



**3.5.1: Number of functional MoUs/linkages with institutions/ industries in India and abroad for internship, on-the-job training, project work, student / faculty exchange and collaborative research during the last five years**

[Copies of Document related to 08(eight) Collaborations]

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**To whom it may concern**

This is to certify that the College has no objection in permitting **Sri/Smt./Dr. Nivedita Chakraborty, Assistant Professor in Geology** to continue her collaborative research/academic linkages/activities with **Department of Applied Geology, School of Applied Natural Sciences, Adama Science and Technology University, Ethiopia** to be started in January, 2023 without hampering the normal duties of the College.

**I wish her all success in life.**

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School of Natural Sciences

2<sup>nd</sup> January 2024

**Certificate of Collaborative Research**

This is to certify that me (Professor Dr. Sreepat Jain, Adama Science and Technology University, Adama, Ethiopia) and Dr. Nivedita Chakraborty (Assistant Professor, Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia, Bankura, West Bengal, India), are actively involved in a collaborative edited book project titled "The Geology of Cauvery Basin (South India)" for CRC Press (Taylor and Francis, UK) since 2<sup>nd</sup> January, 2023. The contract has been accepted by the prestigious publishing house.

The proposed edited book comprising of contribution from national and international scientists, has a multidisciplinary outlook, covering a wide spectrum of topics such as Sedimentology, Stratigraphy, Structure, Tectonics, Hydrocarbon prospects, Paleoclimate, Paleobiogeography and Paleontology (macro and micro; fauna and flora). The book will provide an up-to-date information on the varied geological aspects of the Cauvery Basin and thereby aims to be a one-stop-shop resource for both academicians and industry professionals. Cretaceous deposits are excellent analogs (representatives) to modern-day increasingly globally warm climate, and hence, studying the former enables a better understating of changes brought out by warming oceans and climate to biota, their preservation potential (future hydrocarbon prospecting), depositional history and environmental conditions. Past is the key to the present! Hence, this edited book with its multidisciplinary subject matter encompassing topics on Stratigraphy, Sedimentation and Climatic oscillations (Section 1), Structure, Tectonics and Hydrocarbon perspective (Section 2), and Paleoecology, Paleobiogeography and Paleobiota (Section 3) will immensely interest postgraduate students, researchers, and industry professionals.

Thus, this collaboration with Dr. Nivedita Chakraborty will result in the better understanding of the Cretaceous sedimentary successions of the Cauvery Basin.

This certificate should also serve as a testament to teamwork, professionalism, and ability to work harmoniously across institutional boundaries. Throughout the proposal writing and submission stage, Dr. Nivedita Chakraborty has shown outstanding and unwavering commitment and promptness.

I wish Dr. Nivedita Chakraborty success in all her future endeavors.

Professor (Dr.) Sreepat Jain  
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This is to certify that **Dr. Nivedita Chakraborty**, Assistant Professor, Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia, Bankura is associated with me in collaborative geological field work on Permo-Triassic rocks in Raniganj Basin (Damodar valley), West Bengal since 2022. We did geological field trip to different remote areas of Bankura and Purulia district during the month of August, November and December, 2022 & March, 2023 (total 22 days). This collaborative linkage is for academic and research purpose.

*Lovely Burman* 30.01.2023  
(Signature) Assistant Professor

Lovely Burman  
Assistant Professor  
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**Tidal (?) influence recorded within Gondwana fluvials: Triassic Panchet Formation, Raniganj Basin (Damodar valley), India**

Nivedita Chakraborty<sup>1\*</sup>, Lovely Burman<sup>2</sup>, Anudeb Mandal<sup>3</sup>, Souryadip Ghosh<sup>4</sup>, Indrani Mondal<sup>1,4</sup>  
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Gondwana sediments of the early Triassic Panchet Formation in Raniganj Basin are hitherto inferred as continental fluvial deposits. Field investigation, in accord with the existing view, suggests an overall braided channel pattern within this formation in contrast to the high sinuosity meandering fluvial system comprising the underlying Raniganj Formation. The current study, however, arouses interest recording a few startling sedimentary features within the basal part of the Panchet Formation. The key observations include: i) heterolithic rhythmic packages of thinly laminated sand/silt-mud couplets; ii) periodic variation in foreset thickness; iii) systematic change in cross-lamina style and foreset angle; iv) downcurrent change in brink point height; v) cyclic sequences showing sandstone foresets draped with single or double mud lamina; vi) preservation of mud in ripple troughs; vii) local reversal in paleocurrent direction. Collectively, these features are very difficult to explicate within a low-sinuosity fluvial realm but point toward tidal influence. Present study also confirms presence of at least two remarkable syn-sedimentary deformed (SSD) horizons at two distinct stratigraphic levels within the lower part of the Panchet Formation. At one, the SSD package is huge in dimension and underlies the tidally influenced fluvial deposits. Ample subsidence is evident; possibly guiding path for the tide to impinge upon the continental interior. Another SSD horizon of comparatively lesser dimension is marked at a different level. Here palaeocurrent data within the channel system overlying the SSD zone shows convergence in flow direction and thereby probably indicating an amplified depositional slope.



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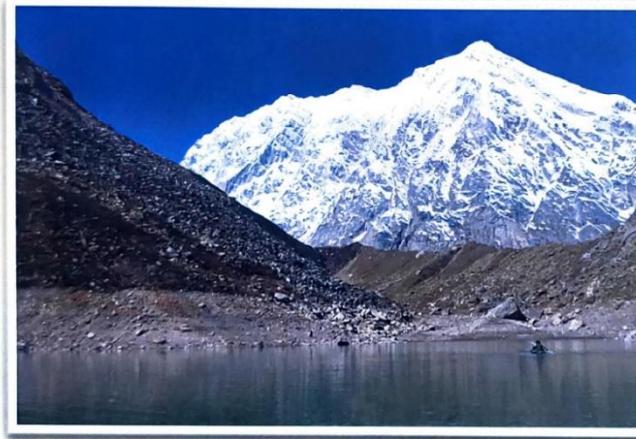
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## Palaeoenvironment, palaeocurrent and palaeohydraulics of the Lower Triassic Panchet Formation: a case study from Banspetali in Raniganj Basin, Eastern India

Lovely Burman<sup>1\*</sup>, Nivedita Chakraborty<sup>2</sup>, Anudeb Mandal<sup>3</sup>

