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Synthesis and Characterization of a Novel Carbazole Based Hole Transporting Material

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Abstract: Carbazole based derivatives are receiving much attention because of their interesting photochemical properties. These compounds constitute a well-known class of hole transporting material. The synthesis of a novel carbazole-based hole transporting material, tris(4-(3,6-diethoxy-9-H-Carbazol-9-yl)phenyl)amine, is carried out using Ullmann Coupling. During this, the intermediate compounds were synthesized by multi-step organic reactions. The synthesized compound is characterized using UV-Visible, FT-IR, NMR, and Mass spectroscopic techniques. These compounds can be used as hole transporting materials for the fabrication of solid-state dye-sensitized solar cells (DSSCs).

Key Words: Carbazole, hole transporting material, Ullmann Coupling, DSSCs.

INTRODUCTION

With the recent increase in awareness of environmental and energy issues, renewable energy sources are given more and more attention. Solar energy provides clean abundant energy and is, therefore, an excellent candidate for a future environmentally friendly energy source. The main aim of solar cell research is to increase the solar energy conversion efficiency at low cost to provide a cost-effective sustainable energy source. Photovoltaic cells are devices that convert the incident photon energy of the solar radiation into electrical energy. Looking at photovoltaics, a dye-sensitized solar cell is considered to be a promising candidate; they have a long shelf life and are low-cost renewable energy sources [1].

Organic materials can be chemically tuned to adjust to physical properties such as band gap and conduction energies, charge transport, solubility, and morphological properties. Small quantities are needed for device preparation. Organic photovoltaic solar cells, therefore, have the potential for development in the search for low-cost modules for the production of domestic electricity [2]. Basic work in our laboratory includes the synthesis of hole transporting materials for the fabrication of solid-state dye-sensitized solar cells [3].

Carbazole based derivatives have attracted much attention because of their interesting photochemical properties [4]. Another fascinating advantage is the versatility of the carbazole reactive sites that can be substituted with a wide variety of functional groups, allowing fine-tuning of its optical and electrical properties [5]. The carbazole derivatives generally possess good thermal stability and hole transport properties [6]. The combination of carbazole derivatives and triphenylamine derivatives is expected to offer improved thermal and morphological stabilities as well as their good hole transport properties [7].

Molecules contain a π -rich heterocyclic or aromatic ring system functionalized with one or more electron donating substituents exhibits good hole transporting properties. The most commonly encountered substituents are amino and alkoxy groups, which contain single bonded heteroatoms possessing sharable lone pairs. These molecules are easily oxidized to resonance stabilized radical cations, which are the actual positive charge bearing species. The most widely used hole transport molecule are aromatic amines, such as anilines, diphenylamines, triphenylamines, carbazoles, and their derivatives. Carbazole based compounds have interesting photochemical properties. Recent interest in the carbazole derivatives has been caused by its good charge transport

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GROUNDWATER EXPLORATION BY ELECTRICAL RESISTIVITY METHOD IN THE COASTLINE PARTS OF NORTHERN KERALA

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ABSTRACT

The electrical resistivity method is most widely accepted and used in ground water exploration. The resistivity of rock formation gives an indication of the presence of groundwater. Resistivity surveys carried out in areas of around Bekal, Mogral, Kumbla, Shiriya, Valiyaparamba, Pulimoottil, and Chal of Kasaragod and Kannur districts of Kerala. The Vertical Electrical Sounding (VES) field data collected by means of Schlumberger array had been analyzed by the computer software IPI2WIN, which results an automatic apparent resistivity interpretation. The interpretation delineated three to four geologic layers from these areas. The geologic sequence in the study area is composed of top laterite soil, middle porous laterite, bottom highly weathered/fractured basement, and fresh basement. The top layer is composed of lateritic hard pan and dry sand with resistivity values ranging from 365 Ω m to 9350 Ω m. The resistivity values indicate that best layer which performs as a yielding aquifer is the second layer. In low lands this layer may be porous laterite and in beach areas it may be saturated sand. The third layer fractured basement / lithomargic clay is also possessed ground water in good amount.

Keywords: Vertical Electrical Sounding, Schlumberger array, aquifer, apparent resistivity.

INTRODUCTION

Groundwater exploration and water quality evaluations by using geophysical techniques have been increased over the last few years due to the recent rapid increases in the usage of computer software. The geophysical method is a quick and reliable technique used for the exploration of groundwater and it has been widely applied across the world (Zhody et al 1974). The geophysical techniques are used to measure and quantify the differences or anomalies of physical properties of different objects that present in the earth, such as gravity, magnetic, seismic and electrical properties. Due to the heterogeneous characteristics of the earth and the non-uniform occurrence of different formations vertically as well as horizontally marked contrast in the physical properties are observed (Singh et al 2002). These variability characteristics are very helpful in identifying and delineating the nature of subsurface features.

Geoelectrical methods have been used for a variety of purposes especially for groundwater exploration and evaluation (Zohdy, 1969; Karanth, 1987; Janardhana Raju et al., 1996). It is an active geophysical method and it utilizes direct currents or low frequency alternating currents to investigate the electrical properties (resistivity) of the subsurface. The resistivity of the aquifer is primarily based on quality of the water in the aquifer, aquifer characteristics such as porosity, permeability, pore size, etc., temperature of the subsurface environment, distribution of the rock, etc. The electrical resistivity methods give fairly accurate results in groundwater study which detects anomalies in electrical resistivity's of rock within the earth's crust, which is used in the field of groundwater exploration are to locate groundwater bearing formations, estimation of depth to the water table, thickness and lateral extent of aquifers, depth to bed rock, delineation of weathered zone, structures and stratigraphic conditions such as fractures, dykes etc., and distribution and configuration of



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Interpretation of natural radionuclides with respect to the petrological aspects: A study along the coastal region of Azhithala, Southwest coast of India

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ABSTRACT

In the present study the activity concentration of natural radionuclides viz. ^{40}K , ^{226}Ra , and ^{232}Th in the sand samples of coastal regions of Azhithala, Kerala measured using the $5'' \times 5''$ flat type NaI (TI) detector. The radiological parameters such as absorbed dose rate (indoor and outdoor), annual effective dose, radium equivalent activity, and excess lifetime cancer risk were measured and compared with the Indian and World average values. The activity concentration of all natural radionuclides is well within the Indian and world average values except for the activity concentration of ^{232}Th . The higher concentration of natural radioactivity in the study area is due to the deposition of weathered zircons or monazites from charnokite rocks. The charnokite group is the predominant lithology of the south the of Kasaragod district. The active erosion by the rivers might be the reason for the presence of the zircons or monazites in the study area. The results of the study are discussed in detail in this manuscript.

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1. Introduction

Radioactivity is the phenomenon of spontaneously emitting ionizing radiation or particles caused by atomic nuclei's spontaneous disintegration. The emission of radiation is a natural process, it can have harmful effects on living cells. Radionuclides are radioactive isotopes that are found in different environmental matrices such as air, water, soil, and vegetation [1]. The concentration of these radionuclides can vary depending on the geology and geological factors of the region. Radionuclides present in the environment come from both natural and artificial sources. Natural background radiation is composed of two types: one that comes from cosmic rays and the other that originates from the Earth's crust. Natural sources, such as cosmic, terrestrial, and solar radiation, contribute

to about 82% of the radiation dose absorbed by humans. The main contributors to natural radioactivity are uranium and thorium found in the soil in the form of minerals, including uranium minerals, thorium minerals, monazite, and uranite. The major naturally occurring radionuclides in the environment are ^{226}Ra , ^{232}Th , and ^{40}K based on dose rate [2].

