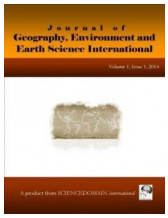

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Foraminiferal Assemblage from the Karai Shale, Uttattur Group, Southern India

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Authors' contributions

This work was carried out in collaboration between both the authors. Authors LH and RV designed the study, performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript, managed the analyses of the study and the literature searches. Both the authors read and approved the final manuscript.

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ABSTRACT

To study the foraminiferal assemblage from the Karai shale, one hundred and nineteen surface sediment samples were collected systematically. The collected samples were processed using standard micropaleontological techniques. Ninety- eight species of well - preserved foraminifera were obtained from the samples. Of the ninety-eight species, eighty-nine were benthic foraminifera and nine were planktic foraminifera. The specific identification of the foraminifera was done after comparing them with those described and illustrated by various workers from the Cretaceous of Southern India. The age of the samples was assigned as Albian based on the presence of planktic foraminiferal species viz. *Hedbergella delrioensis, Hedbergella planispira, Praeglobotruncana delrioensis, Praeglobotruncana stephani, Planomalina buxtorfi* and *Thalmanninella balernaensis.*

Keywords: Cretaceous; Planktic foraminifera; benthic foraminifera; Albian.

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1. INTRODUCTION

Foraminifera are unicellular organisms found in all sorts of environments, representing one of the most important groups of marine protists. In light of their unbelievable fossil record and evolutionary history, foraminifera became the key indices in biostratigraphic, paleoceanographic, and paleoclimatic reconstructions. They are globally used for biostratigraphic subdivision and correlation of sedimentary strata [1].

The Cretaceous has long been recognized as a special episode in the history of the Earth and several of the most important ideas in geology derive from the study of Cretaceous rocks [2]. The Cretaceous system is classified into two subsystems, the lower stretching up to and including the Albian and the upper comprising the rest. In recent years, Middle or mid Cretaceous has been recognized, describe the Aptian through Turonian stages, 119-88.5 ma based on Hortland et al. (1982) and Kent and Gradstein (1985) [3].

The marine Cretaceous Formations are developed both in Peninsular and extra-peninsular regions [4]. The marine Cretaceous sedimentary sequences in the Indian Peninsula are best developed in the Cauvery Basin, ranging in age from Hauterivian to Maastrichtian. The Cauvery basin is the southern - most basin along the eastern margin of India [5]. The Cretaceous rocks of southern India are exposed in five detached outcrop patches in the Cauvery basin. They are Sivaganga, Ariyalur, Vriddachalam and Puduchery basins from south to north [6]. The cretaceous rocks of the Ariyalur area in the Cauvery basin have been classified both lithostratigraphically and they are divided into three Groups, viz. Uttattur, Trichinopoly and Ariyalur Groups in the ascending order and these Groups include many Formations.

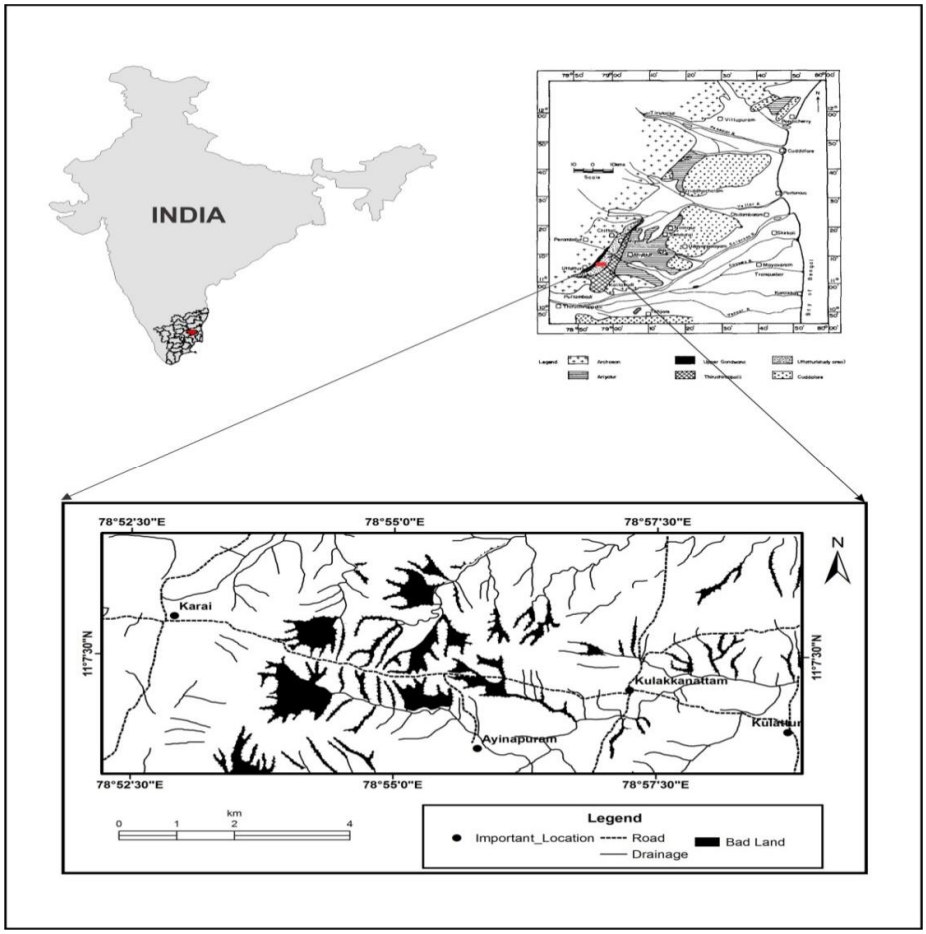

Fig. 1. Location map of the study area

1.1 Study Area

The area under investigation was located between the Karai and Kulakkalnattam villages situated about 13 km South of Perambalur town. The study area falls within North latitudes 11º 06' to 11º 07' and East longitudes 78º 53' to 78º 56' forming part of the toposheet 58 I/16 of Geological Survey of India. The Karai – Kulakkalnattam has been declared as a 'Geological Heritage Site' by the State Government for conservation, protection and maintenance.

