT OF NETRAVATHI-GURUPUR ESTUARY, SOUTHWESTERN COAST OF INDIA

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Abstract

Phosphorus (P) plays an important role in coastal estuarine ecosystem and thus understanding its geochemical forms is crucial for coastal eutrophication management. Sequential extraction procedure was used to evaluate the geochemical forms of P (calcium bound, iron bound, aluminium bound, exchangeable and organic) in the sediment of Netravathi-Gurupur estuary, southwestern coast of India. Total P content varied from 258-810 mg/kg. Inorganic-P was the dominant P form [upto 87% of Total P] in the system with prevalence of iron bound-P indicating anthropogenic stress. However, average phosphorus pollution index were lower than one depicting insignificant eutrophication risk regarding sedimentary TP load.

Keywords: Netravathi-Gurupur estuary; Surface sediment; Phosphorus fractions; Bio-availability; Ecological impact

14

NOVEL APPROACH TO GARNET CHEMISTRY STUDIES IN BEACH SANDS AND ROCKS OF NORTHEASTERN ANDHRA PRADESH, EAST COAST OF INDIA

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Abstract

The garnet mineral chemistry of beach sands and other lithologic is a significant tool in sedimentary provenance studies, although it is unclear which garnet type comes from which host lithology. The majority (83%) of garnets, which have molecular compositions of almandine (Alm. 50–59%), pyrope (Py. 33–43%), and less grossular (Gr. 5%), are made from the khondalite suite of rocks, which has a large area of exposure and is suspectible to physical weathering and the small (17%) number of garnets with almandine (Alm.59-63%), pyrope (30%), and grossular (Gr. >5%) molecular proportions is formed by the charnockite suite of rocks, which has a lower drainage basis and is not susceptible to mechanical weathering. The presence of LREE rather than actinides (Th+U) in garnet-bearing paragenesis rocks such as charnockites and metapelitic rock (khondalite) in the studied area indicates provenance. the garnets 67% analyzed samples fall in the field of Type-A, 11% are fall in each Type-B , Type-Bi and Type-Ci, the trilinear diagram indicate that majority of garnets derived from high grade granulite facies metasediments or charnockite and intermediate felsic igneous rocks. Garnets were generated from magma/anatectic melt with significant oxygen fugacity, based on REE fractionation patterns and positive europium anomalies. The garnet populations in beach sands and other litho strata from northern Andhra Pradesh, southern India, are virtually entirely made up of high-almandine pyrope, low-grossular garnets, according to this article. These are generated from the area's basement, which is made up of high-grade (granulite facies) metasedimentary and charnockitic rock.

Keywords: EPMA,Garnet, Provenance, Almandine, Khondalite and Charnockite

15

ASSESSMENT OF CO_2 MINERALIZATION PROCESS IN COAL AND ASSOCIATED ROCK WITH IMPLICATION TO ECBM/ESGR IN INDIA

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Abstract

The paper assesses the CO_2 injection process kinetics and its mineralization in coal/shale beds for enhanced recovery of methane from the Gondwana and Tertiary basins in India. Discussed several issues, e.g., shrinkage, swelling, reduction in permeability and porosity, and mineralization of injected CO_2 with associated rocks. CO_2 has 2 to 3 times more adsorption affinity with coal/shale beds compared to methane and helps to produce gas upto 90%. Also, the continuous emission of CO_2 from coal combustion to generate power is a major contributor to global warming and climate change. Therefore, capturing CO_2, utilization, and storage (CCUS) in geologic formations has emerged as strategic importance in geopolitics.

Keywords: Coal and shale, CO_2 injection, storage, ECBM/ESGR, reservoir, mineralization

16

KEROGEN EXTRACTION FROM HIGH VOLATILE COAL AND SHALE AN EMERGING CLEAN ALTERNATIVE TECHNOLOGY: A REVIEW

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Abstract

In this study, the emerging clean kerogen extraction and utilization as fuel technology and its potential resources have been discussed. Kerogen extraction from organic rocks like coal, lignite, and shale has attracted researchers and scientists to understand the complex procedure and kinetics associated with different deposits. India has 26 sedimentary basins with a large reserve of thick organic-rich coal and shale beds having laterally varying thermal maturity. The kerogen extraction from coal/shale beds of Gondwana and Tertiary has great potential for new clean energy resource development in the country. This study focuses on the coal, lignite, and shale resources, organo-inorganic composition, paleoclimatic conditions, and paleoenvironment of the Indian coal basin and the technological and environmental challenges of kerogen extraction. It also evaluates the different aspects of kerogen extraction from coal/shale through combustion, pyrolysis, thermal decomposition, heating conditions, required activation energy, etc.

Keywords: Kerogen; pyrolysis; combustion; coal/shale; energy; sedimentary basin;

17

BEHAVIOURAL CHANGES OF GROUNDWATER RESOURCES IN KARNATAKA STATE: SPATIAL APPROACH BY USING GEOSTATISTICAL METHODS

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Abstract

The maximum utilization of surface water resources has made the public and Government to look towards groundwater resources to supplement the water supply. This paper made an effort to study the dynamic behavior of groundwater resources in Karnataka state based on the changing seasonal characteristics of groundwater depth and rate of fluctuation were presented at the district level. The available secondary data set has been processed under the GIS environment for preparing suitable maps for the present study. It also provides a profound base to the planners in the future for planning the optimum utilization of groundwater resources, to conserve water for future generations to come. The behavioural change of ground water resource assessment provides a basic database for groundwater management in the Karnataka state. In this paper made an effort to assess and analyze the groundwater extraction level, based on four-tier classifications as: 'Safe', 'Semi- Critical', 'Critical' and 'Over-exploited' taluks in the particular district depending on Stage of Groundwater Extraction. An over-exploited assessment unit gives a red flag, demanding immediate change in extraction pattern and surface water interventions. Groundwater resources, though is replenishable, over-exploitation has resulted in mining of groundwater resources more than the annual replenishment. The efforts have always been on the supply side interventions but the continued and ever-increasing water stress indicates that simultaneous demand-side interventions also required managing the groundwater resources. This study will be beneficial in the future for planning and management of groundwater for various upcoming projects in the Karnataka State and it will call the attention and awareness and result in conscientious usage of water for overall development of the country.

Keywords: Groundwater dynamics, Utilization pattern, Monitoring, Impact, Regional development.

18

INTERACTION OF CYCLONE TAUKTAE AND WESTERN DISTURBANCE LEADING TO HEAVY RAINFALL OVER DELHI ON 21 MAY 2021

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Abstract

Heavy precipitation of 119 mm in just few hours was recorded over New Delhi on 21 May 2021. It was nearly twice the amount of rain received on a regular monsoon day. It followed the tropical cyclone Tauktae and a Western Disturbance (WD). The interaction between remnants of a tropical cyclone and WD is a very rare phenomenon. The remnants of cyclone Tauktae lasted for more than 48 hours after landfall. The upper level jet was found to be responsible for steering off the WD from the Mediterranean Sea. The high pressure gradient in the Northern parts of India caused by the interaction between cyclone Tauktae and the high ridge led to the formation of the low level jet. This low level jet transported large amounts of moisture from the Arabian Sea towards North India and heavy precipitation developed near its exit region. Thus the interaction between WD and remnants of tropical cyclone Tauktae was characterized by the transmission of moisture from one system to another. This led to heavy downpour over the national capital, New Delhi. This heavy rainfall was due to interaction between the remnants of cyclone Tauktae and a WD.

Key words: Cyclone, Extratropical Transition, Precipitation, Upper level Jet, Western Disturbance

19

MORPHOMETRIC ANALYSIS OF PILI RIVER, SUB TRIBUTARY OF SAPAN RIVER, TALUKA ACHALPUR, DISTRICT AMRAVATI USING RS AND GIS TECHNIQUES.

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Abstract

The present paper deal with the morphometric analysis of the Pili River basin, Achalpur Taluka, Amravati District, Maharashtra, India. The study area is situated in the Survey of India Toposheet nos. 55G/7, 55G/11, and 55G/10 lie between latitude 21°24'0" N, 21°12'0" N longitude 77°30'0" E, and 77°39'0" E. The main purpose of the work is to determine the complete stream properties from the measurement of various stream attributes. The quantitative drainage analysis is done aspects wise such as linear aspects, aerial aspects and relief. The linear aspects include stream order, stream number, stream length, bifurcation ratio, mean length of stream orders, stream length ratio, mean stream length ratio, and form factor. The areal aspects involve drainage density, stream frequency, and texture ratio, as well as the constant channel maintenance and length of overland flow. The relief aspects include relief ratio, relative relief, ruggedness number and melton ruggedness number. Morphometric analysis is carried out using ArcGIS software, an advanced tool for measuring the drainage basin, the earth's surface dimensions of landform, and shape within a short time. The direction of the basin is from North to South. Based on the above results, it is inferred that in the study area, groundwater prospects are good.

***Key Words**: Morphometric Analysis, Remote Sensing, G.I.S., Pili River, Achalpur*

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MORPHOTECTONIC ANALYSIS OF THE IJEI-IRING-TUPUL BASIN, OF MANIPUR

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Abstract

The present study examined the morphotectonic parameters of the Ijei-Iring-Tupul Basin with the emphasis on its implication for tectonic activity. The data for this study were extracted from the DEM and SENTINEL-2 satellite data along with SOI-toposheets with field verification. The hypsometric curve and its integral are also analysed. Different geomorphic indices like SLK index, Transverse Topographic Symmetry (T), Valley Floor Width to Valley Height ratio (V_f), Drainage Basin Asymmetry (AF) and Basin Elongation Ratio (E_b). The basin has an area of 471.7 Km² which was found to be tectonically active as depicted by the values of the different geomorphic parameters viz., along the stresses of the rivers there are numbers of regions having SLK index greater than 10 depicting a large number of knick points. Average value of T for Ijai, Iring and Tupul are found to be 0.4182, 0.1949 and 0.4216 respectively, which reflects asymmetric character. V_f values ranges from 0.053 to 0.263 showing V-shaped valleys with streams that are actively incising and are commonly associated with uplift. The results of AF is 87.407 %, signifies the upliftment of the eastern side of the basin resulting the shifting of the river to western side in general. The result of Basin Elongation ratio is 0.58 which signifies elongated basin undergoing tectonically activities. The result of hypsometric curve and hypsometric integral 50% reveals that basin is passing through early mature stage under the cycle of erosion.

Keywords: Geomorphic indices, Morphometry, Drainage basin, Hypsometry.