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The Raniganj Basin in Damodar Valley, India accommodates ~2000m thick continuous succession of Gondwana Supergroup (Late Carboniferous to Triassic). The present study deals with the Lower Triassic Panchet Formation overlying the Upper Permian Raniganj Formation, and encompassing the P-T boundary in terrestrial realm. Field work has been carried out along the stream sections in and around Banspetali area, within the fault controlled intracratonic rift basin. Although the geochemical and palaeontological evidences are relatively well documented, the sedimentology of this area lacks needed attention. Current investigation intends to form a preliminary idea on palaeoenvironment, palaeocurrent and palaeohydraulics of Banspetal section. Sedimentary facies analyses have been performed identifying four channel belts constituting eleven facies within the Panchet Formation in order to acquire knowledge regarding palaeogeography, transportation mechanism and depositional environment of the clastic Gondwana sediments. Field investigation points towards an overall low-sinuosity braided channel pattern. Thick multi-storied amalgamated channel units with high average bed-thickness and lesser proportion of overbank fines, dominance of mid-channel bars, overall fresh appearance of pebbly to medium grained sand sized sediments, absence of carbonaceous content in mica rich shales and absence of coal broadly characterise the studied Formation. Petrography suggests mineralogically arkosic to sub-arkosic composition, texturally immature to sub-mature character with poor to moderate sorting. Present study also confirms remarkable presence of syn-sedimentary deformation structures associated with the third channel belt within the succession. Deformation structures are characterized by a range of morphology and style: slump folds, convolution, distorted layers in chaotic fashion, load and flame structures, overturned cross-bedding and slide planes. The deformed layers are bounded by undeformed beds of similar facies. Palaeocurrent analysis shows deviation in flow direction from NE to NW below and above the deformed level respectively. Palaeohydrological analysis indicates an increase in different fluvial parameters: mean channel width, mean channel depth, mean discharge, principal stream length and the rest in post SSD package. Moreover an amplified depositional slope and a convergence in flow direction are indicated beyond the disturbed zone. Probably a change in drainage area for post SSD channel systems is reflected. The results of this study are expected to serve as a basis for further sedimentological investigation in the study area.



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2. Start Date of Collaboration : August, 2022
3. End date of Collaboration : Continuing
4. Duration : August, 2022-Continuing
5. Purpose of the Collaboration : Collaborative geological research field work and Publication
6. Collaborative Research Activities : Dr. Nivedita Chakraborty, Kabi Jagadram Roy Government General Degree College and Ms. Lovely Burman, Department of Geology, Sahid Matangini Hazra Government General Degree College For Women carried out collaborative geological research field work in Permo-Triassic rocks of Raniganj Basin, West Bengal since August, 2022 and presented 02 papers in two National Conferences in 2023.
7. Outcomes in terms of Research Publications: i) **Chakraborty, N., Burman, L., Mandal, A., Ghosh, S., Mondal, I., 2023.** Tidal (?) influence recorded within Gondwana fluvials: Triassic Panchet Formation, Raniganj Basin (Damodar valley), India at Department of Geology, University of Delhi, p.10 (National conference on 'Current Understanding from the Indian Sedimentary Basins and Road Ahead' & 38<sup>th</sup> Convention, Indian Association of Sedimentologists).  
ii) **Burman, L., Chakraborty, N., Mandal, A., 2023.** Paleoenvironment, paleocurrent and paleohydraulics of the lower Triassic Panchet Formation: A case study from Banspetali in Raniganj Basin, Eastern India at Annamalai University, Chidambaram, p. 56 (International conference on 'Voyage of Sedimentology from the Mountains to the Oceans: An innovative trajectory' & 39<sup>th</sup> convention of Indian Association of Sedimentologists).

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**I wish her all success in life.**



  
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भारतीय विज्ञान शिक्षा एवं अनुसंधान संस्थान कोलकाता

(भारत सरकार के शिक्षा मंत्रालय द्वारा स्थापित एक स्वायत्तशासी संस्थान)

**INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH KOLKATA**

(An autonomous Institute established by Ministry of Education, Government of India)

This is to certify that Dr. Nivedita Chakraborty, Assistant Professor, Department of Geology, Kabi Jagadram Government College Degree College, Mejia, Bankura is associated with me in collaborative geological research in the Cretaceous successions of the Cauvery Basin, Tamil Nadu. We did publish one scientific research paper in the Journal of the Geological Society of India in 2023.

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<https://doi.org/10.1007/s12594-023-2285-1>

ORIGINAL ARTICLE

## Absence of Belemnites in the Post-Cenomanian Marine Successions of Cauvery Basin, India: Role of Sea Level, Paleogeography, and Belemnite Paleoecology

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### ABSTRACT

Belemnites were important Mesozoic marine organisms, and Cretaceous belemnite rostra are found worldwide, including the Cauvery Basin, south-eastern India. However, in the Cauvery Basin, belemnites of the families Belemnopsidae and Dimitobelidae are found only from the Albian-Cenomanian rocks but are absent in the overlying Turonian-Maastrichtian rocks. Although Belemnopsidae became globally extinct in the Cenomanian, Dimitobelidae was still thriving in the nearby Austral regions, so it is not clear why belemnites suddenly suffered local extinction. Moreover, in the post-Cenomanian interval, the newly evolved family Belemnitellidae was thriving globally but is absent in India. To understand the causes of this local extinction as well as the causes of the complete absence in the younger rocks, an analysis of different paleoecological-paleoenvironmental conditions was carried out of all Albian to Maastrichtian formations of the Cauvery Basin against the background of the global belemnite paleobiogeography and evolutionary patterns. The study reveals, during the end Cenomanian, shallowing of the basin caused the local extinction of the shelf-living Belemnopsidae and Dimitobelidae in this basin. In the younger intervals, since India was migrating towards the equator, the stenothermal Dimitobelidae did not survive the warmer water surrounding India and only thrived in the cooler Austral water. Perhaps for the same reason, Dimitobelidae never invaded India, even during the Late Cretaceous transgression. Moreover, during its northern voyage, India was surrounded by deep ocean, acting as a physical barrier for the shelf-dwelling Belemnitellidae of the Boreal Realm to invade India.

### INTRODUCTION

The Cretaceous, a time of remarkable plate tectonic movements and concomitant sea-level fluctuations, was an interval of global paleobiogeographic redistributions and taxonomic-ecological restructuring in marine invertebrates (Hallam, 1973, 1985). During the early Late Cretaceous, due to global sea level rise, vast areas of the continents were covered by epicontinental seas, and marine sediments were deposited globally, including India (Hancock and Kauffman, 1979; Acharyya and Lahiri, 1991; Chakraborty et al., 2021a). The Cauvery Basin, a NE-SW trending rift basin in the southernmost part of the Indian peninsular shield, hosts a more or less complete marine

succession ranging from the Albian to the Maastrichtian, with a rich marine fossil record (Blanford, 1865; Stoliczka, 1861-1873; Pascoe, 1959; Ayyasami and Banerji, 1984; Acharyya and Lahiri, 1991; Govindan et al. 1996; Tewari, 1996; Sastri et al., 1977; Sundaram et al., 2001; Ayyasami, 2006; Nagendra et al., 2018; Chakraborty et al., 2021a; Nagendra and Nallapa Reddy, 2021). Among these fossils, the Cauvery belemnites have been one of the main focuses of different taxonomic, paleoecological, paleoenvironmental, and paleobiogeographic studies (Blanford, 1865; Stoliczka, 1861-1873; Pascoe, 1959; Bowen, 1961; Ayyasami and Jagannadha Rao, 1987; Doyle, 1992; Ayyasami, 2006; Zakharov et al., 2011).