The coastal environment of Kerala, especially Chavara, and Neendakara in the Kollam district is one of the high background radiation regions in the world. The petrological parameters affects the radionuclide concentrations such as mineralogy, grain size, porosity. Geological history, groundwater flow and weathering can also affect the radionuclide concentration. Different investigators such as Raju et al, (1986), Prakash et al, (1991), Narayana et al, (2005), Shetty et al., (2006), Christa et al, (2012), Mary et al, (2012), Ramaswamy et al., (2013), Pinto and Narayana (2014), Balakrishnan et al, (2016), Vineethkumar et al, (2018), Divya et al., (2019), Ramsiya et al., (2019), Vineethkumar et al., (2020), Vineethkumar

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Groundwater Potential Zonation of Delampady Grama Panchayath, Kasaragod, Northern Kerala: A Geophysical and GIS Approach

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Abstract: Existence of life on the Earth depends on the water, the elixir of life. To ensure the right quantity of water in right quality, exploration of available resources and mapping of the same is very essential. Delampady Grama Panchayath of Kasaragod District, Northern Kerala, located between longitudes 75° 09' 55" to 75° 19' 45" E and latitudes 12° 30' 13" to 12° 37' 02" N is a region where summer monsoon is highest in Kasaragod district but, the Panchayath is measured as one of the area in the district where groundwater obtainability is less. In the Panchayath, a number of places where scarcity for drinking water has been stated. Here, an effort has been made to identify and demarcate the ground water potential zones using electrical resistivity method and geospatial tools which are proven methods by many hydro-geologists. Pre and post monsoon water table fluctuation from 15 open wells, vertical electrical sounding at nearby 12 locations, surface flow accumulation and land form analysis has been done to achieve the goal. The assessment resulted in identification and categorization of groundwater potential zones as high, moderate and low limited. This demarcation of groundwater potential zones will help in planning sustainable water resource development and management strategies for the region.

Keywords: Ground water potential zonation, VES, Geospatial tools, Delampady Grama Panchayath

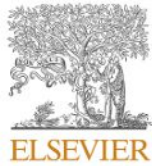
I. INTRODUCTION

Water is a prime natural resource, a basic human need and a precious national asset. It is one of the valuable natural resources that determine the health of a human being in an area (K. Ibrahim Bathis and S.A Ahmed, 2016). The planning and management of water resource and its optimal, economical and equitable use are important and urgent. The available quantity is limited, but the demand on water keeps on increasing with increase in population and to produce more food, and other needed products. The rate of depletion of aquifer storage due to over exploitation and deterioration of water quality due to uncontrolled anthropogenic activities is of immediate concern in major cities and towns of the country (Khurshid et al., 1997; Sohani et al., 2001; Meenakumari and Hosmani, 2003; Dhindsa et al., 2004; Ramasubrahmanian et al., 2004; Subrahmanian, 2000; Singh et al., 2011). This has resulted in the improvement of techniques for investigating the occurrence and movement of ground water. Over past few decades, access to drinking water in India has increased (Singh et al., 2013). Occurrence and distribution of groundwater is closely related with the climate, regional setting, lithology, geomorphology, fractures in hard rocks, structural features and land use type (Edet et al., 1998; Greenbaun, 1992; Jaturon et al., 2014; Kumar et al., 2007; Saud, 2010; Senthil Kumar and Shankar, 2014). Better understanding of the groundwater occurrence and its movement can be achieved only by integrating different existing remote sensing and field studies of geological and geophysical explorations.

Remote Sensing and Geographic Information System provides a better platform to analyze the spatial variations in the above mentioned parameters which are dependent of groundwater occurrence. With the ease of availability of data and its processing in GIS environment for meeting the target of groundwater potential zonation with considerable accuracy led many of hydro-geologists to turn and depend on geospatial technology (Gumma and Pavelic, 2013; Murthy, 2000; Rashid et al., 2011; Senthil Kumar and Shankar, 2014). Advantages of spatial, spectral and temporal availability and manipulation of Earth surface and subsurface data covering vast and inaccessible areas within a short time have a great potentiality in groundwater hydrology for accessing, monitoring and groundwater resources (Dar et al., 2010). Integration of different layers were tried by many researchers such as drainage pattern, geomorphology, soil, lineament (Preeja et al., 2011; Rassam et al., 2008; Saraf and Choudhary, 1998, K. Ibrahim Bathis and S.A Ahmed, 2016), soil texture and rainfall intensity (Magesh et al., 2012), resistivity, aquifer thickness, or fault maps (Senthil Kumar and Shankar, 2014) for better understanding of hydrological and hydrogeological conditions of the area.

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Serpentine-magnesite Association of Salem Ultramafic Complex, Southern India: A Potential Analogue for Mars

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ABSTRACT

The primary mineral olivine and its alteration products, serpentine and magnesite, have been reported from several locales on Mars. The mineralogical similarity of the altered ultramafic rocks on Earth makes them a potential analogue that can provide significant insight into the serpentinization and carbonation processes on Mars. This serpentine-magnesite assemblage is significant in astrobiology because serpentinization is known for the formation of simple organic molecules like methane from inorganic precursors. An association of olivine-serpentine-magnesite is widely distributed in the Salem Ultramafic Complex (SUC) in Southern India. We used hyperspectral, Laser Raman, and Fourier-transform infrared (FTIR) techniques to characterize this mineral association in the SUC. The visible and near-infrared (VNIR) spectra of all the serpentine samples show a narrow and strong absorption feature at 1.4 μm and an in-depth feature at 2.35 μm . Magnesite samples have broad and strong features at 1.4 μm , 2.3 μm , and 2.5 μm . The obtained spectra were compared with their Martian counterparts using the Mars Reconnaissance Orbiter-Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) type spectral library. Raman spectroscopy is used to differentiate serpentine polymorphs. The major polymorph in the area is antigorite, which shows intense Raman peaks at 682 cm^{-1} , 371 cm^{-1} , and 228 cm^{-1} , and weak peaks at 635 cm^{-1} and 1040 cm^{-1} . The Raman peaks at 1096 cm^{-1} and 326 cm^{-1} are typical of magnesite. FTIR spectra from the serpentine samples are characterized by the absorption feature at 3680 cm^{-1} indicative of antigorite, formed due to hydroxyl stretching. Diagnostic absorption features of magnesite are observed at 748 cm^{-1} , 877 cm^{-1} , 1427 cm^{-1} , 1826 cm^{-1} , and 2358 cm^{-1} . The results from this study can be applied to future missions to validate orbital spectroscopic data, instrument calibration purposes, and data interpretation.



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Mechanism of rift flank uplift and escarpment formation evidenced by Western Ghats, India

Radhakrishna T.^{1,3}, Asanulla R. Mohamed¹, Venkateshwarlu M.², Soumya G. S.¹ & Prachiti P. K.¹

The Western Ghats is one of the largest escarpments on earth, containing Reunion plume derived Deccan Traps, it is an excellent example to probe epeirogenic uplift, extension and subsidence in volcanic continental margins. The most continuous unbiased stratigraphic section of basalt down to the basement within a 1250 m drill hole of the Continental Scientific Deep Drilling Project is a valuable resource to investigate the above aspects. The flows across the entire drill core are geologically subaerial in character with basement exposed ~300 m below the mean sea level; they clearly display more evolved compositions from primary melts of mantle in terms of petrology, and only a single geomagnetic polarity transition in palaeomagnetic data. These results, combined with existing geological and geophysical data, constitute a multi-method approach that demonstrates (a) igneous underplating caused uplift prior to frequently suggested flexural isostasy (b) plume impact and eruption are near-simultaneous and extension/rifting essentially followed soon after volcanism and (c) lithosphere beneath the continental margin, while returning to normal temperatures following the Seychelles-India breakup, experienced thermal collapse and subsidence causing slumping of basalt basement below sea level.