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STREAMFLOW SIMULATION IN A HUMID TROPICAL CATCHMENT OF SOUTHERN WESTERN GHATS USING HYBRID MODELLING APPROACH

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KEYWORDS: Streamflow, SWAT, SVM, Hybrid Model, Achankovil River

Abstract

Streamflow modelling studies are important for water resource management and planning, flood forecasting, and irrigation management due to the depleting freshwater resources, and increasing water demand. Different types of physics-based, lumped, semi-distributed, distributed, conceptual, and data-driven statistical models have been used in past for streamflow modelling. In the present work, a hybrid SVM-SWAT model is developed, and the model performance is compared with standalone SWAT (physics-based) and SVM (machine learning) models. The hybrid SVM-SWAT model uses calibrated and validated SWAT model streamflow as an additional predictor variable in SVM. Precipitation, temperature, solar radiation, relative humidity, wind speed, observed streamflow, and spatial data like DEM, LULC, and soil data have been used for the development of streamflow models in the virgin Achankovil River flowing in the Southern Western Ghats of India.

The performance of models has been evaluated using R^2 and Nash Sutcliffe Efficiency (NSE). Standalone SWAT model, SVM model and hybrid SVM-SWAT model have NSE values of 0.39, 0.42, and 0.58, respectively. An increase of 48.72 % and 38.10 % in model efficiency has been noticed in SVM-SWAT model as compared to standalone SWAT and SVM model, respectively. Study suggests that a hybrid SVM-SWAT model can be used for streamflow prediction as it combines the strengths of both the models and gives better prediction results than standalone SWAT and standalone SVM models.

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GROUND WATER QUALITY ASSESSMENT USING WATER QUALITY INDEX: A CASE STUDY OF TIRUPATI RURAL MICRO WATERSHEDS

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Abstract

The assessment and management of water quality and quantity are indispensable impact on our lives. The quality of surface water or groundwater at inlet, outlet and at any point of watershed shows variation in physical, chemical, properties. Due to the passage of water on the surface and in subsurface, the ions dissolve from soil particles, sediments, and rocks may influence the chemical composition and quality of groundwater.The concept of Water Quality Index (WQI) indicates the overall water quality at a certain area and time based on several water quality parameters. WQI reflects a composite influence of contributing factors on the quality of water.Water quality index (WQI) is calculated from the point of view of suitability of groundwater for human consumption.The Sodium adsorption ratio (SAR) is an irrigation water quality parameter used in the management of sodium-affected soils. It is an indicator of the suitability of water for use in agricultural irrigation, as determined from the concentrations of the main alkaline and earth alkaline cations present in the water. Exchangeable Sodium Percentage (ESP) is determined to know the ESP percentage in the soil.

The study area is located in Survey of India (SOI) Toposheet no. 57 O/6 with an extent of 129.64sqkm. To assess the ground water quality of eight locations in tirupati rural areas have been selected. Climate of the area is semi arid. The proposed area is composed of plains, undulated land and hill areas with granite gneisses. The surface water source in the study area is very meager and their availability is seasonal. Hence, the groundwater is the major source for irrigation activity. After analysis of various physico-chemical parameters, we observe the range of WQI from 80.22 to 134.27. The highest value of WQI is observed at sampling stations 5, and the lowest values of WQI is observed at sampling stations 1. Sample stations 1 and 7 come under good water quality and 2,3,4,5,6,8 belong poor quality.. The high value of WQI has been found to be mainly from the higher values of sodium, chloride and sulphate in the groundwater. The analysis reveals that the groundwater of the area needs some degree of treatment before

consumption. Except durgasamudram all the locations are showing high Exchangeable Sodium Percentage. Based on the SAR values it is observed that at tanapalli area the water is having high SAR.

Key words: Water Quality Index, Micro Watershed, Physico-Chemical parameters, Sodium Absorption Ratio, Exchangeable Sodium Par

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ASSESSMENT OF SOLAR RENEWABLE ENERGY IN RAJASTHAN (INDIA) IN COMPARISON OF WORLDWIDE RENEWABLE ENERGY TENDENCIES

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Abstract

The research paper is associated with the development of the renewable energy source (RES) sector in the world and in Rajasthan. The subject is undoubtedly connected with the problem of the energy transformation taking place in most countries nowadays. Energy transformation processes are mainly associated with an increase in the share of energy production from RES and increased awareness of energy use by end consumers. This means that the systematic development of the RES sector, especially in Solar energy, is a necessary condition for linking the effective course of energy transition processes with simultaneous socio-economic development.

The main objective of this study is to present the status of the Solar energy of RES sector in Rajasthan against the background of worldwide development tendencies. The implementation of the objective made it possible to indicate key trends in the production and use of energy from individual RES and to assess to what extent Rajasthan follows global trends. Rajasthan is one of the Indian State where hard coal and lignite constitutes the main source of energy.

Keywords: Solar energy, Wind energy, Hydro energy, Biomass, Geothermal energy

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FUNCTIONAL GROUP NICETIES DURING MICROSTRUCTURAL RESTYLING AND HYDROCARBON GENERATION FROM COAL

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Abstract

The present investigation sketches microstructural minutiae of Palaeogene coals from Meghalaya, India, through spectral attributes. The findings are judged against the Permian bituminous and anthracite coals to document any effects of microstructural reordering on hydrocarbon generation. The aliphatic carbon and the apparent aromaticity alter during first coalification jump (R_r: 0.50 %) and anchizonal metamorphism. The reactive aliphatic moieties in type-IIS kerogen of the Palaeogene coals may crack early mature hydrocarbons. Meanwhile, lesser abundance of aliphatic functionalities in type-II/III kerogen of Permian bituminous coals marks mixed hydrocarbon potential and a post-metagenetic window is indicated by strong aromatic polycondensation at anthracite rank.

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SOURCE ROCK EVALUATION USING ENHANCED PYROLYSIS OF COAL AND SHALE FROM RAJMAHAL BASIN, INDIA

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Abstract

The present study deals with enhanced pyrolysis of carbonaceous shale samples (Depth: 118 – 580 m of a single borehole) from the Rajmahal Basin, India, at 350 °C, 500 °C, and 650 °C under an inert atmosphere. The HI and T_{max} (421 to 433 °C) of original samples suggest early mature to mature type III kerogen capable of gas generation. Kerogen shows maximum reactivity at 350 °C evidenced by large S_1 and S_2 values and maximum Raman-D_6 band intensity. Elevation in residual kerogen aromaticity and aromatic condensation with rising temperature advocates hydrocarbon expulsion through cracking of sp^3 hybridized aliphatic moieties.

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ONSET OF LATE CRETACEOUS DECCAN VOLCANIC ERUPTIONS, A BOON OR BANE FOR THE FLORA: EVIDENCE FROM MEGA AND MICROFLORA OF MALWA GROUP

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Keywords: Deccan intertrappean, Paleoclimate, Late Cretaceous, Maastrichtian palynoflora.

Abstract

The Deccan flows of the Malwa Group, covering an area of about 50,000 km2 occurs in the north western part of the Deccan volcanic province. This group is divided into six formations, namely Mandleshwar, Kalisindh, Kankaria-Pirukheri, Indore, Bargonda and Singarchori formations in ascending stratigraphic order. The flows are underlain by the Lameta Formation or Bagh beds. The intertrappean beds are present only in the Mandleshwar and Kalisindh formations. In the Mandleshwar Formation intertrappean beds are present at seven levels and in the Kalisindh Formation intertrappean beds are present at one level. Palynological studies of the intertrappean sediments at multiple stratigraphic levels in both these formations indicate that the Mandleshwar Formation has good floral diversity. The intertrappean have Maastrichtian palynomorphs such as *Azolla cretacea*, *Farabeipollis minutus, Jiangsupollis striatus* and *J. intertrappea* and dominance of the *Gabonisporis vigourouxii* and *Aquilapollenites bengalensis.* The palaeomagnetic study of the flows associated with the palynomorph bearing intertrappean indicates the Normal polarity, hence the age of these intertrappean is interpreted as Maastrichtian Chron 30N. The study indicates the presence of algae like *Ovoidites* (*Spirogyra*) as well as aquatic and semiaquatic palynoflora such as *Azolla cretacea* (*Salviniaceae*), *Cyathidites australis* (Cyatheaceae), *Gabonisporis vigourouxii, Crybelosporites intertrappea (Marsileaceae*), and *Triplanosporites* sp., *Triporoletes reticulatus* and *Sparganiaceaepollenites (Sparganium/Typha*) at the lower stratigraphic levels and aquatic and semiaquatic herbs and shrubs along with woody arboreal plants such as *Paleosantalaceaepites* (*Rhizophoraceae), Proxapertites* (Araceae), *Spinizonocolpites* (Arecaceae), *Malvacipolloides* (Malvaceae) and Vitaceae at

the higher stratigraphic levels. Megaflora at this level also indicates the presence of well preserved leaf cuticles of monocots (palms) and dicots, fruits, seeds and fossil wood of dicot and monocot. The flora shows similarity with the Maastrichtian palynoflora of eastern part of central India, suggesting an extension of a similar type of vegetation in the Malwa area also. The record of rich and diverse flora in the oldest Deccan volcanic flows of DVS indicates that the initiation of Deccan volcanic activity was not detrimental to the growth of biota. In fact, the onset of Deccan volcanism changed the climate from semiarid to arid during infratrappean (Lameta) times to humid to subhumid during the deposition of intertrappean sediments, which provided a conducive climate for the proliferation of angiosperm flora.

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LANDSLIDE HAZARDS IN NE INDIA: A CASE STUDY ON TUPUL LANDSLIDE ON 20 JUNE 2022 AT NONE DISTRICT, MANIPUR

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Abstract

The present studies focus on a recent massive landslide triggered on midnight of 29-30 June 2022 and claimed the casualties of 79 persons in Tupul area located at Noneh Districts of Manipur. It is part of the Jiribam-Imphal Railway tract developed for train connectivity by the Northeast Frontier Railway. It includes the excavation of tunnels, stations, open yard and railway track on the hill slopes with an approximate distance of 110 kms from Jiribam to Imphal in Manipur. The landslide was investigated by using a Drone survey and further compared with CARTOSAT data to estimate the volume of the slided mass over to the railway formation including the station, yard, and open cut for railway track between two tunnels on the hill slope. The DEM was generated using the above data to estimate the slided mass from an old vulnerable slump at an elevation of 1063 mts, which was 5.00 lakhs cubic meters, and half km of railways formation at a height of 510 mts including open cut was destroyed due to the sliding mass (30 mts width with 40 mts thickness). The causative factors are vulnerable geological Disang rocks formations of Tertiaries age highly jointed and fractured triggered the deadly landslide with excessive rainfall in the last two months (May-June 2022 1000 mm) and claimed 79 casualties among them 61 were succumbed to dead. The massive event left a learning lesson for natural hazards in NE India for continuous monitoring of slope stability and safety of the people and infrastructures.