Belemnites were one of the most important marine coleoid cephalopods during the Cretaceous and have been used for stratigraphic correlation of the Mesozoic rocks (Hoffmann and Stevens, 2020; also, Doyle and Bennett, 1995 and references therein). Paleobiogeographically, from the Aptian/Albian-onwards, belemnites had a 'tripartite' distribution into three distinct marine realms: Boreal (= North Temperate Realm of Christensen, 1997a,b), Tethyan, and Austral (= South Temperate Realm of Christensen, 1997a,b; Aptian-onwards Indo-Pacific Realm of Stevens, 1963) (Stevens, 1963; Christensen, 1976, 1997a,b; Doyle, 1992; Crame, 1992; Hoffmann and Stevens, 2020). The Boreal Realm included Russia across northern Europe to England, Greenland, and North America; and the Tethyan Realm included southern and central Europe and east Africa (Stevens, 1963, 1973; Christensen, 1997a,b). Until the Albian, belemnites were also present in the North Pacific Realm (Iba et al., 2011). During the Aptian-Albian, the Austral Province came into existence in the southern hemisphere and included locations like South America, Madagascar, Antarctica, and South India (Doyle, 1992).

Three belemnite families, all monophyletic except the last one (Stevens, 2021), dominated all these realms (Stevens, 1973; Doyle, 1985, 1987, 1988, 1992; Doyle and Bennett, 1995; Doyle and Howlett, 1989; Crame, 1992): (1) Dimitobelidae (Aptian-Maastrichtian), consisting of the genera like *Pumiliobelus*, *Peratobelus*, *Peratobelus*, and *Dimitobelus* in the Austral Realm, from New Guinea to Argentina, indicating their significant biogeographic presence following the circum-Gondwana migratory route. In comparison, *Pumiliobelus* is so far only known from Western Australia (Williamson and Henderson 2015). *Tetrabelus* was also endemic, and was restricted to south India, Antarctica, and New Zealand (Doyle, 1985, 1987, 1988, 1992; Doyle

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3. End date of Collaboration : Continuing
4. Duration : January,2022- Continuing
5. Purpose of the Collaboration : Collaborative Geological Field work, Research & Publication.
6. Collaborative Research Activities : Dr. Nivedita Chakraborty, Department of Geology, Kabi Jagadram Roy Government General Degree College and Dr. Subronil Mondal, Department of Earth Sciences, IISER Kolkata conducted collaborative geological research in Cretaceous succession of the Cauvery Basin, Tamil Nadu and and **PUBLISHED 01 (ONE) SCIENTIFIC PAPER in 2023.**
7. Outcomes in terms of Research Publications: **Mondal, S., Hazra, S., Chakraborty, N., 2023.** Absence of Belemnites in the Post-Cenomanian Marine successions of Cauvery Basin, India: Role of Sea Level, Paleogeography, and Belemnite Paleoecology. *Journal of Geological Society of India* 99(2), 177-186.

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To whom it may concern

This is to certify that the College has no objection in permitting Sri/Smt./Dr. **Biswajit Bera, Assistant Professor in Mathematics** to continue his collaborative research/academic linkages/activities with **Department of Geology, Raghunathpur College, Purulia** to be started in January, 2020 without hampering the normal duties of the College.

I wish him all success in life.



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### Certificate of Collaborative Research

This is to certify that, Department of Mathematics, Kabi Jagadram Roy Government General Degree College, Mejia, Bankura, 722143 and Department of Mathematics, Raghunathpur College, Raghunathpur, Purulia, 723133 are doing collaborative research on Graph Theory and Picture Fuzzy Graph, since 13.01.2020. The research collaboration between these two esteemed institutions has been ongoing and has resulted in numerous publications in international journals during 2020-2023. The collaborative linkage between two institutions is for academic and research purpose.

  
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## $L(2, 1, 1)$ -labeling of interval graphs

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$L(r, s, t)$ -labeling problem ( $Lr$ -LP) is an important topic in discrete mathematics due to its various applications, like in frequency assignment in mobile communication systems, signal processing, circuit design, etc.  $L211$ -LP is a special case of  $Lr$ -LP. An  $L211$ -labeling ( $L211L$ ) of a graph  $G = (V, E)$  is a mapping  $F : V \rightarrow \{0, 1, 2, \dots\}$  such that  $|F(\xi) - F(\eta)| \geq 2$  if and only if  $d(\xi, \eta) = 1$ ,  $|F(\xi) - F(\eta)| \geq 1$  if  $d(\xi, \eta) = 2$  or  $3$ , where  $d(\xi, \eta)$  is the distance between the nodes  $\xi$  and  $\eta$ . In this work, we have determined the upper bound of  $L211L$  for interval graph (IG) and obtained a tighter upper bound which is  $4\Delta - 2$ . Also, we proposed an efficient algorithm to label any IG by  $L211L$  and also computed the time complexity of the proposed algorithm.

**Keywords:**  $L211$ -labeling; interval graph; efficient algorithm; frequency assignment.

### 1. Introduction

Labeling of graph is an assignment of nonnegative integers to the nodes or edges, or both, subject to

certain conditions. Graph labeling problems had been first introduced in the middle of 1960s. Then, in the last six decades over 250 graph labeling

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## L(2,1,1)-Labeling of Circular-Arc Graphs

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### Abstract

Graph labeling problem has been broadly studied in recent past for its wide applications, in mobile communication system for frequency assignment, radar, circuit design, X-ray crystallography, coding theory, etc. An L211-labeling (L211L) of a graph  $G = (V, E)$  is a function  $\gamma : V \rightarrow Z^*$  such that  $|\gamma(u) - \gamma(v)| \geq 2$ , if  $d(u, v) = 1$  and  $|\gamma(u) - \gamma(v)| \geq 1$ , if  $d(u, v) = 1$  or 2, where  $Z^*$  be the set of non-negative integers and  $d(u, v)$  represents the distance between the nodes  $u$  and  $v$ . The L211L numbers of a graph  $G$ , are denoted by  $\lambda_{2,1,1}(G)$  which is the difference between largest and smallest labels used in L211L. In this article, for circular-arc graph (CAG)  $G$  we have proved that  $\lambda_{2,1,1}(G) \leq 6\Delta - 4$ , where  $\Delta$  represents the degree of the graph. Beside this we have designed a polynomial time algorithm to label a CAG satisfying the conditions of L211L. The time complexity of the algorithm is  $O(n\Delta^2)$ , where  $n$  is the number of nodes of the graph  $G$ .

*Keywords:* L211-labeling; Frequency assignment; Circular-arc graph.

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## 1. Introduction

Graph labeling problems is one of the most important problems in discrete mathematics to solve real life problems. Different types of graph labeling problems such as node labeling, edge labeling, LrstL, graceful labeling, harmonic labeling, anti-magic labeling, magic labeling, total vertex irregular labeling, etc. are studied by many researchers. Nowadays graph domination problem is an important problem of graph theory [2].