The Western Ghat (WG) escarpment was developed from rifting and separation of India from the Seychelles and is closely linked with the late Cretaceous (~65–66 Ma) Deccan flood basalt eruption; it demarcates the low-lying seaward coastal plains in the west from the elevated plateau to the east (Fig. 1). It is one of the largest escarpments on a volcanic continental margin in the world with over 1500 km strike length paralleling the coast and elevations ranging beyond 1 km. Therefore, this is a classic example to investigate the relationship between volcanism, plateau uplift and extension (and rifting) on volcanic continental margins. Many investigations pertain to sustained erosion and retreat of the escarpment much to the east^{1–3}. These studies attribute the uplift to flexural isostasy as a result of onshore denudational unloading and offshore loading in the sedimentary basins; a few others invoked neotectonic activity for the uplift^{4,5}. However, several lines of evidence indicate that flexural loading alone cannot be responsible for the regional uplift (~3 km onshore unroofing is required to account for sediment loading)^{6,7} and it requires a preexisting elevated rift flank in addition to flexural uplift. Furthermore, the uplift and elevation in a non-volcanic rift environment is not commensurate with that found in the WG and such uplift can be linked to the development of a volcanic rift margin⁸. McKenzie⁹ was the first to revive a century old idea that igneous underplating is a possible mechanism for the epeirogenic uplift in regions other than plate boundaries. That is, the rift flank topography on the west coast may have close link with the Deccan flood volcanism.

There is also considerable debate on the extension/rifting and volcanism chronology. One view is that rift-margin igneous provinces form by decompression melting of a hot plume head beneath a region already undergoing extension¹⁰. Alternatively, the plume impact model¹¹ proposes that large-scale volcanism results from melting of upwelling asthenosphere, leading to thinning of lithosphere and thereby extension and rifting. In either case, magmatic underplating is valid and may have induced rift flank uplift. Although a few isolated studies indicate magmatic underplating on the western margin of India, its linkage to uplift remained elusive. For example, a recent study of receiver function analysis¹² suggests underplating in the Kutch region, but the region is much (>150 km) to the west of the escarpment in the north and it also experienced multiple tectonic episodes that may relate to different stages of the Gondwana breakup since the Triassic. The recent Continental Scientific

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Indoor Air Pollution by Ozone at a Tropical Site in India – Kannur

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Abstract

This study examines the indoor ozone (O_3) induced pollution in the rural location of Kannur, a tropical site in India, during March 2010 and the influence of their most important elements. Measurements of indoor O_3 , NO, NO_2 and NO_x were carried out in a residential building for a period of one week. Measurements were taken from the kitchen, as it had been identified as the most polluted room. The levels of background concentrations of O_3 , NO, NO_2 and NO_x were also monitored.

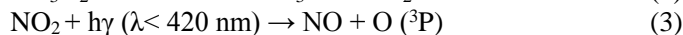
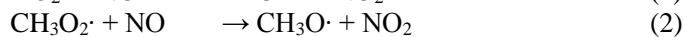
It was found that the average indoor O_3 level in the kitchen was 14.85 ppbv while the corresponding outdoor O_3 level was 17.83 ppbv. The study indicated that outdoor O_3 had a strong impact on indoor O_3 level, which implies greater transport of ozone from outdoors to indoors. Ozone is an important gaseous pollutant which may lead to severe health problems.

Keywords: Air pollution, Indoor air quality, Nitric oxide, Nitrogen dioxide, Ozone, Ventilation.

Introduction

Ozone (O_3) is a trace gas having three oxygen atoms. It is an unstable molecule that is highly reactive with other gases in the air and it is one of the governing components in the atmosphere that controls environmental air quality and atmospheric chemical processes. Ozone occurs in two layers of the atmosphere. The ground level tropospheric ozone is bad, as it is unhealthy, it causes irritation and damage to plants and animals through its strong oxidizing ability and is a constituent of smog¹⁻⁴. The ozone in the stratosphere is good, as it safeguards plant and animal life on earth from the sun's hurtful ultraviolet (UV) rays. This stratospheric ozone layer and its helpful effects should not be confused with the harmful effects of ground level and indoor ozone.

Tropospheric ozone is a secondary pollutant that is not released directly by sources. It is produced photo chemically in the troposphere from reactions comprising a variety of volatile organic compounds (VOCs) and nitrogen oxides ($NO_x = NO + NO_2$) in the presence of adequate UV radiation from the sun⁵. The tropospheric ozone production happens through the conversion of NO to NO_2 by peroxy radicals ($HO_2\cdot$ and $RO_2\cdot$) followed by photolysis of NO_2 . The NO_x is discharged from a variety of natural and anthropogenic sources and through the reactions 1 to 4 produces ozone⁶:



The outdoor ozone can be transported to indoor environment by ventilation and infiltration⁷. Generally, the indoor ozone concentration is lower than that in the outdoors due to ozone removal by indoor surfaces and indoor gas phase reactions. Even low-level indoor ozone can cause adverse effect on human health and is very destructive to organic materials such as plastics, latex etc.⁸ Indoor ozone-initiated chemistry can produce secondary emission of particulate matters and volatile organic compounds (VOCs) such as aldehydes and ketones, which are more harmful than ozone itself, thus making indoor ozone chemistry an essential subject of investigation^{9,10}.

Exposure to indoor ozone is accompanied by exposure to the products of ozone initiated indoor chemistry¹⁰. These products are the results of the ozone reaction with many common organic chemicals that contain unsaturated carbon-carbon bonds (e.g. isoprene, styrene, terpenes, squalene and unsaturated fatty acids and their esters) because these compounds react with ozone much faster than saturated organic compounds. Even in the absence of indoor ozone emissions, there are indoor sources of ozone reactive chemicals including the occupants themselves, soft woods, carpets, linoleum, paints, polishes, cleaning products and air fresheners, soiled fabrics and soiled ventilation filters¹¹⁻¹³. These rich sources result in significant quantities of indoor chemicals that can react with ozone whenever outdoor concentrations are raised.

A vital source of volatile organic compounds (VOCs) in the indoor air is the chemical reaction happening between indoor ozone and occupant surfaces (skin, hair and clothing). Indoor surface reactions are major sources of oxidation products¹⁴⁻¹⁸. Unlike gas-phase reactions, surface chemistry reaction rates are slower than air exchange rates¹⁹. These kinds of chemical reactions can bring obvious impact on indoor air quality (IAQ) and building occupant health.

The stable indoor ozone oxidation products (e.g. organic acids and carbonyls) are correlated with ozone concentrations²⁰⁻²². In addition to stable products, ozone chemistry produces relatively short-lived products such as peroxyhemiacetals, primary and secondary ozonides, α -hydroxy ketones, α -hydroxy hydroperoxides and peroxyacyl nitrates²³⁻²⁷. Although short-lived, they exist long enough to be inhaled and transported into the respiratory tract. Indoor



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Deserts and Oases: Geospatial Analytics of Higher Education Access

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Abstract

Despite the high level of literacy, near universal enrolment in elementary education, and higher indices of social and human development among Indian States, Kerala has not made an impressive headway in higher education. Several studies show that there is ubiquitous relationship between ‘place’ and educational opportunities. Learners’ choice in enrolling to a programme and or an institution of study is largely driven by the geography and physical access to these institutions. This aspect has been widely covered in the Western context, but there are not many studies in the Indian context, especially so in Kerala. In this article, we propose a spatial-metric tool to assess disparity in educational opportunities by assigning a fixed dimension to define the ‘catchment’ area of an institution. We integrated our results with a model of higher education opportunity markets proposed in earlier studies for better understanding. This provides information about the graded nature in the choice of opportunities available in a region and its spatial distribution. Such regions are further classified as regions of negligible opportunities (education deserts) and abundant opportunities (education oases). The spatial-analytical tool proposed here can be recreated and applied across different regions employing various socio-economic and other relevant components of interest. This can have significant implications in educational planning and administration of a region.