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EARTH SYSTEM SCIENCE AND SCIENCE JOURNALISM

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Abstract

Earth System Science is the study of the interconnected components of our environment—the atmosphere, hydrosphere, lithosphere, cryosphere, and biosphere—and how they interact to produce an integrated whole. It utilizes the fundamental disciplines of mathematics, physics, chemistry, and biology and applies them in the context of human activities and landscapes to understand the Earth, at scales ranging from single watersheds to the entire globe.

Earth System science (ESS) is the application of systems science to the Earth. In particular, it considers interactions and 'feedbacks', through material and energy fluxes, between the Earth's sub-systems' cycles, processes and "spheres"—atmosphere, hydrosphere, cryosphere geosphere, pedosphere, lithosphere, biosphere, and even the magnetosphere—as well as the impact of human societies on these components. At its broadest scale, Earth System science brings together researchers across both the natural and social sciences, from fields including ecology, economics, geology, glaciology, meteorology, oceanography, climatology, paleontology, sociology, and space science. Like the broader subject of systems science, Earth System science assumes a holistic view of the dynamic interaction between the Earth's spheres and their many constituent subsystems fluxes and processes, the resulting spatial organization and time evolution of these systems, and their variability, stability and instability. Subsets of Earth System science include systems geology and systems ecology, and many aspects of Earth System science are fundamental to the subjects of physical geography and climate science.

Climatology and climate change have been central to Earth System science since its inception, as evidenced by the prominent place given to climate change in the early NASA reports. The Earth's climate system is a prime example of an emergent property of the whole planetary system, that is, one which cannot be fully understood without regarding it as a single integrated entity. It is also a system where human impacts have been growing rapidly in recent decades, lending immense importance to the

successful development and advancement of Earth System science research. To understanding of the Earth Science System, the Science Journalism and Science Writing the hole Media Exposer is required and we need the Science Journalist to motivate this hole Subjects through Journalism Workshops or other events in India.

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EVOLUTION OF LARGER BENTHIC FORAMINIFERIDS FROM LATE PALEOCENE TO EARLY EOCENE TOGETHER WITH ISOTOPIC CHANGES INDICATING PALEOCENE–EOCENE THERMAL MAXIMUM (PETM) IN SUBATHU SUCCESSION, NW SUB-HIMALAYA, INDIA.

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Abstract

A pronounced global warming event referred to as the Paleocene-Eocene Thermal Maximum (PETM) occurred during the Paleocene-Eocene transition (~55Ma). In the Himalayan region, the oldest unit of the Paleogene succession, i.e., the Subathu succession comprises a package of largely shallow marine sediments ranging in age between the late Paleocene and middle Eocene and hence embodies the Paleocene/Eocene (P/E) boundary as well as the PETM span. We investigated a section of the basal part of the Subathu Group of the stratotype area in Himachal Pradesh (NW sub-Himalaya) using isotopic and larger benthic foraminiferids (LBFs) to identify the signatures of the PETM event. In the studied section, carbon isotope excursion (CIE) of 3.4‰ and carbonate dissolution of larger benthic foraminiferids has been observed. The foot prints of the PETM are well preserved in the basal part of the Subathu Group representing the onset, peak as well as initial recovery phases of the warming event.

Keywords: NW sub-Himalaya Subathu Succession, Paleocene-Eocene Thermal Maximum, Larger Benthic Foraminiferids, Carbon Isotope Excursion.

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MINERAL AUCTION REGIME IN INDIA- A PERSPECTIVE

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Abstract

Mineral and Mining sector, being one of the core sector of economy, provides basic raw materials to many important industries like power generation (thermal), iron and steel, cement, petroleum and natural gas, petro-chemicals, fertilisers, precious & semi-precious metals/stones, electrical & electronics equipment, glass and ceramics etc. The demand for minerals is increasing many folds in view of the rapid urbanization and projected growth in the manufacturing sector in India. India is one of the leading producers in the production of many minerals across the globe. India has constitutional mandate and legal and framework to manage the mineral sector. National Mineral Policy provides the direction for mineral sector. The Mines and Minerals (Development & Regulation) Act (MMDR), 1957 is the principle legislation that governs the mineral and mining sector in India. Judicial pronouncements for allocation of natural resources and recommendations of high-level committees forced government to make paradigm shift and adopt transparency in the allocation of mineral blocks through an auction system. The MMDR Amendment Act, 2015 which came into force on 12th January 2015 has ushered in the regime of transparent and nondiscretionary grant of mineral concessions, therefore all the concession of major mineral are being granted through auction. Further the e-auction process for the grant of mineral blocks has laid the foundation stone for 'ease of doing business' in the mining sector in the country. In the mining sector, the demand and supply will experience a different market condition in near future due to increasing trend of premium for auction of mineral blocks. The recent trend of mineral block auctions has put forth some challenges such as, to define a threshold for high premium in Auction scenario and driving force for high premium to recent mine auction; and its impact on finished product. The future demand outlook for minerals and metals presents notable opportunities to harness mineral wealth to advance economic development and human well-being. The future demand outlook for metals and minerals presents notable opportunities for countries endowed with these resources to harness their extractive wealth to advance economic development and human well-being. Indeed, if managed prudently, mineral wealth presents enormous opportunities for advancing sustainable development - particularly in low-income countries. e-Auctions mandated for the grant of

mineral concession to ensure transparent process of allotment of mineral blocks. India is the first nation in the world to grant minerals completely through the auction route. Auctions have definitely improved–credibility, transparency, certainty of allocation and clearly demonstrate policy continuity. Impact of auctions will be visible on the economy over a decade. Auction is only small part of mineral grant process and auctions cannot fructify unless other steps are completed in time. Time bound clearances/consents from relevant departments/ ministries are essential for long term success of auctions. Post-auction monitoring and facilitation is the most critical element for making auctions successful for converting auctioned blocks into mines.

Keywords: minerals, mining, legislations, auction, policy, premium, demand

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GEOCHEMICAL STUDY AND PETROGENESIS OF MUL GRANITE FROM CHANDRAPUR DISTRICT, MAHARASHTRA, THE WESTERN BASTAR CRATON, CENTRAL INDIA

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Abstract

The Mul area in the Chandrapur District of Maharashtra is dominated by Mul granite pluton (MGP), which is intrusive into the Precambrian orthogneiss complex.The Precambrian basement complex of WBC comprises of granulite-orthogneiss-granite suite, charnokite, hornblende-gneiss, pyroxenite, norite, gabbro and gabbroic anorthosite, which are intruded by younger granites and syenite. The mafic- ultramafic rocks i.e. pyroxenite, norite, gabbro and gabbroic anorthosite occur as xenoliths within the hornblende gneiss.The paper attempts to highlight the salient features of geochemistry and petrogenesis of granite suite of rocks that are noticed as intrusive bodies around Mul area of Chandrapur district in Maharashtra State.The rocks are marked by high SiO2 (69.36 -70.34%), alkali (11.86 % to 12.94%), with moderate calcium (1.38 -1.46 %), low to moderate alumina (13.21 - 14.29%), low Mg (0.27- 0.52%) and Ti (0.11 to 0.20 %). (The rocks are meta-aluminous to per-aluminous in nature as shown by the alumina saturation Index (molar A/CNK). Predominance of K2O and Na2O and higher K2O/Na2O ratio are characteristic feature of the granite. Among the large ion lithophile (LIL) elements Ba values are generally high, ranging from 241 to 1690 ppm and Sr values are low to moderate 16-119.6 ppm. Ba shows an overall decrease with increasing SiO2, compared to that of K2O.Tectonic discrimination diagram (MgO+FeOt+TiO2)/SiO2 vs (Al2O3+CaO)/ (FeOt+Na2O+K2O) suggested that samples of Mul granite falls under alkaline field. Tectonic discrimination diagram SiO2 vs FeOt/(FeOt+MgO) and SiO2 vs Na2O+K2O-CaO throw lights on alkali nature of Mul granite. In the AFM diagram shows samples of Mul granite are of Calc-alkaline nature. The rocks are Metaluminous in nature as shown by the alumina saturation Index.

Keywords: Granite, Geochemistry, petrogenesis, Mul area, Chandrapur District, Maharashtra.

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HYDROGEOCHEMICAL CHARACTERISTICS AND SUITABILITY OF GROUNDWATER FROM SHALLOW AQUIFERS OF PG1 WATERSHED, CHANDRAPUR DISTRICT, MAHARASHTRA

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Abstract

An endeavor has been done to understand the hydrogeochemical characteristics groundwater from shallow aquifers of PG1 watershed (latitudes 19° 38'30" to 19° 50'30"N and longitudes 79° 04'00" to 79° 11'00"E). The appropriateness of groundwater has also been checked for various purposes. The groundwater from study area is alkaline and slightly saline in nature. The Ca2+ > Mg2+ > Na+ > K+ and HCO3- > SO42- > Cl- > NO3- was the ascendancy of cations and anions. The earth metals (Ca + Mg) found to exceed the alkali metals (Na + K). The positive correlation interpreted from interrelationship of Na+ vs Cl- exhibited, silicate weathering process for liberation of ions in groundwater at rock-water interface. In addition the non-lithological source, anthropogenic inputs were also inferred indicating the agricultural fertilizers and domestic wastewaters. All the groundwater samples from the study area are suitable for drinking as well as domestic use. The groundwater from study area is also suitable for irrigation purpose with negligible exceptions.

Keywords: Hydrogeochemical characteristics, cations and anions, shallow aquifers, PG1 watershed, Chandrapur district, Maharashtra

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GROUNDWATER QUALITY AND SUITABILITY OF PG2 WATERSHED, CHANDRAPUR DISTRICT, MAHARASHTRA: AN APPRAISAL OF HYDROGEOCHEMICAL BEHAVIOR

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Abstract

Groundwater samples were studied to understand the concentrations of cations and anions, rock-water interaction as well as groundwater suitability at regional level. The samples were collected from the phreatic aquifers of PG2 watershed of Chandrapur district, Maharashtra. $Ca^{2+} > Mg^{2+} > Na^{+} > K^{+}$ is the dominance sequence with Ca^{2+} as dominant cation. The geogenic processes like dissolution of calcium rich minerals are responsible for increase of Ca^{2+} content in groundwater. In the groundwater samples, HCO_3^- and SO_4^{2-} are the prevailing dominant anions, with the dominance sequence as $HCO_3^- > SO_4^{2-} > NO_3^- > Cl^-$. In the study area, in general, alkaline earths (Ca + Mg) exceed the alkalis (Na + K); while in 28% samples, alkalis (Na + K) exceed alkaline earths (Ca + Mg). However, the mixed sectional types suggest the geogenic as well as anthropogenic sources of cations and anions; and the combinational water type. The interrelationship of HCO_3^- and Ca^{2+} divulges negative correlation also, the scatter diagram of Na^+ vs Cl^- interpret the rock-water interaction, which points out towards the silicate weathering as well as sources of calcium and bicarbonate. The high Na/Cl ratio corroborates the intense water-rock interaction, most likely by feldspar weathering. The groundwater is marginally suitable for drinking purpose; however, it is not appropriate for the intolerant crops which are vulnerable to anions of Cl^- and SO_4^{2-}

Keywords: Groundwater, quality, PG2 watershed, Rock-water interaction, Chandrapur district, Maharashtra

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MINERALOGY AND GEOCHEMISTRY OF A LAMPROPHYRE DYKE FROM THE SARNU-DANDALI ALKALINE IGNEOUS COMPLEX, RAJASTHAN, NORTH-WESTERN INDIA.