An L211L of a graph  $G = (V, E)$  is a function  $\gamma$  from its node set  $V$  to  $Z^*$  such that  $|\gamma(u) - \gamma(v)| \geq 2$  if  $d(u, v) = 1$ ,  $|\gamma(u) - \gamma(v)| \geq 1$  if  $d(u, v) = 1$  or 2. The L211L number,

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## Balanced picture fuzzy graph with application

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### Abstract

Picture fuzzy graphs are an extension of intuitionistic fuzzy graphs. Balanced picture fuzzy graph is a special type of picture fuzzy graph (PFG). In this study, the definition and important properties of PFG like, average PFG, balanced PFG, size, order, density of a PFG, isomorphism, the direct product of two PFG, etc have been studied. The necessary and sufficient conditions for balanced picture fuzzy graphs have also been studied in this article. Beside this, we proposed an algorithm to test whether a PFG is balanced or not. The proof of correctness and an illustration of the proposed algorithm is presented in this article. Lastly, an application of balanced PFG to business alliance is presented.

**Keywords** Picture fuzzy graph · Balanced picture fuzzy graph · Average picture fuzzy graph · Density of a picture fuzzy graph

### 1 Introduction

A picture fuzzy set is a generalization of intuitionistic fuzzy set (Atanassov 1986). Picture fuzzy models give more precision, flexibility and compatibility to the system as compared to the intuitionistic fuzzy models. The concept of a picture fuzzy set was first introduced by Cuong and Kreinovich (2013). In addition to intuitionistic fuzzy sets, Cuong appended new components which determine the degree of neutral membership. The intuitionistic fuzzy set gives the degree of membership and the degree of non-membership of an element, while the picture fuzzy set gives the degree of positive membership, the degree of neutral membership and the degree of negative membership of an element. These memberships

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## Real world applications of discrete mathematics

Sk Amanathulla<sup>1</sup>, Biswajit Bera<sup>2\*</sup> and Madhumangal Pal<sup>3</sup>

### Abstract

Discrete mathematics is an important branch of applied mathematics and graph theory is an important part of discrete mathematics. It has a lot of applications in modern society. Graph colouring or graph labeling is an important branch of graph theory which can easily solve many real life problems. In this article, we have shown some direct applications of discrete mathematics, like applications of graph theory to scheduling problems, coloring of map in GSM mobile phone networks, google maps or GPS, traffic signal lights, Social networks, aircraft scheduling, etc.

### Keywords

colouring, scheduling problem, interval graph.

### AMS Subject Classification

05C85, 68R10.

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### 1. Introduction

Mathematics is classified into two branches, *Applied Mathematics* and *Pure Mathematics*. *Discrete Mathematics* is an essential branch of *Applied Mathematics* and *Graph Theory* is a crucial topic in the field of *Discrete Mathematics*. Graphs are significant since the graph is the only way of revealing information in pictorial form. A graph displays information which is equivalent to many words. Computer science applications highly utilize graph-theoretical notions. Some well-known graph theoretic problems are: Shortest path problem, job sequencing problem, conditional covering problem, traveling salesman problem, graph colouring problem, etc.

*Graph Colouring* is a significant problem in graph theory. This problem is widely needed to solve many real problems, viz:

scheduling, resource allocation, traffic phasing, task assignment, etc [1, 2, 13].  $L(h_1, h_2, \dots, h_m)$ -labeling of the graph is the generalization of *Graph Colouring* problem and it has also been widely applied to solve frequency assignment problems in wireless communication [3–12].

In this article, some applications of graph colouring have been studied. An introduction is given in section 1, some basic terms related to graph theory are provided in section 2. Graph colouring and extension of graph colouring are provided in section 3. Then, in section 4, some important graph theory applications and graph colouring to solve real life problems are presented. Finally, in section 5, a brief conclusion has been presented.

### 2. Basic Concept in Graph Theory

Earlier, we may realize the graph's application, so we must know graph theory related some definition. The author of this paper defined some terms related to graph theory most readily.

**Definition 2.1.** A graph usually denoted by  $G = (V, E)$  and consists of the set of vertices (nodes)  $V$  together with a set of edges  $E$ . The number of vertices in a graph is generally denoted by  $n$  while the number of edges is denoted by  $m$ .

**Example:** Let there be direct flights between the countries, India( $i$ ) and America( $a$ ); India( $i$ ) and China( $c$ ); America( $a$ )



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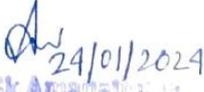


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3. End date of Collaboration : Continuing
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5. Purpose of the Collaboration : Collaborative Research on Graph Theory and Picture Fuzzy Graph & Publication.
6. Collaborative Research Activities : Shri Biswajit Bera, Assistant Professor of Mathematics conducted collaborative research on Graph Theory and Picture Fuzzy Graph
7. Outcomes in terms of Research Publications: Published 04 (four) Scientific Research Papers in International Journals.

- Amanathulla, S., Bera, B., Pal, M., (2021). Real world applications of discrete mathematics. Malaya Journal of Matematik. 9(1), 152-158.
- Amanathulla, S., Bera, B., Pal, M., (2021).L(2,1,1)- Labelling of Circular-Arc Graph. Journal of Scientific Research. 13(2), 537-544.
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**To whom it may concern**

This is to certify that the College has no objection in permitting **Sri/Smt./Dr. Nivedita Chakraborty, Assistant Professor in Geology** to continue her collaborative research/academic linkages/activities with **Department of Geology, Presidency University, Kolkata** to be started in January, 2017 without hampering the normal duties of the College.

I wish her all success in life.

Dr. Aresh Kumar Maji  
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This is to certify that **Dr. Nivedita Chakraborty**, Assistant Professor, Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia (Bankura) has been associated with me in collaborative research since 2017. We did geological field works in different remote areas and open cast mines in and around Ariyalur, Cauvery Basin (Tamil Nadu), and Bhuj, Kutch Basin (Gujarat) during 2017-2022. We have published several papers in different peer-reviewed journals/book chapters.

We have started collaborative research on the Permo-Triassic rocks in the Raniganj Basin (Damodar Valley), West Bengal too since 2021. We did geological field trip to different rural areas of the Bankura and the Purulia district. The collaborative linkage between Dr. Chakraborty and me is for academic and research purposes.

  
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# Ecological Significance of River Ecosystems

Challenges and Management Strategies



Edited by  
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CHAPTER

19

Palaeoclimatic imprint on fluvial  
sediments: examples from Indian  
Phanerozoic successions

Nivedita Chakraborty<sup>a</sup>, Anudeb Mandal<sup>b</sup>, Sunipa Mandal<sup>c</sup>

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19.1 Introduction

Rivers on earth are the major dynamic geomorphic entities within the continental realm, leading to extremely complex response to considerable spatiotemporal variability of different natural factors (Knox, 1983). Fluvial systems are highly sensitive to climatic and environmental changes, along with base-level change and tectonics, which governs their morphology and sedimentation pattern. Though, it is very difficult to compartmentalize the influences of climate and tectonics as the interaction between them controls weathering and erosion in the catchment areas of major rivers (Burbank et al., 2003; Clift, 2010). Fluvial response to climatic change may be classified into stratigraphic (stratigraphic architecture produced by aggradation, degradation, or lateral migration), morphological (change in channel geometry), and sedimentological (spatial distribution of depositional environments and palaeogeography) components (Blum and Tornqvist, 2000). The fluvial archives, encompassing riverine sediments especially paleosols and slack water deposits of floodplain, climate-sensitive lithologies (coal, evaporite, eolianite, etc.) along with palaeoecological constituents like preserved fossil plants and trace fossils, hold the potential for developing a detail record of fluvial-climate connection in space and time (Allen et al., 2011). Although there is a growing call for novel research in this field, studies connecting fluvial systems and climate change in the pre-quaternary time are relatively neglected (Allen et al., 2011; Blum and Tornqvist, 2000; Goodbred, 2003; Meetei et al., 2007).