Keywords

Educational opportunity, geospatial technique, education deserts, policy interventions, higher education, Kerala

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Geoscience Curriculum: Approach Through Learning Taxonomy and Outcome Based Education

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Abstract

Learning outcomes are inevitably to be declared by any university and educational institution at every level of their programmes. It should have a general scheme for all programmes regardless of the discipline specificities, individual courses or even independent instructional units. Such outcomes are stated at different levels based on the taxonomy of learning adopted in each scheme. People follow different learning taxonomies for stating course contents, designing the assessment items and measuring the attainment. In this work, revised Bloom's taxonomy (Anderson and Krathwohl, 2001) has been adopted as a classic model to express different cognitive levels in outcome statements and assessment items. This has been demonstrated here based on an 80 credit postgraduate programme in geology offered by state universities and autonomous institutions. This article presents outcome statements and assessment items for three courses of the programme, namely (a) Biostratigraphy and Palaeontology, (b) Metamorphic Petrology and (c) Structural Geology, which can be ideal specimen for adopting the learning taxonomy and outcome-based education in any similar disciplines of educational programmes.

Keywords

Learning outcomes, taxonomy of learning, geology, postgraduate programme, outcome-based education

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ORIGINAL ARTICLE



Morphometric Analysis for Sustainable Development of Watersheds Using Multisensor Satellite Data: A Case Study from Shiriya River Basin

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Abstract

Objectives: The goal of this research is to calculate, compare and analyze the morphometric drainage parameters of Shiriya River Basin (SRB), Kasaragod, Kerala, using DEMs acquired by different satellite sensors and topographic data (SOI toposheet) for sustainable watershed development. **Methods:** The Arc GIS 10.3.1 software was used to measure linear, relief, and areal aspects of morphometry. The input data used for deriving the drainage network of the SRB were SOI toposheet (1:50000 scale), SRTM DEM (90m), Cartosat, ASTER and ALOS PALSAR DEM of resolution 30 m each. The relative error percentage of basic parameters derived from DEMs concerning the toposheet is calculated. A groundwater potential map is prepared using weighted overlay analysis of thematic layers (geology, geomorphology, slope, drainage density, lineament density and depth to water level). **Findings:** Present study revealed that the parameters derived from SRTM DEM data are more similar to those derived from toposheet. Most of the parameters obtained from each input DEM are more or less equal, and the minor variation may be due to varied data collecting and processing methodologies used for DEM creation. SRB is characterized by 6 th order stream with a dendritic drainage pattern, which is elongated and less susceptible to soil erosion. SRB has an intermediate texture and is in a mature stage of geomorphic evolution. Inference from the ground water potential zonation map indicates that major portion of the SRB has moderate ground water potential. **Application/improvement:** The study would be a valuable source for identifying water recharge sites, basin modelling, and groundwater prospect mapping. **Novelty:** This research has attempted to compare and analyze the morphometric parameters' results from multisensor satellite data for sustainable watershed management. An attempt has been done to understand the relation between morphometric parameters and ground water potential of SRB using Groundwater potential zonation map.

Keywords: Drainage morphometry; Shiriya River basin; GIS; Karnataka; Kerala



Geoscience Curriculum: Approach Through Learning Taxonomy and Outcome Based Education

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Abstract

Learning outcomes are inevitably to be declared by any university and educational institution at every level of their programmes. It should have a general scheme for all programmes regardless of the discipline specificities, individual courses or even independent instructional units. Such outcomes are stated at different levels based on the taxonomy of learning adopted in each scheme. People follow different learning taxonomies for stating course contents, designing the assessment items and measuring the attainment. In this work, revised Bloom's taxonomy (Anderson and Krathwohl, 2001) has been adopted as a classic model to express different cognitive levels in outcome statements and assessment items. This has been demonstrated here based on an 80 credit postgraduate programme in geology offered by state universities and autonomous institutions. This article presents outcome statements and assessment items for three courses of the programme, namely (a) Biostratigraphy and Palaeontology, (b) Metamorphic Petrology and (c) Structural Geology, which can be ideal specimen for adopting the learning taxonomy and outcome-based education in any similar disciplines of educational programmes.

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OPEN

Low geomagnetic field strength during End-Cretaceous Deccan volcanism and whole mantle convection

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Knowledge about long-term variation of the geomagnetic dipole field remains in its nascent stage because of the paucity of reliable experimental data over geological periods. Here, we present the first robust experimental data from the largest Cretaceous flood basalt province on Earth, the ~65–66 Ma Deccan basalt within a thick (1250 m) unbiased stratigraphic section down to the basement, recovered from a drill hole of the Koyna Deep Scientific Drilling Project in the Western Ghats, India. Critical analysis of the result along with similar results of the Cretaceous age find that (i) the dipole moment during the end Cretaceous Deccan eruption is the lowest in whole of Cretaceous (ii) dipole moment at the onset/termination of the Cretaceous Normal Superchron is apparently lower relative to that in mid-superchron, however, such differences cannot be deciphered in shorter polarities probably because of insufficient time to develop recognizable variations (iii) inverse relation between dipole moment and reversal rate is lacking and (iv) a cause and effect relation between core-mantle boundary heat flux and low dipole moment that appears to be the principle governing factor in forming the Large Igneous Provinces on the surface of earth.

Long-term variability of Earth's early Dipole magnetic field (palaeointensity; PI) is a complex internally driven phenomenon. Numerical simulations apart, geological materials are the only source for direct experimental estimates. However, large failure rate, prolonged duration of experiments and increased complexities in deciphering magnetic field at early periods have become a serious hindrance for this experimental approach; therefore, a vast number of studies have focused over the period of one million year, where the determinations are relatively more straight forward. Yet, in recent years, there have been compilations of PI data over the geological period with an objective to develop a robust global database (for example, PINT15 database: <http://earth.liv.ac.uk/pint/>).

The Mesozoic period has drawn a special attention with the proposal of a period of relatively low field, one-third of the Cenozoic value, known as the Mesozoic Dipole Low (MDL)¹. Whereas some investigations argue that the MDL proposal is not tenable^{2–6}, the hypothesis has gained wider support^{7–9} although many disagreements exist on the duration of the low field. The MDL was suggested to confine to the Jurassic Quiet Zone (~145–165 Ma)¹⁰, and some others extend it into early Cretaceous^{11–13}. The low field strength is also variably described with respect to the Cretaceous Normal Superchron (CNS); some argue that the MDL extended into the CNS^{14,15}, some others, mostly from China, report a low field at the onset of CNS^{16–18} and some works find it at the end of the CNS^{19–22}. Likewise, the low fields are correlated with high reversal frequency^{9,23–26}, but there are arguments decoupling the two^{21,27,28}. The fluctuation in geomagnetic field strength is intricately linked to core-mantle boundary (CMB) heat flow and whole mantle convection processes^{25,29–32}. In light of the ongoing hot debate and the large-scale geodynamic significance, we conducted a comprehensive PI study on one of the prominent surface manifestations of whole mantle convection, the Deccan flood basalt covering an unbiased stratigraphic section within a thick drill hole of the Continental Scientific Deep Drilling Project in the Koyna region of the Western Ghats, India (Fig. 1). We combine the results with other high quality Cretaceous global data and interpret in terms of relationships between geomagnetic behavior, polarity reversals and deep mantle processes.