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Abstract

A lamprophyre dyke intruded in syenites and associated with carbonatites from the Sarnu-Dandali Alkaline Igneous Complex is studied. Mineralogically, the dyke is rich in phlogopite (magmatic and xenocrystic) and clinopyroxene, exhibits a typical panidiomorphic texture and is geochemically similar to other lamprophyres reported previously from the Deccan Province. It shows low content of whole-rock SiO2 (c. 44 wt%), higher abundances of high field strength elements (HFSE) (e.g., Nb = 120–137 ppm; Zr = >360 ppm; Pb = >25 ppm; Ce = 136–149 ppm) as well as large ion lithophile elements (LILE). Based on mineral and whole-rock geochemical (major and trace elements) compositions it is classified as an alkaline lamprophyre similar to the other Deccan alkaline lamprophyres. Trace element compositions show small amounts of partial melting and magma derivation from OIB-type enriched (metasomatized) mantle source regions with more involvement of phlogopite.

Keywords: Lamprophyre, Mineralogy, Geochemistry, Sarnu-Dandali Complex

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GEOGRAPHICAL ANALYSIS OF THE ROLE OF AHAR AND PINE IN CROP IRRIGATION IN MOKAMA TALL

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Abstract

Since the birth of agriculture in the Neolithic period, human beings mainly started living a permanent life. There was a shortage of hunting in the forests. Agricultural activity emerged as an option to solve the problem of human hunger. The basis of agriculture is irrigation system. With the help of which agricultural productivity can be increased. There are many alternatives related to irrigation. Like canal irrigation, wells, ponds, tube wells, rain water, etc. Out of this, landforms named Ahar and Pine are found in almost all geographical areas. In the plains, it is found in abundance. Seasonal water is stored in this structure, from which irrigation is also done for some time. Some Ahar and Pan are related to small and big rivers and other water sources. While some diets and pins are ground-charged. If both these geomorphic structures are used scientifically, then they can be important means of irrigation. Mokama Tal is the eastern part of Patna district of Bihar, which is prone to floods. Ahar and Pin are found in abundance here. Keeping this fact in mind, the goal of preparing the present research paper has been set. So that I wish to present it at the Indian Science Congress Nagpur in 2023. Before preparing the research paper, the landform observation of the area has been done and it has been seen that how the utility of Ahar and Pin can be important in the irrigation system of this area. So that the crops of this area can be irrigated. The paper has also been completed with the necessary maps and drawings. Along with this, the irrigation problem of the area and its solution has also been highlighted. The rivers of the research area have also been described and the water logging of the research area has also been highlighted. It is hoped that a new message will spread from this small geographical area.

Keywords: feed, pine, Neolithic period, rivers, landform, tally, crop, irrigation, productivity, well, pond, tube well, canal, hunger, flood, afflicted, problem

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ASSESSMENT OF GROUNDWATER QUALITY IN PAZHAYAR RIVER BASIN, KANNIYAKUMARI DISTRICT, USING THE WATER QUALITY INDEX (WQI)AND REMOTE SENSING AND GIS

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Abstract

Water is where life begins, continues to exist, and grows. The river was griddled using ArcGIS. Grid sample for 2021 Pechiparai to Thengapatnam samples were collected. The samples were completely airtight. Grid and point samples were kept in acid-clean bottles. Field investigation Temperature, pH, EC, TDS, cations (Ca, Mg, Na, K), and anions (Cl, SO4) were all measured in water samples using ion chromatography (NO3). Carbonate and bicarbonate measurements This feature purifies groundwater for drinking and irrigation. Regional hydrology is influenced by population growth and industrialization. Overuse of groundwater is harmful. Check to see if there is enough groundwater and if it can be moved. The groundwater quality in the Kodaiyar river basin has been tested. Based on water samples, the research site had good groundwater. Groundwater from Pechiparai to Thengapatnam can be used for drinking and farming, according to hydrogeochemical research. Calcium and magnesium are inferior to sodium and potassium. Calcium and magnesium are found in some places. Chloride, bicarbonate, sulphate, and nutrients are all found in safe drinking water. The pH of surface water is within WHO guidelines. S8 had the highest pH and S1 had the lowest. G1 had the highest pH and G4 had the lowest. The pH is within WHO guidelines. The flow of electricity is WHO-approved. S10 had the highest EC, while S1 had the lowest. G13 is less conductive than G17. G15 and G17 are the exceptions. Changes in conductivity, particularly rises, can indicate a discharge or other water disturbance. Other issues may arise with high-conductivity water. TDS levels are within WHO guidelines. S10 has the highest TDS and S1 has the lowest. The WHO recommends a TDS level of 1000 mg/l. G13 and G17 have the highest concentrations of dissolved solids. TDS was prevalent in G1-G18. The water at the research site is hard. Sawyer received G2, G3, G12, G13, G14, G15, G16, and G17 ratings. Levels G1, G4, G5, G6, G7, G8, G9, and G10 are all difficult. It is challenging. Calcium (Ca) levels required by WHO S10 possessed more calcium than S6. The World Health Organization recommends 75mg/l calcium (Ca). G14 is lower in calcium than G18. G4-G12 and G18-G21

were both excessively calcium-rich. The small increase in calcium ions in the research area hardens the groundwater. S7 and S9 were both high in magnesium. S7 contained the most Mg, while S10 contained the least. The WHO recommends a magnesium level of 50mg/l. G13 is lower in magnesium than G11. G1-G22 had a high magnesium content. Magnesium makes groundwater more difficult to sample at most sampling stations. It complies with WHO standards. S8 had more sodium than S1. The WHO suggests 200mg/l (Na). The G17 is the one with the fewest. It complies with WHO standards. The presence of high sodium levels in the samples indicates that the ocean is not contaminating the groundwater. Potassium levels recommended by WHO S9 was higher in potassium than S1. The WHO suggests 10mg/l K. (K). G5, G7, G8, G12, G13, G14, and G22 had the lowest potassium levels. G6, G9, and potassium Indian bicarbonate standards are exceeded. S10 has the least amount of bicarbonate. Potassium deficiency indicates safe drinking and agricultural water.

Keywords: South East coast, Ground water quality assessment, WQI

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PALAEOMAGNETIC POLARITY AND FLOW MAPPING OF THE DECCAN BASALT, EXPOSED AROUND MASOD AREA, AMRAVATI DISTRICT, PART OF CENTRAL INDIA

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Abstract

Basalt is one of the classic rock which preserve Natural Remanent Magnetization (NRM). Detail mapping of the basalt lava flows is an important aspect to established flow stratigraphy of any region. During this study an attempt has been made to establish palaeomagnetic polarity of different basalt lava flows which differ in their exposed thickness, mineral content, structural characteristics and physiography. Accordingly a field traverse was carried out around Masod area of Amravati district, Maharashtra State, India by covering highest to lowest elevation between 440 meter 372 meters (amsl). After mapping and detail palaeomagnetic study, it is clear that total three lava flows are exposed in the area as: lower most Flow-I is fine to medium grained, mafic plagioclase microphyric basalt which indicate Reverse Palaeomagnetic Polarity; overlain by middle Flow-II which is coarse grained, mafic plagioclase phyric basalt with Normal Palaeomagnetic Polarity and the topmost Flow-III is fine to medium grained, mafic plagioclase micro-phyric basalt which indicate Normal Palaeomagnetic Polarity.

Keywords: Deccan Traps, Flow Mapping, Palaeomagnetism, Normal-Reverse Polarity

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MAGNETO-STRATIGRAPHY OF THE DECCAN BASALT, EXPOSED AROUND EASTERN PART OF AMRAVATI DISTRICT, MAHARASHTRA STATE, INDIA

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Abstract

Some rocks exhibit magnetic properties due to ferromagnetic minerals. The Deccan basalt also preserves Natural Remanent Magnetization, which can give clue to their past positions and palaeomagnetic polarity. This study incorporates flow by flow mapping of basalt lava flows with detail field characteristics. A flow mapping and palaeomagnetic was carried out, due East of Amravati town of Maharashtra State, India, covering basalt pile between 440 to 400 meters with respect to mean sea level. This 40 meter thick lava pile comprises three lava flows as: lower most Flow-I is fine to medium grained, mafic plagioclase micro-phyric basalt which indicate Reverse Palaeomagnetic Polarity; overlain by middle Flow-II is coarse grained, mafic plagioclase phyric basalt with Normal Palaeomagnetic Polarity and the topmost Flow-III is fine to medium grained, mafic plagioclase micro-phyric basalt which indicate Normal Palaeomagnetic Polarity.Thus there exist Normal-Reverse polarity sequence in the area.

Keywords: Deccan Traps, Flow Mapping, Palaeomagnetism, Normal-Reverse Polarity

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A SUSTAINABLE APPROACH TO PARTICIPATORY WATERSHED DEVELOPMENT IN THE DHODANA NALA MINI WATERSHED, USING REMOTE SENSING AND GIS TECHNIQUE

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Abstract

Participatory approaches to watershed conservation, in which local communities actively participate in water conservation activities, can be used to achieve sustainable watershed conservation. The research was carried out in the Dhodana Nala Mini Watershed to determine the level of public participation in the watershed development programme. The investigators created a fully structured plan for many parts of local people's participation in soil and water conservation for watershed management programmes. The participation of each individual was recorded to determine the extent to which people participate in the program. Personal interviews with villagers were used to collect data for this study. The results of this study revealed the level to which people were involved in the development, optimisation, and maintenance. It demonstrates that people's participation was high during the design and execution phases of the watershed programme, but very low during the maintenance phase. The data also indicate that socioeconomic level of the villagers improved after the implementation of the watershed development programmes. During this study, it is also clear that remote sensing and GIS techniques are very effective for detail investigation of the area, along with the preparation and analysis of maps.