The present article aims to make a brief appraisal on palaeoclimatic clues hidden within the fluvial sediments highlighting some of the potential palaeoclimatic archives (paleosol,



  
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## Indigenous siliciclastic and extraneous polygenetic carbonate facies in the Albian-Turonian Karai Shale, Cauvery Basin, India

Nivedita Chakraborty<sup>1</sup> · Anudeb Mandal<sup>2</sup> · Adrita Choudhuri<sup>3</sup> · Sunipa Mandal<sup>3</sup> · Subir Sarkar<sup>3</sup>

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### Abstract

The Albian-Turonian marine Karai Shale, a mixed siliciclastic–carbonate formation in the pericratonic Cauvery rift basin, India, arouses interest as its evenly laminated siliciclastic beds appear indigenous, settling from suspension, while the calcarenite beds are made of materials that were deposited elsewhere and then shifted by agents that occasionally invaded the present depositional site. Three calcarenite facies recognized differ in body geometry, sedimentary structures, recurrence and in association. One of the two calcarenite facies enclosed by grey shale is most widely distributed, characterized by tabular geometry, internal wave-cum current structures, overall graded nature and gutters at base. It is inferred as product of meteorological storms. The other calcarenite facies overlapping in occurrence constitutes a single amalgamated bed package that is characterized by highest degree of dilution by siliciclastics in coarsest fraction, selectively incorporating pebble-sized fragments of the granitic basement and wood. Its beds are internally massive or cross-stratified and interpreted as products of successive pulses of ebb of a very strong event may be a megastorm or tsunami. The third calcarenite facies is represented by a couple of trough cross-stratified sheets embedded within greenish grey shale enriched in phosphate nodules and glauconite pellets and completely devoid of storm beds. Near-orthogonal diversion of palaeocurrent between the two associations invokes ocean bottom current to impinge upon the shelf-margin during maximum transgression for the third calcarenite facies. The  $\delta^{13}\text{C}$  ratio in the TST part is consistent with deposition on open marine shelf, but in the HST part they indicate influx of meteoric water.

**Keywords** Karai Shale formation · Mixed siliciclastic–carbonate shelf · Indigenous siliciclastics · Polygenetic clastic carbonates · Sedimentation dynamics · TST–HST transects

### Introduction

Mixed siliciclastic–carbonate deposits generally embrace indigenous chemical and extraneous clastic fractions occurring together. Deposition of mixed sediments predominantly

involves marine shelves, where siliciclastic sediments are generally trapped in the nearshore zone and carbonate deposition is held in clear, deeper water subtidal settings (Myrow and Landing 1992) and at the shelf margin where carbonate deposits interfinger with deep basin shales (e.g. Handford 1986). A number of studies have documented such heterolithic systems depicting interfingering between laterally adjacent facies in ancient as well as modern geological settings where carbonates represent locally generated sediment, while the siliciclastic fraction is driven from outside (e.g. Łabaj and Pratt 2016; Zeller et al. 2015; Chiarella and Longhitano 2012; Ryan-Mishkin et al. 2009; Wright et al. 2005; Dunbar and Dickens 2003; Osleger and Montanez 1996; Budd and Harris 1990; Mount 1984). However, the Albian-Turonian marine shelf-originated mixed siliciclastic–carbonate Karai Shale Formation of the Cauvery Basin, India (Chakraborty and Sarkar 2013; Chakraborty et al. 2015; Nagendra et al. 2011; Tewari et al. 1996a), shows

The original version of this article was revised: Figure 1 was incorrectly published in original publication and the same is corrected here.

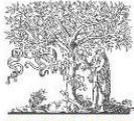
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Research paper

### Microenvironmental constraint on $\delta^{13}\text{C}$ depletion: Garudamangalam Sandstone, Cauvery Basin, India

Nivedita Chakraborty<sup>a</sup>, Subir Sarkar<sup>b,\*</sup>, Anudeb Mandal<sup>c</sup>, Sunipa Mandal<sup>b</sup>, Adam Bumby<sup>d</sup>

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#### ARTICLE INFO

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Methane  
Methanotrophs transportation  
Tidal slackening  
Garudamangalam sandstone

#### ABSTRACT

Within the hydrocarbon-producing Cretaceous marine Uttatur Group, Cauvery Basin, India, the Garudamangalam Sandstone Formation is at top of a TST-HST transit. The  $\delta^{13}\text{C}$  value is expectedly depleted within the calcareous Garudamangalam Sandstone, which is the top most unit of the Uttatur Group, overlying the Karai Shale. The calcareous sandstone was deposited in a coastal setting around a shore-parallel river mouth bar. Instances of excessive depletion of  $\delta^{13}\text{C}$  up to  $-44.5\%$  in the carbonate cement is suggestive of methane generation and its subsequent sequestration. The common occurrence of early diagenetic pyrite in these rocks testifies to the proliferation of sulfate-reducing bacteria and is suggestive of methane generation beneath the sulfate reduction zone. Upward-moving diffusive methane was possibly consumed by methanotrophs at the base of the sulfate-reduction zone. Abundant fabric-selective carbonate cement corroborates microbially-controlled anaerobic oxidation of methane. The presumed high rate of nutrient supply, abundance of vegetative material and moderately high organic carbon content in sediments (av. 1.6%), support this contention. All the samples which have the greatest  $\delta^{13}\text{C}$  depletion are characterized by enriched organic carbon and are derived from a tidal inlet-mouth facies, and selectively from mud drapes on cross-bedding in tidal strata. Calcareous at the base of the same cross-strata are invariably much less depleted in  $\delta^{13}\text{C}$ . This range of relationships indicates the transport of methanotrophs that settled on foreset beds mostly as tides slackened under the broader control of neap-spring cycles.

#### 1. Introduction

An unusual negative excursion of  $\delta^{13}\text{C}$  in calcite values approaching  $-50\%$  is commonly correlated with methane sequestration (Claypool and Kaplan, 1974). The topic gains importance in the view of recent trend of  $\sim 1\% \text{ yr}^{-1}$  increase in atmospheric methane (Reeburgh, 2007 and references therein). Reeburgh (2007) made a review of earlier work on the natural processes of methanogenesis and methane oxidation. This paper focuses upon environmental constraints on spatial variation of  $\delta^{13}\text{C}$ , locally depleted to an extraordinary extent ( $-44.5\%$ ) in the Cretaceous Garudamangalam Sandstone (GS), Trichinopoly, India (Fig. 1). It presents evidence for reworking of methanotrophs, originally invoked by Pohlman et al. (2013). It brings to light a selective environmental constraint on spatial variation of  $\delta^{13}\text{C}$ , which decreased values to about  $-50\%$ .