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Mirroring Narratives: An analysis of spatial representations in Vikram Chandra's
Sacred Games

With the rise of global, local and glocal movements, the questions of space have increasingly gained significance. Modern geographic studies underline the mythological, symbolic, perceptual and representational aspects of space. Consequentially postcolonial narratives exhibit a keen interest in reflecting and analyzing the hidden politics of spatial representations. Postcolonial Indian fiction too sheds light on the political nature of spatial representations. Vikram Chandra's novels exemplify such a theoretical turn towards the representing place and different modes of spatial representations. In Sacred Games, Chandra presents city as a text. Like any other text, city is composed of various signs working towards to communicate culturally significant meanings. The novel joins with the current trends in cultural geography that read landscape as a text. The novel also introduces a wide variety of spatial



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Morphology of the north-western wall of Eos Chaos, Valles Marineris: Evidence for glaciation during late Amazonian high obliquity

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ABSTRACT

Glacial landforms have been reported from various regions on Mars; most notably from the mid-to-high latitude regions. We studied Eos Chaos, located towards the eastern boundary of Valles Marineris, for the possible glacial processes occurring in the low-latitude areas on Mars. A thorough investigation of the morphology of the north-western wall of Eos Chaos was carried out using planetary datasets such as context camera (CTX) and High-resolution Imaging Science Experiment (HIRISE) images from NASA's Mars Reconnaissance Orbiter (MRO) mission and Mars Color Camera (MCC) images from ISRO's Mars Orbiter Mission-1 (MOM-1). We identified various geomorphological features that may have resulted from diverse geological processes. The glacial processes are manifested by the morphological features such as tongue-shaped lobate flows, alternative dark and light strata (~10-15 m thick), light-toned fragmented sediments, kettle lake-like structures, surface striations, sublimation hollows, and pit and knob structures. The flow features correspond to three stages of evolution: developing (~0.3 km length), intermediate size (1.5 km length), and mature (~15 km length). These three stages culminated in developing a model depicting the evolution of the glacial landforms of the region based on morphological features. We deduce that the glacial landforms of the region were formed during episodes of higher planetary spin axis obliquity during the late Amazonian.



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Evolutionary history of western Eos Chaos of Valles Marineris, Mars: Insights from morphological characteristics

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ABSTRACT

The dynamics of aqueous processes within the Eos Chasma region in the trough of Valles Marineris on Mars have been attributed to a variety of Hesperian-aged landforms. We aim to improve the understanding of the geological characteristics of the western part of the Eos Chaos by investigating the morphological, topographical, and thermo-physical characteristics of the western semi-circular segment of Valles Marineris. The western Eos Chaos is characterized by remnants of an elevated crater rim, a central peak, and a circular boundary. Based on these observations, we infer that the study area is an ancient, highly degraded impact crater. Our observations indicate that numerous geological processes, such as fluvial, tectonic, and aeolian processes, have shaped the landforms. For instance, channels on the slope of the wall with a mean v -index of 0.2 indicate a fluvial origin. The chaotic mounds within the study regions are highly degraded. However, the presence of eroded inselberg peaks above the maximum ponding level of eastern Valles Marineris (~3560 m) suggests that both aeolian and fluvial processes have played a role in the denudation of the impact crater. Furthermore, both aeolian and fluvial processes also influenced the morphological evolution of inselbergs of this impact crater of Eos Chaos. The morphological, topographic, and thermal inertia characteristics of the landforms in the Eos Chaos are similar to those found elsewhere in Valles Marineris. In this study, the impact crater of Eos Chaos is considered a sub-region of Valles Marineris, in which evidence for many past geological processes is preserved. Based on possible chronological markers, we have developed a model that explains the evolution of the Eos Chaos impact crater and its incorporation into Valles Marineris.

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1. Introduction

Valles Marineris, the largest canyon of the solar system, has been subjected to various planetary processes in the past. These processes, such as aeolian activities, fluvial processes, tectonic movements, meteorite impact, and landslides, shaped the diverse landforms found in Valles Marineris (Luchitta et al., 1994; McKenzie and Nimmo, 1999; Flahaut et al., 2011; Andrews-Hanna, 2012; McEwen et al., 2014; Davis et al., 2018; Rajaneesh et al., 2022). Recent studies on Valles Marineris have focused on understanding the sub-regions of the canyon, which

include seven parallel chasmata and related chaotic terrains. Scientists have gained a better understanding of the canyon as a whole by studying these sub-regions. However, collating a chronological sequence of events in this region is challenging. Of all the geological agents, wind and water were considered the most prominent in carving out several landforms within this trough system. Wind, the most powerful geological agent shaping Valles Marineris, has created many erosional and depositional landforms throughout the canyon system (McEwen et al., 2014; Burr et al., 2010). Dune fields can be found in all the subunits of Valles Marineris, including Ius Chasma, Melas Chasma, Coprates Chasma, Capri Chasma, Ganges Chasma, and Juventae Chasma (McEwen et al., 2014; Burr et al., 2010). The sediments that make up dune fields in Valles Marineris come from various sources, including layered deposits within the

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Self-reversible mechanochromism and aggregation induced emission in neutral triarylmethanes and their application in water sensing†

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The photophysical properties and imaging/sensing applications of triarylmethane carbeniums are well recognised, whereas the neutral triarylmethane precursors are less investigated in this respect. Herein, we describe the synthesis of three triarylmethane derivatives, namely **PhMBD**, **PyMBD** and **PrMBD**, having a general structure $R'R''_2CH$, where R' = phenanthrene, pyrene, and perylene, respectively and R'' = N,N' -dimethylaniline. The photophysical studies of these molecules revealed the existence of intramolecular exciplexes even in solvents of moderate polarity. Supportive evidence for exciplex formation was obtained from TD-DFT calculations and solvent polarity/protonation-dependent absorption/emission profiles. Among the three, **PrMBD** exhibited high contrast and self-reversible mechanochromism with a hypsochromic shift of 74 nm on grinding. Moreover, it also showed time-dependent multicolour acidochromism in the solid state. **PyMBD** and **PrMBD** were aggregation induced emission (AIE) active and all three molecules responded to increasing viscosity of the medium with emission enhancement. The emission of these molecules was highly sensitive to solvent polarity and consequently responded to low levels of water in organic solvents with 'turn off' fluorescence.

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Introduction

Recent years have witnessed an upsurge in the design and synthesis of structurally diverse fluorophores that absorb/emit in the UV-vis to NIR region, with tremendous application potential in areas like materials science, medicine and biology. However, the practical utility of many of these fluorophores is often limited in the condensed phase due to aggregation caused quenching (ACQ). Polyaromatic hydrocarbons (PAH) are typical examples of this category. They exhibit good chemical stability and interesting photophysical behaviors in solution, but suffer from severe emission quenching on aggregation. This is attributed to highly efficient π - π stacking in the aggregated state, which activates the non-radiative decay pathways.¹ A solution to this impediment was identified by Tang and co-workers in 2001, when they came across the reverse phenomenon, where aggregation induced emission was observed

for the first time in a series of silole derivatives.² They coined the term AIE (aggregation induced emission)/AIEE (aggregation induced emission enhancement) to represent this process. Ever since, the repertoire of AIE fluorophores has grown substantially due to the intense research activity in this area. A seminal review by Tang *et al.* encompasses the development in this area till 2015.³ These investigations provided information about the necessary structural requirements a fluorophore must possess for exhibiting AIE activity. Apart from the rational design of novel AIE fluorophores, emphasis was also given to convert existing fluorophores to AIE active molecules through suitable structural modifications. An extensively used structural modification for effectively transforming the traditional ACQphores to AIEgens is the disruption of planarity of the molecule through introduction of appropriate substituents, which can either be AIE active (*e.g.*, tetraphenylene ethylene)^{4–13} or substituents without a specific fluorogenic activity.^{14–24} These modifications promote AIE through two effects: restriction of intramolecular rotation of the substituents connected to the fluorophore core in the condensed phase and/or via disruption of close packing due to twisted geometry.^{25–32} These two effects can operate either independently or in combination to produce the AIE properties. Apart from satisfying the steric and geometric requirements for AIE activity, appropriate substituents can also modulate the photophysical properties of