Keywords: Participatory Watershed Development, Soil conservation, Water conservation, Watershed development programme, Remote Sensing and GIS technique

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ARTIFICIAL RECHARGE OF GROUNDWATER IN THE DECCAN BASALTIC TERRAIN: A CASE STUDY OF THE OVER-EXPLOITED DEO RIVER MINI-WATERSHED USING DUG WELL RECHARGE TECHNIQUE

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Abstract

Water resources are not equally distributed and accordingly water scarcity occurs, especially in the hard rock areas with adverse geomorphic conditions and complex hydrogeological setup. On the other hand, despite the fact that most of the zones of Amravati area are covered under assured rainfall, but most of the precipitation is lost as surface runoff and negligible amount of water percolates below ground level due to quick overland flow and the predominantly impermeable lithology. Generally open dug wells and bore wells are drilled for drinking and irrigation purpose. These wells can be recharged, utilizing dug well recharge technique. This technique can be applicable to confined as well as unconfined aquifers through special technique. During this study an attempt has been made to apply this technique to some parts of over-exploited Deo river mini-watershed of Wardha river basin, especially near the main course of Deo river stream in storage zone of the watershed, where surplus water was available to recharge. The water levels of adjoining area was continuously monitored to evaluate the benefit of this technique. It is observed that static groundwater levels are considerably increased in dug wells of surrounding area. This method of artificial recharge is very safe and can be applied to other water scares areas with some modifications.

Keywords: Artificial Recharge, Watershed Management, Dug Well Recharge Technique, Groundwater.

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IDENTIFICATION OF SUITABLE SITES FOR ARTIFICIAL RECHARGE MEASURES IN THE CENTRAL PART OF WRJ-2 WATERSHED, DECCAN BASALTIC TERRAIN, MAHARASHTRA STATE, INDIA

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Abstract

Main hydrogeological unit of central WRJ-2 watershed is the Deccan Traps, which comprises different lava flows of different hydrogeological characteristics. There are simple lava flows, exposed in the area which can be divided into upper vesicular unit and lower massive units. The study area is a part of vast belt of orange and citrus cultivation of Central India, which is now declared as critical due to excessive withdrawal of groundwater resources. During this study central part of the WRJ-2 watershed is examined carefully during hydrogeological field work, especially to identify suitable sites for the artificial recharge structures. It is observed that central part of the WRJ-2 watershed is dominantly covered by the vesicular and fractured massive basalts, which are comparatively better aquifers as compared to the massive lava flows. Thus on the basis of flow mapping and existing hydrogeological condition, sites for the cement nala bund and percolation tanks are selected, which are best suitable for the area.

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GROUNDWATER ASSESSMENT OF THE CRITICAL WRJ-2 WATERSHED, NARKHED AND KATOL TEHSILS, NAGPUR DISTRICT, MAHARASHTRA STATE, INDIA.

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Abstract

The groundwater plays a very important role in maintaining the water levels and also flow into rivers, lakes and wetlands. A majority of water problems in India are related to the groundwater as, India is the largest consumer of groundwater in the world, and therefore highly dependent on it. This study incorporates groundwater assessment of the critical WRJ-2 Watershed which is included in Survey of India toposheets 55K/11 and 55K/7 and bounded by latitude 210 17 '30" - 21029' 00" E and longitude 78030'00"-78059'15" N.The WRJ-2 watershed has a total area of 219.86 Sq. km. and is included in the critical category, after groundwater assessment. The stage of Groundwater development which is expressed as a percentage is 99.37 % as per groundwater assessment carried out by Government agencies. The stage of Groundwater development was 96.67% as per groundwater assessment of 2017.The Groundwater Recharge of the area in 2019 was 2226.75 Ham and total groundwater availability in the area is 417.92 Ham. The increase in stage of groundwater development over years, especially due to excessive withdrawal of groundwater for orange and citrus cultivation poses the problem of severe scarcity of water in the area during summer season. The present study would help to make an overall assessment of the groundwater availability and for future groundwater development.

Keywords: Groundwater Assessment, Critical Watershed, Stage of Groundwater development.

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A CASE STUDY OF THE OVER-EXPLOITED SHIRKHED AREA, PART OF CHARGARH RIVER BASIN, CENTRAL INDIA: SOME INSIGHTS OF WATERSHED MANAGEMENT

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Abstract

Intensive agricultural activities, especially for orange cultivation in the over-exploited Shirkhed Area, part of Chargarh River Basin, Amravati district Maharashtra State, India pose excessive stress on the aquifer system, causing considerable depletion in static water levels. Accordingly the area is declared as over-exploited after groundwater assessment. It is essential to study these areas using a scientific approach to the hydrogeological characteristics to understand the problem. The remote sensing and geographic information system (GIS) technique provides a high-quality perspective to tackle issues, also beneficial to the planners in achieving better results for long-term water resource production and management. The main aim of this study is to use remote sensing and GIS techniques to establish a land and water resource management for identification of suitable groundwater recharge sites. During this study remote sensing and GIS technique was utilized to generate different types of thematic maps. The IRS-LISS-III multispectral images, SRTM information and Survey of India toposheets were utilized for this purpose. While preparing conservation plans, geology, geomorphology and slope aspects are considered. On the basis of field geological studies and remote sensing technique, a comprehensive plan is prepared for the area for various conservation measures viz. continuous contour trenches, gabion plug, village tank, KT-weir, percolation tank, minor irrigation tank, underground plug, recharge shaft, farm ponds, cement nala bund etc. This type of mitigatory measures is essential for the critical and over-exploited areas for watershed management.

Keywords: Deccan Traps, Over-Exploited Watershed, Artificial Recharge, Watershed Management.

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ENVIRONMENTAL AND SOCIAL IMPACT OF RECKLESS MINING OF GYPSUM AT KOLAYAT AREA OF BIKANER, RAJASTHAN, INDIA.

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Abstract

Rajasthan produces 99% of the total mineral gypsum production in India. And the most promising deposits occur in the Bikaner district. The excavation rate of gypsum has been increasing in the last few years, but the various environmental and social impacts are neglected and overlooked. This reckless mining of gypsum will cause many adverse effects not only on our surrounding environment but also on the local society. In this study, air, water, and soil pollution were analyzed using secondary data by standard methods. The degradation of the environment could be measured by studying the geo-environmental parameters: Air Quality, Water quality, Soil quality, Vegetation, Surface deformation, Wastage of land.

Keywords: Gypsum, Mining, Environmental Impact, Kolayat, Bikaner

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GEOCHEMICAL INVESTIGATIONS TO SEARCH MINERALIZATION IN MALANI GRANITES AROUND PIPAR CITY, JODHPUR NORTHWESTERN RAJASTHAN

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Abstract

Mineral resources provides basic raw material for diverse industries. Malani Igneous Suite of rocks constitutes the largest orogenic felsic magmatism activity in the northwestern part of India and extends up to Sindh province in Pakistan during late Proterozoic. The area around Pipapr city about 60 km NE of Jodhpur show outcrps of granites at and around villages Riya, Jaliwara, Nanan, Madliya, Khejarla, Rawaniana and Roop Nagar. These are post-Delhi granites shows medium to coarse grained, leucocratic to equigranular porphyritic textures. Interestingly, the periods have shown Sn – W mineralization in the equivalent granites elsewhere, also these granites can serve as source for “calcrete type uranium”. Detailed geochemical analyses of selected rock sample have been performed in the present study by XRF for major oxides and trace elements and ICP-MS for REE. The geochemical data granites of study area show very low K/Rb ratio, Ba/Rb ratio and very high Rb/Sr ratio which is characteristics of highly evolved melts. The average K/Rb, Ba/Rb and Rb/Sr of granitic rocks of highly evolved melts will be less than 100, less than 0.25 and more than 5 respectively. The granites of study area are low calcium granites and having characters of highly evolved magma because average K/Rb, Ba/Rb and Rb/Sr are much higher than average ratio. Also granites of study area show high Rb, low Sr, low Nb values. Present study proposed to possibilities of some mineralization associated with granites and must have been formed in the last phase of the magmatism.

Keywords: Geochmemical, Granites, Malani Igneous Suite, Mineralization.

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ECONOMIC ANALYSIS OF MINERALS OF BIKANER (RAJASTHAN)

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Abstract

Bikaner is bestowed with huge deposits of non-metallic minerals including Ball clay, gypsum, bajari, limestone, and lignite and masonry stones. All these resources, which generate millions of rupees as revenue for the government's exchequer, have vast employment potential but they are not given their due importance in the development of this region.

The study shows that Kankar-Bajri, ball clay, Lignite and gypsum are dominant among minerals produced in Bikaner which contribute significantly in government's revenue. Time Series Analysis related with Production Revenue and Sale value of Minerals has been carried out. Their trend values are calculated by adopting OLS technique.

Some important aspects regarding minerals in Bikaner: There is an unsystematic and un-organized mining of ball clay in Bikaner, Lack of proper marketing of mining product according to the demand of buyers. The main reason for insignificant value of revenue from gypsum is increasing illegal practice of gypsum mining in Bikaner. Employment status is not satisfactory in mineral sector in Bikaner.

The factors responsible for the declining trend in employment of major and minor minerals are: Ban on bajari mining around the city due to land subsidence and environmental threat, the region has large deposits of lime stone but it is not of the SMS grade, lack of value addition facility in ceramics in Bikaner, Lack of R&D facilities in major and minor minerals, and lack of skilled man power required by various power plants, ceramic tile industries and gypsum manufacturing board.

Keywords: Bikaner, Economic Analysis, Ball clay, employment

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GEOTHERMAL ENERGY RESOURCES OF INDIA - A CASE STUDY FROM MANUGURU GEOTHERMAL FIELD, TELANGANA, INDIA

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Abstract

The world is moving to a new energy system, which is largely dependent on renewable energy complimented by green hydrogen and bioenergy. India is prioritizing a phased transition to cleaner fuels and slashing household consumption to achieve net zero emissions by 2070 according to a national report released at the United Nations COP27 climate summit in Egypt. The Geological Survey of India (GSI) is actively involved in the development of geothermal energy resources for achieving the goal of creating a carbon-neutral India, a clarion call of the honorable Prime Minister of India on Independence Day, 2020.

The GSI has carried out detailed studies in Manuguru Geothermal Field (MGF), which is one of the least explored geothermal fields in India. Geologically, the rocks of the Gondwana Supergroup unconformably lie over the Precambrian basement in the NNW-SSE trending Godavari graben.

It is the first time in India that drilling was carried out for geothermal investigation upto 1000m depth. Total of 8nos. exploratory boreholes were drilled cumulating 7900 m depth and resource estimation was carried out for a 19 sq km area. The calculated stored heat is 12 x 10^{14} kJ and the installed power capacity is 63 MW at 1000 m depth for a period of 20 years.

The recommendation drawn on the basis of the exploration work done by GSI, a 20 kW demonstration power plant using ORC has been initiated by the Ministry of Coal. The Singareni Collieries Company Limited has converted the drilled exploratory borehole MGR-4 (17°58´29.1´´N:80°44´4.5´´E) into a production well where the geothermal energy-based power plant will be commissioned soon. This will become the first step towards green energy in India and will open the gate for geothermal-based power plants to reach the goal of net zero emission by 2070.