Calcite precipitated inorganically from sea water yields  $\delta^{13}\text{C} -2$  to  $+2\%$  PDB (Rollinson, 1993), while  $\delta^{13}\text{C}$  values from organic carbon

are much lower, at  $\sim -25\%$  (Irwin et al., 1977; Rollinson, 1993). Methane  $\delta^{13}\text{C}$  values are far more depleted;  $< -50\%$  when biogenic, and lower when abiotic (Claypool and Kaplan, 1974; Henderson, 2004; Reeburgh, 2007). Whether biogenic or abiotic,  $^{12}\text{C}$  is preferentially lost upon oxidation, and hence the residual methane turns heavier.

Sarkar et al. (2014) proposed a shore-parallel deltaic mouth-bar palaeogeography during deposition of the GS, which may have significance in this regard, especially if the methane is biogenic. Bange et al. (1994) identified the coastal zone as source of  $\sim 75\%$  global oceanic methane emission to the atmosphere. Supersaturation of methane in coastal waters readily arises because of the addition of organic matter, including vegetative organic matter especially rich in  $\text{C}^{12}$ , from land (Cynar and Yayanos, 1992; Ward, 1992). Additionally, the high rate of nutrient supply in a deltaic environment induces high rates of in-situ biogenic production and further boosts methane generation. Faecal pellets which are extraordinarily rich in methane are abundant in such an environment (Turner, 2002; Wilson and Schieber, 2015). Stagnant

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5. Purpose of the Collaboration : Collaborative Geological Field work, Research & Publication.
6. Collaborative Research Activities : Dr. Nivedita Chakraborty, Department of Geology, Kabi Jagadram Roy Government General Degree College carried out collaborative geological research field work with Dr. Anudeb Mondal, Department of Geology, Presidency University in and around Ariyahur, Cauvery Basin and Bhuj, Kutch basin during 2017-2022, and **PUBLISHED 03 (THREE) SCIENTIFIC PAPERS during 2018-2022.**
7. Outcomes in terms of Research Publications: i) **Chakraborty, N., Mandal, A., Mandal, S., 2022.** Palaeoclimatic imprint on fluvial sediments: examples from Indian Phanerozoic successions in: Madhav et al., (eds.) *Ecological Significance of River Ecosystem*, Elsevier.  
ii) **Chakraborty, N., Sarkar, S., Mandal, A., Mandal, S. Bumby, A., 2018.** Microenvironmental Constraint on  $\delta^{13}\text{C}$  Depletion: Garudamangalam Sandstone, Cauvery Basin, India. *Journal of Marine and Petroleum Geology* 91, 776-784.  
iii) **Chakraborty, N., Mandal, A., Choudhuri, A., Mandal, S., Sarkar, S., 2018.** Indigenous siliciclastic and extraneous polygenetic carbonate beds in the Albian-Turonian Karai Shale, Cauvery Basin, India. *Carbonates and Evaporites* 33(3), 561-576.

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**A REPORT ON THE COLLABORATIVE RESEARCH WORK BETWEEN  
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&  
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- 3 End date of Collaboration : Continuing
- 4 Duration : January, 2016- Continuing
- 5 Purpose of the Collaboration : Collaborative Research, Geological field Work & Publication.
- 6 Collaborative Research : Collaborative research with field work in Cretaceous Rocks of  
Activities Cauvery, Kaladgi and Kutch Basins
7. Outcomes in terms of Research Publications: 02 (two) Publications during the period 2018-2019
  - i) Mukhopadhyay, S., Choudhuri, A., **Chakraborty, N., Sarkar, S.**, 2019. Aseismic tectonism-induced soft-sediment deformation in a tranquil palaeogeography: Chikkshelikere Limestone Member, India in: Mondal, M.E.A. (ed.) *Geological Evolution of Precambrian Indian Shield* (Ed.), SES Series, Springer, Chapter 16, 351-372p.
  - ii) **Chakraborty, N., Sarkar, S.**, 2018. Syn-sedimentary tectonics and facies analysis in a rift setting: Cretaceous Dalmiapuram Formation, Cauvery Basin, SE India. *Journal of Palaeogeography* 7 (2), 146-167.



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**Date: 17.12.2015**

**To whom it may concern**

This is to certify that the College has no objection in permitting Sri/Smt./Dr. Nivedita Chakraborty, Assistant Professor in Geology to continue her collaborative research/academic linkages/activities with Department of Geological Sciences, Jadavpur University, Kolkata to be started in January 2016 without hampering the normal duties of the College.

I wish her all success in life.

Dr. Aresh Kumar Maji  
Officer-in-Charge

Dr. ASESH KUMAR MAJI, W.B.E.S.  
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কলকাতা-৭০০০৩২, ভারত



JADAVPUR UNIVERSITY  
KOLKATA-700032, INDIA

FACULTY OF SCIENCE, DEPARTMENT OF GEOLOGICAL SCIENCES

This is to certify that Dr. Nivedita Chakraborty, Assistant Professor, Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia (Bankura) and me are doing a collaborative research on Cretaceous rocks of Cauvery (East coast) and Kutch Basin (West coast), India since 2016. We did geological field works together in different remote areas and open cast mines in and around Ariyalur (Tamil Nadu) and Bhuj (Gujarat) since 2016. We have published multiple papers in different peer reviewed journals and books during 2016-2021.

The collaborative linkage between Dr. Chakraborty and me is for academic and research purpose.

  
Dr. Subir Sarkar 17/11/2023  
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### **Collaborative Geological Fieldwork at Cauveri Basin (December, 2022)**

[Collaboration (Geology) between Kabi Jagadram Roy Government General Degree College (Dr. Nivedita Chakraborty, Asst. Prof. of Geology) & Jadavpur University (Dr. Subir Sarkar, Professor of Geology)]



### **Collaborative Geological Fieldwork at Kaladgi Basin (January, 2023)**

[Collaboration (Geology) between Kabi Jagadram Roy Government General Degree College (Dr. Nivedita Chakraborty, Asst. Prof. of Geology) & Jadavpur University (Dr. Subir Sarkar, Professor of Geology)]



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### **Collaborative Geological Fieldwork at Kutch Basin (15/12/2023)**

[Collaboration (Geology) between Kabi Jagadram Roy Government General Degree College (Dr. Nivedita Chakraborty, Asst. Prof. of Geology) & Jadavpur University (Dr. Subir Sarkar, Professor of Geology)]



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**Aseismic Tectonism-Induced  
Soft-Sediment Deformation  
in a Tranquil Palaeogeography:  
Chikkshelikere Limestone Member,  
Proterozoic Kaladgi Basin, Southern  
India**