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† Electronic supplementary information (ESI) available: Spectroscopic properties, DFT calculations, DSC measurements, fluorescent microscopic images and spectroscopic and thermal characterizations. See DOI: 10.1039/c8nj04479a

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Colonialism and Institutional Practices in Agriculture: Some Observations on Agricultural Research in Kasaragod

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Abstract: Colonialism had no uniform method of intervention and form of exploitation. It is dynamic and the forms of intervention changed according to the needs and requirements of colonial state and according to the nature of the region conquered. Kasaragod, which was once become the southernmost taluk of colonial South Canara witnessed some effort of the colonial state to transform the agricultural landscape by establishing coconut research stations for the scientific study of coconut cultivation. Kasaragod had a rich tradition of paddy cultivation which was cultivated in both low lying as well as in high land hills and hill slopes in the name of 'kumeri' or shifting cultivation.. In the beginning of the 20th century the colonial state opened research stations on major crops like coconut which satisfy colonial needs.

Coconut is popularly known as "*kalpa vriksha*" which means the "Tree of Heaven". There is not even a single part of the coconut palm which is to be considered as useless. There was a huge increase in the demand for coconut products in world market in the beginning of the 20th century. It was considered as a fruit tree like jack, mango etc. And hence, the extent of coconut was very less in this region. In order to increase the production of coconut, four research stations were opened in kasaragod based up on different soil properties. Irrigation is totally dependent on monsoon and the area had no irrigation projects. One of the initial aims of research was the possibility of raising coconut under dry system of cultivation. Coconut can be considered as a trend setter to the new agrarian order of Kerala economy which does not need regular care and labour and also indicate the shift from paddy based agrarian order to more market oriented commercial agriculture. The village and village life which once revolved around paddy and its manifold production activities had gradually wiped out from the region which also wiped out the age old tradition of mutual dependence and mutual co existence.

Keywords: Colonialism, Agriculture, Science, Coconut, Kasaragod.

1. INTRODUCTION

*"The chief industry of India has always been agriculture, but it was not until about the year 1870 that the Indian Government directed systematic attention to fostering and improving Indian agriculture. Since that time there has been established in every province of India a department of agriculture, which collects and distributes early information concerning the crops, controls or advises upon model and experimental farms, introduces new agricultural appliances, tries new staples, and has established institutions for teaching the chemistry and science of agriculture."*¹

The study of the agricultural conditions of different localities and the proposal of measures to remedy such defects as they may present occupies a central theme among the officials of agricultural department of the British Colonial government from the second half of the 19th century onwards. The above mentioned quotation clearly shows the intervention of the colonial state in the field of Indian agriculture and the need for establishing institutions for teaching the "chemistry" and "science" of agriculture. It shows the notion that, Indian agriculture needs the lessons from science and production can be multiplied with the application of scientific knowledge in the field of agriculture. Experiment and observation are the two main processes through which modern science develop knowledge of everything. In the case of agriculture, the colonial state realised the importance of agriculture and the need for its development only in the last decade of the 19th



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ORIGINAL ARTICLE

A BULK ARRIVAL SINGLE AND BATCH SERVICE QUEUE UNDER THE POLICY (c, b)

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Abstract: In this study we consider a bulk arrival single and batch service queue under (c, b) policy. Here the arrivals occur in batches and are served by a single server either one at a time or in batches. If the number of customers in the system is less than a specified level c , then the server serves the customer one at a time and if the number of customers in the system is at least c , then the server starts batch service and serves a maximum of b units in a batch. The steady state analysis of the model is considered and generating functions of the probabilities of the system states are obtained.

Key words: Bulk arrival, Markovian Arrival, Exponential service, Generating functions.

Cite this article

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1. Introduction

Queueing model with bulk arrival/service are very useful to investigate the performance of various telecommunication system. At present bulk arrival/service single and batch service queues are emerging as an essential area of queueing theory and have been studied widely and deeply due to their various application in the field of manufacturing, production, transportation and other stochastic areas. Single and batch service queues were considered by many researchers. Baburaj and Jayakumar considered an (a, c, d) policy single and batch service queue. Baburaj and Rekha (2014) considered an (a, b) policy discrete time bulk service queue with accessible and non-accessible batches under customer choices. Baburaj and Manoharan (1999), Baburaj and Sunila (2018) also considered single and batch service queue. Banik (2015) considered single server queues with a batch Markovian arrival process and bulk renewal or non-renewal service. In this paper we consider a bulk arrival single and batch service queue under (c, b) policy. Here the arrivals occur in batches and are served by a single server either one at a time or in batches. If the number of customers in the system

is less than a specified level c , then the server serves the customer one at a time and if the number of customers in the system is at least c , then the server starts batch service and serves a maximum of b units in a batch. The arrivals occur in batches of variable size x . The service time distribution in the case of manual service is assumed to be exponential with rate μ_1 and the service time distribution in the case of batch service is exponential with rate μ_2 . The arrivals occur according to a Poisson process. The analysis of the model is carried out and generating functions of the steady state probabilities are computed. Also performance measure in some special cases are computed.

2. Notations and Definitions

Here the arrival process is assumed to be Poisson and a batch of i customers arrive with rate γ_i

Define,

$P_{1,n}(t)$: Probability that there are n customers in the system and service is idle or busy with a single service according as $n = 0$ or $n = 1, 2, 3, \dots, c-1$



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Effect of Cross-linking Time on Sodium Alginate Based Blend Films as a Supporter of Bordeaux Mixture

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ABSTRACT

Blend films based on sodium alginate (SA) are synthesized and the use of these films as a supporter for Bordeaux mixture to adhere the crops for longer time and sustained release of active ingredient were studied. An aqueous solution of Sodium alginate was prepared and the obtained solution was added to bordeaux mixture of fixed compositions. Alginate solution is cross-linked by the multivalent cations present in bordeaux mixture and forms films. Blends based on sodium alginate with gelatin (SAGN) and sodium alginate with guar gum (SAGM) were synthesised. The thickening and cross linking action of these films were controlled by varying the cross linking time. The films were dried at 50°C in an oven and kept in different buffer solutions for swelling studies. From the swelling data, rate and kinetics of swelling were studied and swelling parameters were tabulated. The swelling parameters showed that the various bordeaux mixture cross-linked films were stable and they can absorb sufficient quantity of water and may prevent leaching out of active ingredients on rough weathers. Also the cross-linked polymer film may serve in increasing life and sustained release of active ingredients.

Key words: Blends, Bordeaux mixture, ionic cross linking, pH sensitivity, sustained release

amount of water while retaining the three dimensional structure and find extensive use in medical, pharmaceutical, agricultural and industrial fields[1-3]. “Stimuli responsive hydrogels” refers to a special class of hydrogels which exhibit dramatic changes in their physical or chemical behavior in response to slight variations in external conditions such as temperature, ionic strength or pH of the medium etc. Intensive studies are being carried out on the development of such hydrogel materials, especially for biomedical and pharmaceutical applications [4-6]. Hydrogels have been extensively used in agriculture as a moisture conditioner for soil and controlled release of active ingredients like fertilizer and micro-nutrients. Cross linking of polymer matrix with selected polyvalent cations can improve rheology of the matrix, controlled release of the active ingredient and controlled release of bio compatible ions if used[7,8]. Again by incorporating spherical eco-friendly nano particle allows the modification of the physical properties of polymers as well as the implementation of new features in the polymer matrix[9,10].