Keywords: *Manuguru geothermal field, Carbon neutral, resources estimation, installed power, geothermal power plant.*

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PETROLOGICAL AND ORE MINERALOGICAL STUDY IN SAKOLI FOLD BELT, CENTRAL INDIA

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Abstract

The Archaean – Paleo Proterozoic to Proterozoic transition of rocks in Sakoli area, Central India has preserved evidences of inter related tectonic crustal evolutionary cycles with multiple metallogenic events, widespread over the area in time and space. Remobilization of Cu and Au ore mineralization, in response to both pre-Grenvillian and Grenvillian deformation events yielded cross cutting epigenetic quartz veins (Bandopadhyay, 2001). Breccia zones, stock work, several mineralized quartz veins, oriented opaque vein minerals in older granite and BIF are aligned parallel to the NE-SW trace of Sakoli fold belt. Sakoli metallogenic province are characterized by mineralization of the primary nature in older granite south of Lakhandur and intermediate metavolcanics near Kitari forest area and final stages in form of quartz vein observed all over area from Tambekhani, Kitari up to Koka and Behrodi near Kardha during the development of the mineralized Sakoli mobile belt (Au, As, Fe, F, Cu, W, Mn, Au, Ag, Cu F). Most of the area of metavolcanics and persistent quartz reef contain sulphide mineralization. Hydrothermal mineralization is inextricably linked with granitic magmatism and volcanisim. Chemeogenic events preserved as a primary iron ore may be magnetite and BIF formation near the copper and gold bearing quartz vein in the phyllitic country rock (series of isolated phenomena of ore mineral intrusion) in time and space, and related with igneous activity (older grainite and basic-metavolcanic and volcanics). The Sakoli Fold Belt, Central India has three prominent tectonic trends, NNE- SSW or N-S, NE-SW (dominant) and NW-SE for most of lithologies. The existence of three trends/events indicate emerging temporal outcrop pattern of copper and gold with iron ridge (early stage of development of mobile belt), oxide, sulphide and redox states of iron indicate biogeochemical climatic changes and suggest impact of Neo-Proterozoic events.

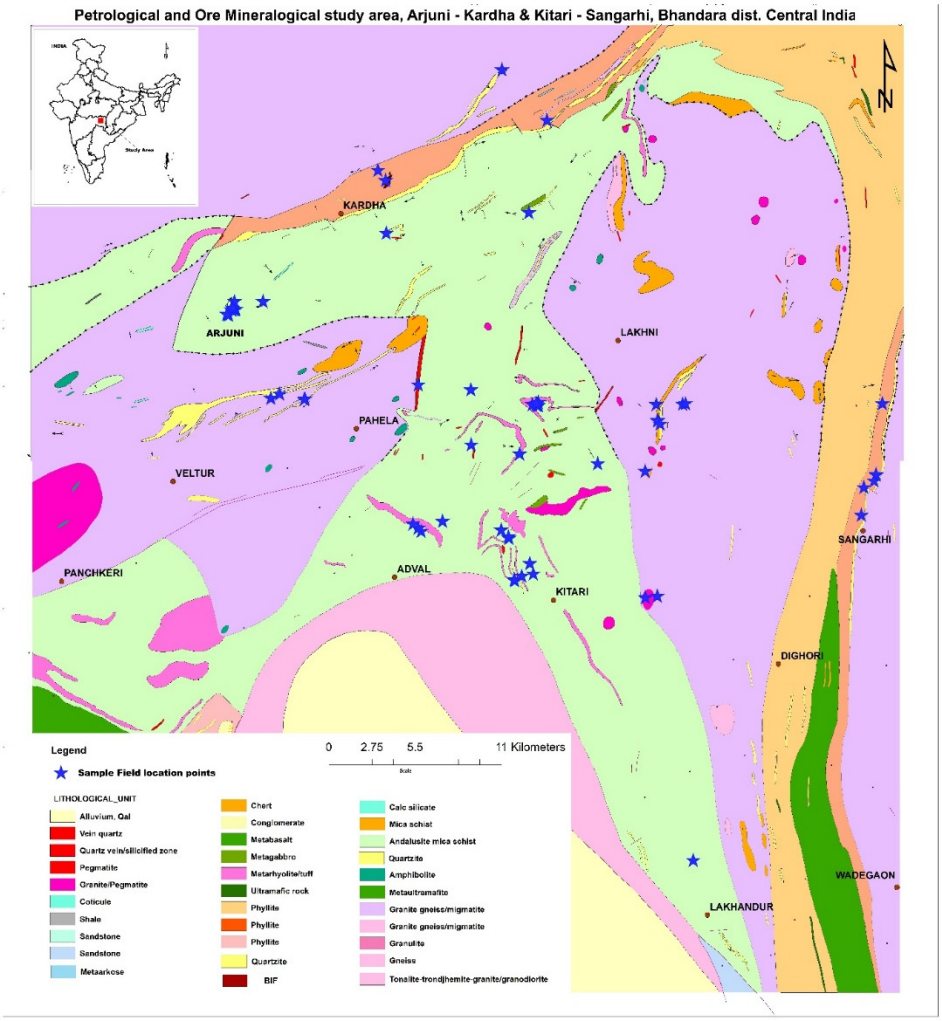

Figure: Geological map of the study area.

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THE LAUMONTITE-CALCITE VEINS WITHIN AMPHIBOLITE, CHANDARDINGA AREA, DHUBRI DISTRICT, ASSAM: ITS GENETIC SIGNIFICANCE

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Abstract

Laumontite is a hydrated calcium-aluminium silicate ($CaAl_2Si_4O_{12}.4H_2O$) mineral of zeolite group. The drill core samples of Bore Hole no. DCB-16 at 43 m depth consists of laumontite as veins and fracture filling within garnet bearing amphibolite from Chandardinga area, Dhubri district, Assam. Two distinct types laumontite veins have been studied. The first one is white to light orange and another is bright orange. These veins are co-folded with the host rock and prominently show zonation. Petrographic studies show that the laumontite crystals are growing from wall towards centre (calcite) as radiating and tabular crystals. The XRD study indicates laumontite is major mineral phase and greenish groundmass phase made up of magnetite, quartz, pyrite, magnesioferrite (spinel) and cordierite. The EPMA study of laumontite indicate high SiO_2 varies from 59.67 to 62.85 wt. %., CaO from 8.50 to 8.90 wt.% and the amount of Al_2O_3 varying from 13.01 to 14.70 wt.%. The ternary classification diagrams reflect laumontite field. The mode of occurrence, microscopic, SEM and EPMA studies reveals hydrothermal origin of laumontite in fractures within amphibolite.

Keywords: Laumontite, zeolite, XRD, Bore Hole, hydrothermal, Chandradinga.

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CURRENT STATUS OF RARE EARTH EELEMENTS IN INDIA AND FUTURE STRATEGIES

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Abstract

Rare earths are significant in the national security architecture. Due to their indispensable role in current technological innovations, the rare earths are among the most sought-after commodities in the mineral world. Due to an exclusive importance of REE in the field of magnetism, superconductivity, ammunition, and clean energy, REE are considered to be a major player in transforming the global energy system. Although India has rich reserves of REE, currently there is only one producing mine and has ~100% import dependency. On the contrary, due to growing industrialization, especially under Make in India initiative, Indian demand for REE has increased manifold. Real bone of contention lies in the fact that China has monopoly over the REE resources, and they are dominating the world market. Indian position is highly vulnerable due to unpredictable nature of Chinese government. Under these circumstances, India needs to secure sufficient quantity of REE to cater its domestic demand and also to save for critical needs. Nevertheless, India has started to adopt self-reliance and focused on the sustainable options to overcome global economic crisis; since many countries are imposing restrictions on export of rare earths.

Although the annual turnover of Indian rare earth industry is of rupees 90,000 crore and post pandemic REEs contribution to Indian economy is increased to nearly $ 200 billion, the industry registered no momentum, resulting in lack of utility due to technical inefficiency. The participation in strategic alliances with its global partners viz., MSP, Quad and BIMSTEC provides a chance for India to enter the global market and strengthen the supply chain. The exploration input and regular follow up is required in the target areas where geological settings and traces of RE mineralization persist. The cumulative efforts, technological upgradation and involvement of various stakeholders will sequentially open up new areas for further resource acquisition.

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GEOLOGICAL SIGNIFICANCE OF VANADIUM GARNET-GOLDMANITE FROM METAGABBOIC ROCKS OF DONGARGARH SUPERGROUP, CENTRAL INDIA

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Abstract

Vanadium (V) is a strategic metal, occurs as a refractory, lithophilic element, and is present in all major types of rocks of the Earth's crust, in meteorites, spectra of stars, and the Sun. It generally possesses a relatively low concentration in the Earth's crust and can create compounds or be present in the form of $V^{2+,}$ V^{3+}, V^{4+} and V^{5+}. As a result, they associate with a range of oxides and hydroxides, silicates, and relatively rare sulfides. Still, there is relatively little information available on the diversity of vanadium and vanadium-bearing minerals formed in different rock types under various genetic settings. V is present predominantly in oxide minerals as an isomorphic admixture. Still, vanadium silicate minerals are rare, discovered in rocks initially enriched with vanadium and metamorphosed up to amphibolite facies-bearing garnet belongs to the goldmanite-grossular [$Ca_3V_2(SiO_4)_3$], a member of the ugrandite garnet subgroup. VTM deposits are the principal source of vanadium and consist of magmatic accumulations of ilmenite and magnetite containing 0.2 to 1 wt% vanadium pentoxide (V_2O_5). Most of the vanadium was reported from China, Russia, and South Africa. In India, V-Ti oxide mineralization occurs in the rocks of various ages, tectonic settings, and Cratonic areas has been reported from many deposits of India, such as the Nuasahi ultramafic Complex; stratiform V-Ti magnetite ores in layered gabbro-anorthosites-ultramafic rocks of Western Dharwar craton; Singbhum region, Eastern India, Alkaline-carbonatite complex, Tiruppattur, Tamil Nadu; syenite-hosted lumpy and sporadic occurrences of V-Ti bearing magnetite from Ganjang, northeastern India; base metal deposits of Rampura- Agucha in the Proterozoic Aravalli-Delhi orogenic belt, northwestern India. V-Ti oxide mineralization is also known to occur in the Khurshipar area, the Bastar

Craton; however, V-bearing silicate has not been reported so far from this area. In this communication, the occurrence of a rare type V-bearing garnet is being reported for the first time from Neo-Archean-Paleoproterozoic mafic bodies from the Dongargarh Supergroup of rocks in central India. This new occurrence is located about 200 km SE of Nagpur. It is associated with V-Ti mineralization hosted in gabbro variants of Nandgaon Group based on mineralogical and petrogenetic results using detailed petrography, scanning electron microscope followed by electron-microprobe analysis (EMPA).