**Soumik Mukhopadhyay, Adrita Choudhuri, Nivedita Chakraborty  
and Subir Sarkar**

**Abstract** The wide spectrum of synsedimentary deformation products occurring almost at all stratigraphic levels within the ~40 m-thick section of the Chikkshelikere Limestone Member of tentative Mesoproterozoic age in India is evaluated for its origin. Among the two principal facies components, both carbonate, of this Member the dark micritic facies generally underwent brittle deformation, and the light microsparry facies responded in ductile fashion to the same deformational stress. Breccia patches, hardly having any boundary, abound at almost every stratigraphic level within the Chikkshelikere Limestone Member. The third facies constituting less than 3% by volume of the Member is of laterally persistent carbonate intraclastic conglomerate beds. The dark facies is of massive micrite, while the light facies is made up of interlocking microspar crystals, but bears minor wave-current structures, and rare minute erosional features at its base. Non-luminescent character of the former under CL is reminiscent of oxidizing basin-floor environment, while the bright orange luminescence of the latter testifies pervasive burial recrystallization. The dark micritic facies is interpreted as indigenous and the light microsparry facies as allochthonous, possibly laid by highly energy-depleted storm wave-cum-current. Mineralogical as well as geochemical analyses indicate preferred dolomitization and carbon enrichment in the dark micritic facies. Selective pyritization is also observed along the base of the same facies. These features collectively suggest selective microbial mat proliferation within this facies. Despite early induration being the rule for carbonate sediments, microbial mat growth apparently enhanced its rate within the dark micritic facies

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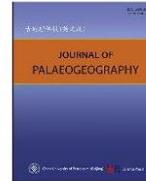
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## Syn-sedimentary tectonics and facies analysis in a rift setting: Cretaceous Dalmiapuram Formation, Cauvery Basin, SE India



Nivedita Chakraborty <sup>a,\*</sup>, Subir Sarkar <sup>b</sup>

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**Abstract** The Cretaceous (Albian–Cenomanian) Dalmiapuram Formation is one of the economically significant constituents in the hydrocarbon-producing Cauvery rift basin, SE India that opened up during the Late Jurassic–Early Cretaceous Gondwanaland fragmentation. The fossil-rich Dalmiapuram Formation, exposed at Ariyalur within the Pondicherry sub-basin of Cauvery Basin, rests in most places directly on the Archean basement and locally on the Lower Cretaceous (Barremian–Aptian) Basal Siliciclastic Formation. In the Dalmiapuram Formation, a facies association of tectonically-disturbed phase is sandwiched between two drastically quieter phases. The early syn-rift facies association (FA 1), records the first carbonate marine transgression within the basin, comprising a bar–lagoon system with occasionally storms affecting along the shore and a sheet-like non-recurrent biomicritic limestone bed on the shallow shelf that laterally grades into pyrite–glauconite-bearing dark-colored shale in the deeper shelf. Spectacular breccias together with varied kinds of mass-flow products comprise the syn-rift facies association (FA 2). While the breccias occur at the basin margin area, the latter extend in the deeper inland sea. Clast composition of the coarse clastics includes large, even block-sized limestone fragments and small fragments of granite and sandstone from the basement. Marl beds of quieter intervals between tectonic pulses occur in alternation with them. Faulted basal contact of the formation, and small grabens filled by multiple mass-flow packages bear the clear signature of the syn-tectonic activity localized contortions, slump folds, and pillow beds associated with mega slump/slide planes and joints, which corroborates this contention further. This phase of tectonic intervention is followed by another relatively quieter phase and accommodates the late syn-rift facies association (FA 3). A tidal bar–interbar shelf depositional system allowed a transgressive systems tract motif to grow eventually passing upwards into the Karai Shale Formation, whose contact with the Dalmiapuram Formation is gradational.

**Keywords** Syn-sedimentary tectonics, Facies analysis, Carbonate shelf, Cretaceous, Dalmiapuram Formation, Cauvery Basin

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**[Dr. Subir Sarkar, Professor of Geology]**
2. Start Date of Collaboration : January, 2016
3. End date of Collaboration : Continuing
4. Duration : January, 2016- Continuing
5. Purpose of the Collaboration : Collaborative Research, Geological field Work & Publication.
6. Collaborative Research Activities : Dr. Nivedita Chakraborty, Department of Geology, Kabi Jagadram Roy Government General Degree College and Prof. Subir Sarkar, Department of Geological Sciences, Jadavpur University carried out collaborative research, field work in Cretaceous rocks of Cauvery, Kaladgi and Kutch Basins.

**PUBLISHED 02 (TWO) SCIENTIFIC PAPERS during 2018-2019.**

7. Outcomes in terms of Research Publications: i) Mukhopadhyay, S., Choudhuri, A., **Chakraborty, N., Sarkar, S.**, 2019. Aseismic tectonism-induced soft-sediment deformation in a tranquil palaeogeography: Chikkshelikere Limestone Member, India in: Mondal, M.E.A. (ed.) *Geological Evolution of Precambrian Indian Shield* (Ed.), SES Series, Springer, Chapter 16, 351-372p.

ii) **Chakraborty, N., Sarkar, S.**, 2018. Syn-sedimentary tectonics and facies analysis in a rift setting: Cretaceous Dalmiapuram Formation, Cauvery Basin, SE India. *Journal of Palaeogeography* 7 (2), 146-167.

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Date: 23.07.2015

To whom it may concern

This is to certify that the College has no objection in permitting  
Sri/Smt./Dr. Nivedita Chakraborty, Assistant Professor in Geology  
to continue her collaborative research/academic linkages/activities with  
Department of Earth Sciences, IIT Bombay since 2010 without  
hampering the normal duties of the College.

I wish her all success in life.

Dr. Aresh Kumar Maji  
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This is to certify that Dr. Nivedita Chakraborty, Assistant Professor, Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia, Bankura is associated with me in collaborative geological field work in Cretaceous successions of Cauvery Basin, Tamil Nadu since 2010. We did geological field trip to different remote areas and open cast mines in and around Ariyalur during the month of July 2018 (10 days). This collaborative linkage is for academic and research purpose.

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## Cretaceous Deposits of India: A Review



**Nivedita Chakraborty, Anudeb Mandal, R. Nagendra, Shilpa Srimani,  
Santanu Banerjee, and Subir Sarkar**

**Abstract** India offers a graceful natural laboratory for time traveling to the Cretaceous world. The present chapter attempts a review of Cretaceous geology from India heading for its stance on evolution of basin, stratigraphy, sedimentation, climate, volcanism, relative sea level, biogeography and mass extinction. It was the era when India separated from the Gondwanaland next to the South Pole and initiated the longest passage in a northward direction. Tectonic spurt and reformation steered the geography of the island continent. Margins of the land got novel shape, new ocean and bays opened up, coastlines were formed and new sedimentary basins developed at the continental margins as well as in the interior part. Later, Gondwana sedimentation was ceased. Relative sea level (RSL) was set to fluctuate at a similar pace to global transgression and regression. Sediments were deposited on the east coast, west coast, and offshore basins in response to the rise in RSL during Albian, Turonian and Campanian. A Late Cretaceous transgression in central India came from the west. The maximum fossil foraminifer diversity was in the late Cenomanian/earliest Turonian and this time-interval is corresponding with the maximum sea-level recorded during the Mesozoic. Apparently, a warm temperate humid palaeoclimate prevailed with a tendency of increasing humidity at the end of the Cretaceous. The paleotemperature graph was higher in Late Cretaceous too. India witnessed three renowned volcanic episodes during this period: Rajmahal and Sylhet flood basalts in the eastern part and Deccan volcanism in the western sector. India perhaps retained the biotic link with

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**[Dr. Santanu Banerjee, Professor of Geology]**
2. Start Date of Collaboration : July, 2015
3. End date of Collaboration : Continuing
4. Duration : July, 2015- Continuing
5. Purpose of the Collaboration : Collaborative Geological Field work, Research & Publication.
6. Collaborative Research Activities : Dr. Nivedita Chakraborty, Department of Geology, Kabi Jagadram Roy Government General Degree College and Prof. Santanu Banerjee, Department of Earth Sciences, IIT Bombay carried out Collaborative Geological Field Work and Research in Cretaceous Rocks in India and **PUBLISHED 01 (ONE) SCIENTIFIC PAPER in 2021.**
7. Outcomes in terms of Research Publications: **Chakraborty, N., Mandal, A., Nagendra, R., Srimani, S., Banerjee, S., and Sarkar, S., 2021.** 'Cretaceous deposits of India: A review', in: Banerjee, S., and Sarkar, S. (eds.) *Mesozoic Stratigraphy of India* (Society of Earth Scientists Series), Springer, Chapter 2, 39-85p.