1. INTRODUCTION

Hydrogels are three dimensional networks of hydrophilic polymers obtained by physical or chemical cross linking of the polymer chains. They possess the ability to absorb large

2. EXPERIMENTAL PROCEDURE

2.1. Materials

Sodium alginate, gelatin, guar gum, calcium chloride, copper sulphate, potassium hydrogen phthalate, potassium dihydrogen



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Enols, Diamino enols and Breslow Intermediates: A Comparative Quantum Chemical Analysis

Tejender Singh^[a], Anjana George^[b], Pattiyil Parameswaran,^[b] and Prasad V. Bharatam^{*[a]}

Abstract: Breslow intermediates (BIs) are generally referred as diamino enols, however, there are subtle differences between enols, diamino enols and Breslow intermediates. Quantum chemical analysis has been carried out to establish the differences among the three classes of compounds. Electronic structure details, charge distribution, bond dissociation energies, etc. were analyzed in a few BIs and compared with that of enols and diamino enols. Energy decomposition analysis has been carried out to establish the variation in the C-C bond character among these systems. There are clear differences among the three classes of the compounds, though there are a few overlaps. A few systems which were earlier considered as BIs do not exhibit the expected characteristics.

Introduction

Enols (**1**, Figure 1) are tautomers of carbonyl compounds, less stable and transient, they carry $R_2C=COH(R')$ functional unit.^[1] Simplest enol vinyl alcohol is thermodynamically less stable than its tautomer acetaldehyde by about 15-16 kcal/mol.^[2] Methods to generate and stabilize enols were explored extensively. These efforts lead to the isolation, crystallization and structural characterisation of a few stable enols.^[3] Till now, no report is available on the generation of diamino enols **2** with NR_2 groups, although they have been considered in the chemical reactions between diamino carbenes and aldehydes.^[4] Compounds with the general formula **3** are known and they have been referred as diamino enols as well as Breslow intermediates (BIs).

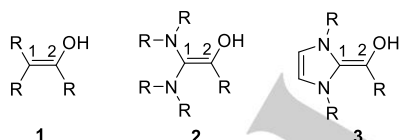


Figure 1. Schematic representation of simple enols (**1**), diamino enols (**2**) and BIs (**3**). R = alkyl / aryl.

Ronald Breslow proposed that the biochemical reactions like pyruvate decarboxylation and benzoin type condensation involve

the formation of a carbene (later termed as *N*-heterocyclic carbene, NHC) as the catalytically active entity.^[5] The reaction mechanism of the chemical/biochemical reactions originating from the NHCs go through an intermediate which is popularly known as Breslow intermediate (BI) **3**.

The importance of BIs was established in benzoin condensation,^[6] Stetter reaction,^[7] and many other organocatalytic reactions catalysed by NHCs.^[8] The carbonyl carbon in benzaldehyde is electrophilic, the electronic character at this centre becomes nucleophilic in the corresponding BI, this inversed of chemical reactivity at the carbon centre (umpolung chemistry)^[9] is facilitated by the NHC.

Berkessel and co-workers made extensive efforts to obtain stable BIs and reported the crystal structures of a few of them (entries 1-6, Table 1).^[10] The *O*-methylated derivatives of BIs were also reported along with their crystal structures.^[10c] Mayr and co-workers explored the nucleophilicity at the C2 centre of BIs, they observed that BIs derived from unsaturated NHCs (aromatic) are more nucleophilic than BIs derived from saturated NHCs (non-aromatic).^[11] The crystal structures of a few BIs are also reported under enzymatic conditions (entries 7-12, Table 1). The bound ligands in the enzymes were not labelled as BIs, however, their structural features such as sp^2 character at C1 as well as at C2 centres, confirm that they are indeed BIs (**3**).^[12] Some of the authors^{[11],[13]} report that BIs (**A**) probably are existing in the corresponding keto tautomeric form **B** (Figure 2). **D** represents a precursor to BI first proposed by Breslow.^[5a] It is also probable that these bound ligands exist in the ionic forms **F** and **G** (Figure 2), as the position of the hydrogen was not clearly established. Tittmann and co-workers^[14] observed pyramidal character at C1 as well as at C2 centres in the BI and labelled the bound ligand as a carbanion. Kluger and co-workers recently argued that a charge separation state is present in BIs under the enzymatic conditions.^[12]

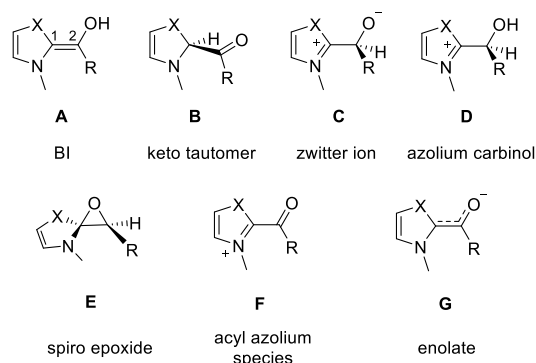


Figure 2. Structural representation of tautomeric, isomeric and ionic forms of Breslow intermediate known in the literature. X = S, NR. R = alkyl / aryl. Structure **A** is also often considered as an alcohol derivative of NHO (*N*-heterocyclic olefin).

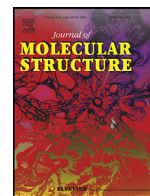
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Experimental and theoretical studies of azo derivatives in terms of different donors, acceptors and position isomerism: Synthesis, characterization and a combined electronic absorption, electrochemical and DFT study



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ABSTRACT

Eight azo derivatives with two donor groups- diphenylamine and N,N-dimethylphenyl, and four acceptor groups - 3-nitrophenyl, 4-nitrophenyl, 4-phenylcarboxylic acid, and 3-phenylcarboxylic acid, were synthesized and characterized using ¹H-NMR and HRMS spectroscopies. Both experimental and computational vibrational spectroscopic analyses of the derivatives have been performed. Solvatochromism in different solvent polarities has been studied, both computationally and experimentally. We have also performed electrochemical studies on the chosen dyes. From cyclic voltammetry and UV-Visible absorption spectra, the HOMO and LUMO energies of the dyes were calculated, and compared with computational results, which are found to be in fair agreement. Protonation studies of the dyes showed that the neutral and the protonated forms of the dyes absorb differently in solvents of differing polarities. This anomaly in different solvents could be explained with the help of differential pulse voltammetry experiments. Our studies show that the HOMO energy levels of the molecules are shifted upward in energy in nonpolar DCM solvent which reduces the bandgap and is responsible for the bathochromic shift in absorption. Thermal stability investigations showed that all the dyes are very well stable at least until 220 °C.