Petrography and scanning electron microscope study reveal that V-rich andradite-grossular garnets are closely associated with VTM and sulfides within metagabbro. Ore microscopic studies reveal that magnetite is associated with hematite and ilmenite, depicting different textural patterns. They display post-cumulus, adcumulus growth, intergrowth, and exsolution textures. The EPMA analysis of VTM shows V_2O_3 varies from 0.9 to 1.4 wt %, TiO2 from 0.4 to 18 wt %, and Ilmenite shows 0.1 to 0.2 % V_2O_3. Whereas. the garnet (n=10) contains 2.2-5.76 wt% V_2O_3, 0.03-0.4 wt% Cr_2O_3, 5.86-9.76 wt% Al_2O_3 and 13.85-19.62 Fe_2O_3 wt% with sum range from 96 to 99 %. The mineral is, therefore, the vanadium analogue of grossular and andradite garnet characterized as Goldmanite. The V-rich garnets-Goldmanite in the Shurtoli-Kanholi area might have been formed in fracture after interaction with plagioclase, and sulfide may be due to metasomatic reactions between earlier formed mafic minerals and late-stage fluids.

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LATE CRETACEOUS-EARLY PALAEOGENEFLORAL BIODIVERSITY OF DECCAN LARGE IGNEOUS PROVINCE IN MANDLA LOBE: PALEOCLIMATIC IMPLICATIONS

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Abstract

The Deccan volcanic province is one of the largest continental flood basalt provinces in the world. The eruptionsof this unique Large Igneous Province (LIP) has been estimated to be around the Cretaceous-Paleogene boundary in numerous discrete, geographically restricted phases (Kale et al., 2019). The oldest of these eruptive phases has been dated to be Maastrichtian in age ~67Mya, while the youngest phase is believed to have occurred at about ~63My (Pande et al., 2017). Hence, in addition to paleo-latitudinal and paleo-geomorphological influence, the Deccan volcanic eruptive eventsspaced over a large temporal range (~ 4My), outpouring huge volumes of lava onto then Indian subcontinent is expected to have played a significant role in affecting the biodiversity of contemporary flora and fauna and in shaping the paleoclimates and palaeoecology. In this context, preserved floral and palynological remains recovered from the intertrappean sediments at different stratigraphic levels in the Deccan volcanic sequences give a comprehensive idea ofthe climatic conditions that prevailed within the periods of hiatus between successive eruptive pulses. The Mandla Lobe, has flora and fauna rich intertrappean beds of Maastrichtian to Paleocene age. Fossil flora from this area includes fossils of wood, leaves, flowers, fruits, seed and palynomorphs of pteridophytes, gymnosperm and angiosperm plants (Samant and Mohabey, 2009; Smith et al., 2015). Based on Nearest living relatives (NRL's) of the fossil mega and microfloral records and using the Coexistence Approach (Utescher et al., 2014), we have tried to quantify the paleoclimatic conditions of the MandlaLobe during Late Cretaceous-Early Paleogene Deccan eruptions. The study indicatesthe prevalence of a warm and humid tropical climate with good rainfall, at the time of deposition. Lithology of some of the intertrappean beds also indicate some intermittent semiarid to arid climatic conditions possibly due to volcanism induced mock aridity.

Keywords: Deccan intertrappean, Palaeoclimatic, Late Cretaceous, Early Paleogene, Mega and Microflora.

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GROUNDWATER POTENTIAL ZONES IDENTIFICATION FOR SOIL AND WATER CONSERVATION IN B13TAU-031 (UPPER TAPI SUB BASIN), BASIN USING GEOSPATIAL TECHNIQUES

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Abstract

The proposed research work attempts an accurate and timely generation of geospatial and geoscientific database of the study area on various aspects of lithology, geomorphology, drainage networks, structure, slope elevation, rainfall, surface water, well yield, groundwater potential and socio-economic parameter using remote sensing and geographic information system (GIS). This provide the scope for assessment, prioritization of the sub watersheds and problem for optimal utilization of the resources and preparation of better development plants which help in improving the socio-economic condition of the people in the area. The area under study is categorized as over- exploited and also critical at some places by the State Groundwater Survey and Development Agency (GSDA). For undertaking this work the purpose is to design a strategy of water resources management that would change the status of over exploited and decisive mini watershed to safe category. This would provide the ground water assessment in the watershed with the round year supply of drinking water by way of sustainable groundwater development. Geologically study area mainly covered by the Basaltic lava flows of Cretaceous to Palaeocene age and Purna Alluvium of Quaternary age. The elevation in the study area ranges from 239 m to 553 m above mean sea level which indicating 314 m of relative relief in the study area. In the landuse landcover mapping the area is divided in agriculture land with an area of 837.46 km^2, Builtup area 25.59 km^2, Forest covers159.69 km^2, wasteland 282.48 km^2 and waterbody 28.04 km^2.

Keywords: Geospatial Techniques, Upper Tapi Sub Basin, Hydrology

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ORIGIN OF CHROMIUM-BEARING KAOLINITE AND PYROPHYLLITE IN THE SAIGAON QUARTZITES, WESTERN BASTAR CRATON

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Abstract

Pyrophyllite and kaolinite are alumino-phyllosilicates which occur as hydrothermal alteration product or weathering product of other aluminosilicates. In the Saigaon-Palasgaon area which represents an Archaean metasedimentary basin, pyrophyllite and kaolinite occur in association with mica and rutile. The Electron Probe Micro Analysis (EPMA) has shown that the pyrophyllite as well as kaolinite are chromium bearing (Cr_2O_3 0.09-0.25%). Chromium is not a common constituent of kaolinite and pyrophyllite, although reported in other localities such as Almaden mercury mining district of Spain. In that area, a pseudomorphic replacement of primary igneous minerals such as olivine, pyroxene and plagioclase by chlorite + Ca-Mg-Fe carbonate + silica; and the replacement which is characterized by formation of pyrophyllite, kaolinite, illite and illite-smectite ("argillic alteration") were considered to be the main sources of Cr in these minerals. However, in Saigaon - Palasgaon area, a pseudomorphic replacement of primary igneous minerals was not noticed on any scale. However, there is an alternate mechanism for incorporation of Cr in pyrophyllite and kaolinite is also available. Kaolinite is reported as a product of weathering of Cr-muscovite in Windmill Hill railway cutting near Toodaay, Western Australia. Here, the alteration of Cr-muscovite to kaolinite by weathering has indicated that the kaolinite crystals developed from muscovite preserve the crystallographic orientation of mica, and that the topotactic alteration show retention of some Cr and Fe in kaolinites. Present observations are in-line with above observations, and it is envisaged that the chrome-muscovite (green mica) has significantly lost its cations, viz. Cr, Fe and Mg due to weathering, which was incorporated by the weathering products (kaolinite, pyrophyllite). Thus, the mineral assemblage chlorite-pyrophyllite-kaolinite-muscovite in the Palasgaon-Saigaon area possibly represents root weathering of pre-existing Cr-rich muscovite, which resulted in formation of the Cr-deficient muscovite and Cr-rich pyrophyllite and kaolinite.

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MORPHOMETRIC ANALYSIS OF WRJ-4 WATERSHED - AN INTEGRATED APPROACH

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Abstract

The study is an effort to determine Morphometric parameters of WRJ-4 watershed located in Nagpur district, Maharashtra. The watershed is covered in the SOI toposheet 55 K/11 & 55 K/12. In this study morphometric analysis has been carried out in Jam river basin using remote sensing and GIS. The SRTM data with 30m resolution is used to evaluate linear, areal and relief aspects with the help of ARC GIS 10.2 software. Lithologically the terrain mainly comprises of basaltic rocks with alluvium deposits in the north part of the watershed. High drainage density, dendritic drainage pattern, elongated basin shape & low to moderate bifurcation ratio indicates a normal basin. The study shows that remote sensing data with geoprocessing techniques prove to be a competent tool in morphometric analysis and the data can be used for basin management and other hydrological studies for other sub-basins. It is proposed that these sub-watersheds may be taken up for development and management plans to conserve natural resource on sustainable basis with immediate effects. Such works will ultimately lead to formulate soil and water conservation ideas.

Keywords : WRJ-4 Watershed, Remote Sensing and GIS

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NUMERICAL SIMULATION OF SHALLOW WATER WAVES USING FINITE DIFFERENCE METHOD

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Abstract

Shallow Water Equations (SWE's), based on conservation laws of mass and momentum, are used as models for numerical simulation of shallow water waves. These models, both linear and nonlinear, are used for studying all shallow water ocean dynamics, e.g. tsunamis, storm surges, tides, etc. In this article one-dimensional (1-D) linear model of Shallow Water Equations (SWE's) is adopted to study the propagation of shallow water waves over continental shelf in the off coast of West Bengal in India. For discretization of the SWE's, Crank-Nicolson scheme of Finite Difference Method (FDM) is adopted with forward difference in time and second order central difference in space. MATLAB codes have been developed for the simulation. Simulation results have been validated with exiting literature and presented for some test bathymetry.

Keywords: Shallow Water Equation, Finite Difference Method, Crank-Nicolson scheme, MATLAB.

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SUSTAINING GROUNDWATER RESOURCES THROUGH COMMUNITY EMPOWERMENT AND ETHICAL PRACTICES

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Abstract

Groundwater is major source of water supply, and is intensively exploited globally for private, domestic and industrial use. Warnings of groundwater resource unsustainability are evidenced with falling groundwater tables and polluted aquifers The impacts of overabstraction and water-level declines have been reported widely. The overabstraction have found to cause a wide array of social, economic and environmental consequences including: critical changes in patterns of groundwater flow to and from adjacent aquifer systems; declines in stream base flows, wetlands, etc. with consequent damage to ecosystems and downstream users; increased pumping costs and energy usage; land subsidence and damage to surface infrastructure; reduction in access to water for drinking, irrigation and other uses, particularly for the poor. Pollution by Industrial agricultural and urban activities along with geogenic contamination are widely recognized as one of the most serious challenge to the sustainable management of groundwater resources. Emergence of more and more such incidences have led to good number of discussion and management responses with no such convincing management option in sight which may be applied universally to insure sustainability of the groundwater resources.

The rising population, growth, enhanced urbanization, modernizing agriculture and expanding industrial base, increasing food demand and adverse impact of climate change have further made the scarcity of renewable water supplies more critical. Water related science and technology has its own limitation in addressing the challenges.

In opinion of the author, resource may be managed more efficiently and effectively by its user community and stakeholders. If Community is empowered with new modern technique and applies ethics in using and managing the resource it may result in best practices for the resource management and the groundwater resources may become sustainable. The paper deals with the role of community empowerment and ethical practices by all the stake holders towards making the groundwater resource sustainable

Keywords: groundwater, Sustainability, Community, Ethical practices.