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Date: 22.07.2015

To whom it may concern

This is to certify that the College has no objection in permitting Sri/Smt./Dr. Nivedita Chakraborty, Assistant Professor in Geology to continue her collaborative research/academic linkages/activities with Department of Geology, Anna University, Chennai since 2010 without hampering the normal duties of the College.

I wish her all success in life.

Dr. Aresh Kumar Maji  
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### Certificate of Collaborative Research

This is to certify that Dr. Nivedita Chakraborty, Assistant Professor at the Department of Geology, Kabi Jagadram Roy Government General Degree College, Mejia, Bankura, has been actively involved in a collaborative research project on Sedimentology and Stratigraphy of Cauvery Basin, southern India with the Department of Geology, Anna University, Chennai, since 2010. The research collaboration between these two esteemed institutions has been ongoing and has resulted in numerous publications in national and international journals. Additionally, efforts are underway to compile a comprehensive book on the Geology of the Cauvery Basin. The research interactions and intra-university collaboration have significantly contributed to the fields of sequence stratigraphy, sedimentary facies studies, and the promotion of students in Cretaceous field studies. Dr. Nivedita Chakraborty and researchers from both universities have effectively combined their expertise, resources, and efforts to complete the research project. Their collaboration has provided valuable insights and made noteworthy contributions to the understanding of Cretaceous sedimentary successions. The outcomes of this collaborative research endeavour have shed light on the correlation between outcrop and subcrop Cretaceous successions, enhancing the interpretation of seismic profiles and the refinement of litho- and biostratigraphy. We take great pleasure in acknowledging the exceptional work and dedication exhibited by Dr. Nivedita Chakraborty throughout this collaborative research initiative.

Dr. Nivedita Chakraborty's commitment to academic excellence and the pursuit of knowledge has been instrumental in the successful outcome of the collaborative project and subsequent research publications. This certificate serves as a testament to their outstanding teamwork, professionalism, and ability to work harmoniously across institutional boundaries. It recognizes its unwavering commitment to advancing scientific understanding and fostering academic collaboration. We firmly believe that the collaborative efforts will continue to yield significant advancements in the respective fields of research and inspire others to engage in fruitful collaborations. We express our sincere appreciation for Dr. Nivedita Chakraborty's contributions and extend our best wishes for continued success in their future endeavours.



July 14 2023



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## Continental-to-Marine Transition in an Ongoing Rift Setting: Barremian-Turonian Sediments of Cauvery Basin, India



Nivedita Chakraborty, Subir Sarkar, and R. Nagendra

**Abstract** Study of Cretaceous (Barremian-Turonian) sediments within the Ariyalur-Pondicherry sub-basin, Cauvery Basin, India mirrors the deposition of fluvial-to-marine transition in a syn-rift setting during the Mesozoic breakup of east Gondwanaland. Within the investigated interval, fluvial Basal Siliciclastic Formation (Upper Gondwana equivalent), overlying the Archean Basement, is succeeded by the marine Dalmiapuram Formation (shallow water) and the Karai Shale Formation (offshore). However, both the marine formations demonstrate the lithocontact with the basement locally. Process-based sedimentary facies analysis identifies nine facies associations categorized in non-marine, shallow marine and deep marine super associations, cumulatively comprising forty sedimentary facies. Facies associations vary in its lithology, primary sedimentary structures, stratal geometry and pattern, paleocurrent direction, as well as in grain size and sorting. The present study reveals the depositional processes ensued across the environmental continuum of mountain front to the ocean. Basal Siliciclastic sediments are restricted in isolated outcrops, along the western margin of the basin. Within this formation, scree-alluvial fan and channel amalgamation are restricted at basin-margin while flood-plain governs in basin-interior. The depositional contextual shifted from continental to marine during Albian on the advent of marine transgression along the eastern passive margin of India. A carbonate (non-rimmed) ramp platform, evolving from homoclinal to distally steepened, shaped the pre-fall shelf by depositing carbonates (Dalmiapuram Formation) while, organic-rich glauconite, phosphate nodule bearing shale (Karai Shale Formation) settled in the basin center. The fluvial-to-marine transition surface records a sequence boundary with the overlying formations reflecting relative sea level change. Limestone to shale conversion is gradational in accord with

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CHAPTER

6

Physico-Chemical Characteristics  
of the Barremian-Aptian Siliciclastic  
Rocks in the Pondicherry Embryonic  
Rift Sub-basin, India

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Pretoria, South Africa

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### SUMMARY OF THE COLLABORATIVE RESEARCH WORK AND OUTCOME

1. Name of the Collaborating Institution with contact details : ANNA UNIVERSITY, CHENNAI  
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[Dr. R. Nagendra, Professor of Geology]
2. Start Date of Collaboration : July, 2015
3. End date of Collaboration : Continuing
4. Duration : July, 2015- Continuing
5. Purpose of the Collaboration : Collaborative Research Work on Sedimentology and Stratigraphy & Publication.
6. Collaborative Research Activities : Dr. Nivedita Chakraborty, Department of Geology, Kabi Jagadram Roy Government General Degree College and Prof. R. Nagendra, Department of Geology, Anna University, Chennai conducted collaborative research work on Sedimentology and Stratigraphy of Cauvery basin and **PUBLISHED 02 (TWO) SCIENTIFIC PAPERS during 2018-2021.**
7. Outcomes in terms of Research Publications: i) **Chakraborty, N., Sarkar, S., Nagendra, R.,** 2021. Continental-to-marine transition in an ongoing rift setting: Barremian-Turonian sediments of Cauvery Basin, India, in: Banerjee, S., and Sarkar, S. (eds.) *Mesozoic Stratigraphy of India* (Society of Earth Scientists Series), Springer, Chapter 20, 587-622p.  
ii) **Chakraborty, N., Sarkar, S., Mandal, A., Mejjama, W., Tawfik, H. A., Nagendra, R., Bose, P. K. and Eriksson, P. G.,** 2017. Physico-chemical Characteristics of the Barremian-Aptian Siliciclastic Rocks in the Pondicherry Embryonic Rift Sub-basin, India in: Mazumder, R. (ed.) *Sediment provenance: influences on compositional change from Source to Sink*, Elsevier, Chapter 6, 85-121p.

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