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1. Introduction

Azo dyes are versatile dye molecules which find wide varieties of applications. Although it was first vastly used in textile industry for coloring fabric [1–3], later on it was found that these dyes also possess biological activities such as antioxidant, antibacterial, antifungal, anti-inflammatory, antitumor, antiviral, anticancer and anti-diabetic properties [1,4–12]. Being deeply colored, these dyes have also been explored as potential candidates for organic solar cells, especially dye sensitized solar cells, owing to its substituent dependent tunable absorption, redox behavior and its capability to be attached to non-stoichiometric oxides such as TiO₂, ZnO etc. [13–15]. Azo dyes also find applications in analytical chemistry as some of them exhibit excellent pH dependent color changes in aqueous as well as in organic solvents [16–18]. Some azo dyes have also been reported to show liquid crystalline and also nonlinear optical properties [19,20]. The synthesis of azo dyes are often achieved in

mild conditions and also usually obtained in a single step [21], so that the economic aspects associated with its easy synthesis makes these dyes an attractive candidate for being used in the above mentioned applications. The groups on either side of the azo functional group and also the substituents on such groups influence the properties of the azo dyes formed. This structure-property relationship is what makes each azo dye suited for its application [22–24]. Hence a detailed study pertaining to structure-property relation in azo dyes deserves attention [25,26].

Herein, we have synthesized eight azo dye molecules by interchanging the donor and acceptor moieties on either side of the azo bridge functional group. We have used two donor moieties, viz. diphenylamine and N, N-Dimethylphenyl groups and four acceptor moieties, viz. 3-nitrophenyl, 4-nitrophenyl, 4-phenylcarboxylic acid and 3-phenylcarboxylic acid, resulting in the dyes named as Azo- (111–118), in this work. Chemical structures of the compounds used in this study are given in Fig. 1. For a better understanding, Azo 111–114 could be viewed as a set of azo compounds which has the donor - diphenylamine, whereas Azo 115–118 is another set of compounds having the other donor - N,N-Dimethylphenyl,

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Groundwater quality and chemical characteristics of Bekal watershed, Kasaragod district, Kerala, India

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Abstract

Evaluation of the groundwater quality for domestic and agricultural purposes is an essential step in any stage of development of groundwater resources. Hydrogeochemistry is the major tool to assess the suitability of water for drinking and irrigation purposes. A detailed study has been carried out to get a better understanding of the quality and chemical characteristics of the groundwater resources of Bekal river basin, Kasaragod district, Kerala. Groundwater is the major source for domestic and agricultural activity in this area. Groundwater samples were collected from 16 open wells during January 2020. It is found that the acidic trend of groundwater is the major quality problem in the study area. Low pH can cause several gastrointestinal disorders in the users. The interaction of the lateritic aquifer with the circulating groundwater may be the reason for the lower pH values. The groundwater facies analysis plotted using Hill–Piper diagram showed that the water samples were dominated by alkalis and fall in sodium chloride type. Evaluating the obtained result and comparing it with the permissible standard values for sodium adsorption ratio, residual sodium carbonate and sodium percentage revealed that majority of the samples were suitable for irrigation purposes. This study also dealt with the interpretation of hydrogeochemical data using correlation and R-mode factor analyses.

Keywords Bekal river basin · Hydrogeochemistry · Hill–Piper diagram · Correlation · Factor analysis

Introduction

Human beings need water for their survival and it is an inevitable natural resource for their vital life processes. It is a limited resource and a crucial asset for all life forms. Global hydrosphere has an estimate of 1386 million km³ of water (Kibona et al. 2009; Lui et al. 2011; Du Plessis 2017). Around 97% of the global water is in oceans, and the remaining 3% constitute the freshwater. Among the freshwater, 69% is seen as ice sheets or glaciers. Around 30% is accounted as groundwater, and only 0.3% of total freshwater is available

as surface water as rivers, lakes and reservoirs (Cassardo and Jones 2011; Du Plessis 2017). In the case of groundwater, almost 69% of the total withdrawal has been gone to agricultural, 22% to industrial, 8% to domestic and the leftover 1% to recreational purposes (Rosegrant et al. 2009; Du Plessis 2017). As the global population continues to increase rapidly, water demand will exceed supply, over the coming decades. If the current water consumption trend continues, two out of every three persons across the globe may face water stressed situations by the year 2025 (Bansil 2004).

In India, per capita average annual freshwater availability has declined from 5177 cubic meters in 1951 to about 1869 cubic meters in 2001 and is expected to decline further to 1341 cubic meters in 2025 and 1140 cubic meters in 2050 (Bansil 2004). In terms of quality, the utilizable surface water and replenishable ground water resources are estimated and are in the order of 690 billion cubic meters and 433 billion cubic meters, respectively (CGWB 2007). Groundwater is the major source of drinking water in urban and rural India. The state of Kerala is fortunate to have surplus rainfall of 3000 mm/year and there are 44 rivers flowing through different regions of the state.

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تجليات الخطاب السردى في روايات جمال الغيطاني

عبد الناصر سي. ج

الأستاذ المساعد، الكلية الحكومية بكاسركوت، والباحث قسم العربية، جامعة كاليكوت

الموضوعات من الوقائع والأفعال والشخصيات وفضائي المكان والزمان. فالخطاب هو أداء أو إجراء ذلك المتن إلى متلق مفترض في صياغة كتابية ناجزة^١. ومن الجدير بالذكر أن هذين العنصرين هما ليسا موجودين في النص ولا خارجه ولكن يظهران للقارئ أثناء قراءته، وهما روح الكتابة وليس شيئين ماديين.

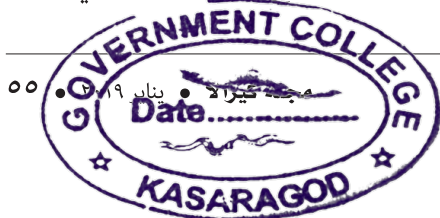
١. إن الوقائع الحكائية في روايات جمال الغيطاني تعتمد على خلفيات تاريخية مختلفة كما تعتمد الروايات الأخرى ويمكن تحديدها فيما يلي: (١) خلفية الواقع الإجتماعي المعاصر الذي يشابه مجتمع مصر، هذه الوقائع ظاهرة في روايته «رسالة المصائر في البصائر» حيث يحكي: «عمل عند رجل من أهل البلاد، موظف في دائرة الأوقاف، إلا أنه يستثمر ماله في أمور شتى، فمن ذلك مصنع لتعليب التمر وحشوه باللوز، متجر لبيع الأدوات الكهربائية، ودكان لبيع الحقائق بكافة أنواعها، وآخر لبيع الملابس النسائية.....»^٢

٢. خلفية الحنين إلى الماضي ممثلا مصر القديمة حيث تصور الأوضاع الإجتماعية في تلك

يتناول هذا البحث القضايا الثلاثة من قضايا الخطاب السردى وتجلياته. فالأول منها الواقع والتمثيل، والثاني يبحث عن مدخل النص، والثالث يبحث عن صوت السرد خلال النص. وهذا البحث منحصر في الروايات التالية لجمال الغيطاني هي: «التجليات الأسفار الثلاثة» و «رسالة البصائر في المصائر»، و«خطط الغيطاني»، و «دفتر التدوين»، و «الرفاعي»، و«الزيني بركات». فالغيطاني هو روائي مصري معاصر الذي مزج في رواياته التاريخ والتراث والسرد الصوفي، ومعظم رواياته تنير إلى التراث العربي المصري وفي ابداعاته «حضور الموروث التاريخي بصورة لافتة، ويتجلى هذا الموروث، أحيانا على مستوى استعادة الأحداث والأخبار الماضية.. وعلى مستوى اعتماد التمثيل الشعبي وعلى مستوى إعادة إنتاج اشكال أجناسية قديمة ونماذج لغوية ونصية سألقة كما هو الشأن في «خطط الغيطاني والتجليات..»^١.

أولا: الواقع والتمثيل

ومن البديهي أن كل نص سردي يتكون من عاملين متكاملين متداخلين وهما: الحكاية والخطاب. أما «الحكاية فهي مجموعة بمكونات مختلفة لمتن



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