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THE PALACE OF GEOGRAPHICAL IMPORTANCE "JHUNJHUNWA HILLS" LOCATED AT PAWAI VILLAGE AURANGABAD DISTRICT IN BIHAR WITH A SPECIFIC ROCK METALIC TONE

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Abstract

The Pawai hills rock with on earth surface near Punpun river. The hills exhibit a natural landform that extends. Above the surrounding terrain, it is less than 984 to 1968 feet and less steep so comparatively easier to climb this mountain. There are several reasons for formation of the hill e,g. faulting (constant movement of rocks beneath the earth surface),melting and shifting of glaciers, land erosion etc. This hill is surrounded by lots of rocks and out of that there is a specific rock which looks same like others but it is different in characteristic. It makes a sound like a musical instrument when it is hit by another stone. This hill shows numerous variations due to varied geography phenomena.

Keywords: Metalic sound, Geographical, Terrain, Occurrence, land mark, rock.

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MICRO IRRIGATION TECHNIQUES FOR SUSTAINABLE RURAL DEVELOPMENT: A CASE STUDY OF CHITTOOR DISTRICT, ANDHRA PRADESH USING GEOSPATIAL TECHNOLOGIES#*

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Abstract

Indian Agriculture is majorly depends on Monsoons, very few perennial rivers and low ground water potentiality. Rayalaseema Region of Andhra Pradesh is identified as one of the Drought Prone region of the country. It has limited Irrigation facilities, very low underground water source-and that to extremely exploited. Due uncertain monsoon onset and continuation, depletion of underground water failure of crops leading to farmers suicide, which current debatable important issue. Chittoor district of Andhra Pradesh is one among Rayalaseema region districts and has varied Physical and Climatic conditions and the district population is mainly depending on agriculture and its related activities. But, the district is far behind in irrigation sources which is the back bone of agriculture. The district soils and weather phenomenon are very much favorable for agricultural operations. But the district is located in low rain fall receiving and drought prone area and it is vulnerable for discontinues, un reliable, onset failure of monsoons. More over the district does not have any perennial/ big river system or other big irrigation source. Once, the district is known for several agriculture surface wells and yearlong water flowing streams. Surface wells are totally replaced by tube wells and water flowing streams became dry and encroached. In later stage majority tube wells of the district became dry even 1400 – 1500 feet wells. In want of irrigation water, several farmers constructed more than one tube well. Some framers failed in obtaining water even from five to six tube wells constructed which has been leading for 'Farmer Suicides' noticed in several parts of low rainfall receiving areas of Andhra Pradesh state. In this circumstances Andhra Pradesh Micro Irrigation Project (APMIP) was launched in united Andhra Pradesh in the month of November 2003 with an objective of enhancing the crop productivity by improving the water use efficiency through micro irrigation techniques, improving the economic conditions of the farmers by conserving water, bringing additional area into cultivation with the available water resources, enhancing the crop productivity and production, quality, facilitating judicious usage of underground water,

saving in power consumption and cost of cultivation. The Andhra Pradesh Micro Irrigation Project (APMIP) did a sea change in agriculture by bringing major fallow land under cultivation and creating the awareness about various benefits of micro-irrigation techniques in the farming community to achieve the slogan 'more crops per drop'. In this circumstance emergence of micro-irrigation system has very much needed in drought prone area like Chittoor district of Andhra Pradesh with an aim of enhancing the crop productivity by improving the water use efficiency through micro irrigation systems for sustainable agriculture. The present study is based on both empirical observations and secondary information sources to analyze the achievement of micro irrigation in drought prone Chittoor district of Andhra Pradesh by using Geospatial technologies.

Keywords: Geo spatial techniques, Drought Prone, Micro Irrigation, Monsoons. More crop per drop

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CROP IDENTIFICATION AND ACREAGE ESTIMATION USING OPTICAL REMOTE SENSING AND GIS BASED LAND BASED OBSERVATION

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Abstract

Crop identification and mapping is pre-requisite for various crop planning and management activities. Crop type maps were generated by national and multinational agricultural agencies, insurance agencies, and regional agricultural boards to prepare an inventory of what was grown in certain areas and when. This serves the purpose of forecasting of grain supplies (yield prediction), collection of crop statistics, facilitating crop rotation records, mapping soil productivity, identification of factors influencing the crop stress, assessment of crop damage due to storms and drought, and monitoring the farming activities. Identification of crop types and delineating their extent to generate the reliable statistics play the key role in agriculture planning. Optical remote sensing makes use of visible, near infrared and short-wave infrared sensors to form images of the Earth's surface by detecting the solar radiation reflected in these wavelengths from targets on the ground. Different materials reflect and absorb energy differently at the visible and infrared wavelengths. Thus, targets can be differentiated by their spectral reflectance signatures captured in the remotely sensed images. The aim of present study was to identification of crop types, mapping and acreage estimation using time series satellite images. The optical remote sensing have equal capabilities in crop identification and acreage estimation with some of the limitations like, availability of cloud free images and spatial resolutions. However, advancement in spatial and temporal resolution optical remote sensing allowed accurate discrimination amongst the crop types and other vegetation.

Key words: Acreage estimation, optical remote sensing, crop mapping
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CRUSTAL DEFORMATION STUDIES OF IMPHAL VALLEY USING HIGH ACCURACY GLOBAL POSITIONING SYSTEM (GPS)

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Abstract

The evolution of the arc, structure, earthquake occurrence processes and seismic hazard of the Indo-Burmese arc is poorly studied. This region occupies three countries, namely, Bangladesh, India and Myanmar. Any comprehensive and efficient detailed study in region should include all the three regions and to answer a few questions, about the structure, tectonics, plate motion, etc. To understand the ongoing crustal deformation, we install a permanent station in the Imphal Valley of Indo-Burmese Wedge. We report results of data processing (2003-2021) of GPS measurements and results suggest that the site is actually located on the Burma plate and the velocity with reference to the Indian plate provides a constraint on the motion accommodated at the plate boundary fault located between the India and Burma plate.

Keywords*: GPS, Crustal deformation, Indo-Burmese wedge (IBW),*

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DELINEATION OF FLUORIDE GEOGENIC CONTAMINATION ZONES IN GROUNDWATER FROM SOUTHERN PART OF CHANDRAPUR DISTRICT, MAHARASHTRA, INDIA

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Abstract

The assessment of fluoride contamination from geogenic sources and seasonal groundwater quality variation were studied by collecting 100 groundwater samples in the Rajura and Korpana tahasil area of Chandrapur district in pre and post monsoon season. The hydrogeochemistry were studied by assessing physicochemical parameters of groundwater and majority of samples have greater fluoride (F^-) concentrations.

The Petrographic studies of different litho unit were carried out for finding the genesis of fluoride in groundwater. In X-Ray Diffraction (XRD) analysis the concentration of fluoride as well as fluoride bearing minerals in the rock and soil samples of the study area were estimated and petrographic results also compared and confirmed. The X-Ray Diffraction (XRD) studies confirmed that, the presence of various fluoride bearing minerals in rock as well as soil samples which are the main geogenic natural sources for fluoridated groundwater. The primary mechanism for the source of F- enrichment in the research area's groundwater is the rock-water interaction, together with physiochemical conditions including breakdown, dissociation, and subsequent dissolution. The groundwater is stabilized by high levels of Na^+ and HCO_3, as shown by the positive correlation of F^- with Na^+ and $HCO3^-$. The hydrogeochemical characteristics of groundwater containing excess F^- show that, ion exchange and weathering regulate the amount of F^-.

Keywords: *Hydrogeochemistry of groundwater, fluoride geogenic contamination, Petrography and XRD analysis.*

108th INDIAN SCIENCE CONGRESS
3 – 7 January, 2023
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IV
LIST OF
PAST SECTIONAL PRESIDEDNTS

PAST SECTIONAL PRESIDENTS

R. B. Singh	2020	S S Thigale	2004
J.P. Shrivastava	2019	Promod Kumar Varma	2003
Devesh Wlaia	2018	Anshu Kumar Sinha	2002
Onkar Singh Chauhan	2017	B Thakur	2001
Tejender Nath Jowhar	2016	S Acharya	2000
K L Shrivastava	2015	S M Casshyap	1999
Amarrendra K. Sinha	2014	P S Saklani	1998
Ajay	2013	V C Chavadi	1997
Pramod K. Verma	2012	A C Chatterjee	1996
Arun kumar	2011	B G Deshpande	1971
H S Sharma	2010	G C Chatterji	1970
Hari B Srivastava	2009	R C Misra	1969
VP Dimri	2008	K L Bhola	1968
M P Singh	2007	R L Singh	1967
Ravendra Kumar	2006	S P Nautiyal	1966
B Satyanarayana	2005	S Deb	1965-1964

P R J Naidu	1963	H Crookshank	1946
K P Rode	1962	N N Chatterjee	1945
W B Metre	1961	A S Kalapsi	1944
V S Dubey	1960	J A Dunn	1943
S C Chatterjee	1959	V P Sondhi	1942
A G Jhingran	1958	**Geology**	
Bhabesh Chandra Roy	1956	N Subrahmanyan	1939
A M N Ghosh	1956	V C Thakur	1995
V P Sondhi	1955	Harsh k Gupta	1994
H L Chibber	1954	D R Gadekar	1993
N L Sharma	1953	N K Mukherjee	1992
L A N Iyer	1952	C Naganna	1991
J B Auden	1951	**Geology & Geography**	
J Coates	1950	B D Pathak	1990
C Mahadevan	1949	M N Mehrotra	1989
P K Ghosh	1948	S L Kayastha	1988
C S Pichamuthu	1947	K B Power	1987

P Verma	1986	S K Roy	1939
V K Verma	1985	D N Wadia	1938
P G Adyalkar	1984	**Geology & Geography**	
M N Viswanathiah	1983	W D West	1937
G W Chiplonkar	1982	B Rama Rao	1936
S M Mathur	1981	M S Krishnan	1935
S S Merh	1980	K K Mathur	1934
R. S. Mithal	1979	N P Gandhi	1933
A B Das Gupta	1978	P Evans	1932
P Dayal	1977	G de P Cotter	1931
F Fahad	1976	David Penmam	1930
I C Pande	1975	Cyril Fox	1929
Mukti Nath	1974	H C Dasgupta	1928
M S Balasundram	1973	L Dudley Stamp	1927
Hari Narain	1972	B Sahni	1926
M R Shani	1941	G E Pilgrim	1925
L Rama Rao	1940	W F Smeeth	1924

G H Tipper	1922	W F Smeeth	1915
D N Wadia	1921	H H Hayden	1914
P Samiat Iyengar	1920	**Geography & Geology**	
L Leigh Fermor	1919	S M Tahir Rizvi	1941
E S Pinfold	1918	Shibaprasad Chatterjee	1940
C S Middlemiss	1917	A H Heron	1938