1.2 Geology and Stratigraphy of the Study Area

The Uttattur beds consist of silts, calcareous shales and sandy clays containing ferruginous, phosphatic and calcareous nodules. The clays are often streaked with yellow and brown ferruginous stains.

The Uttattur Group is divided into Terani Formation, Arogyapuram Formation, Dalmiapuram Formation and Karai Formation (Sundaram et al. [7]). The Karai Formation is the top most Formation of the Uttattur Group and is overlain by the Kulakkalnattam Formation of the Trichinopoly Group with a regional unconformity. This Formation is named after the Karai village, adjacent to which the unit is exposed well as badland in an easterly draining catchment to the east of Karai.

Karai Formation is made up of grey-brown, gypsiferous, glauconitic mudstone and marl which is black and gypsum free when fresh with sporadic thin, interbeds of siltstone, calcareous sandstone and conquinite particularly in its upper part. Sporadic calcareous, sideritic and phosphatic concretions and concretionary horizons occur in some intervals. Scattered macrofossils, predominantly molluscs, are typical of the formation [8,9].

The lower and middle parts of Karai Formation contain rich late Albian and Cenomanian mega and micro fossil assemblages respectively, while its upper part contains fossil assemblages of late Turonian. Age assignment was made based on the ammonites and planktic foraminifera. The formation reaches a maximum thickness of some 410 m [10].

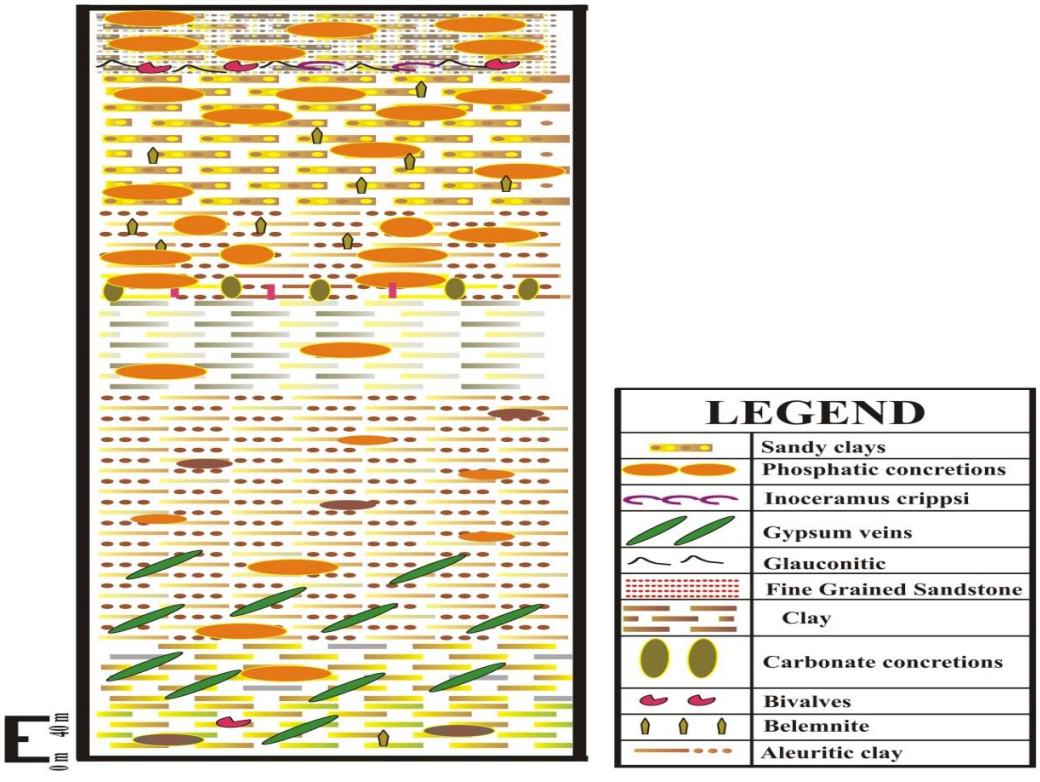

Fig. 2. Lithology of samples in the study area

Table 1. The benthic foraminifera percentage contribution

Genus name	Percentage	Genus name	Percentage
Ammodiscus	0.43	Lenticulina	19.21
Anomalinoides	0.45	Lingulina	0.6
Citharina	0.30	Lingulogavelinella	0.76
Conorboides	1.10	Marginulina	4.79
Dentalina	7.44	Nodosaria	2.51
Dorothia	0.34	Oolina	0.25
Eouvigerina	2.70	Patellina	0.28
Frondicularia	4.35	Pleurostomella	0.59
Gaudryina	0.71	Pseudonodosaria	0.93
Gavelinella	19.93	Pyrulina	0.17
Globulina	0.6	Quadrimorphina	5.24
Glomospira	0.16	Ramulina	1.06
Glomospirella	0.3	Saracenaria	1.11
Gyroidinoides	15.74	Tristix	3.19
Haplophragmoides	0.59	Vaginulina	2.92
Lagena	0.86	Verneulinoides	0.38

2. MATERIALS AND METHODS

One hundred and nineteen (119) surface sediment samples were collected systematically from the study area. For the present study, 50 grams of each sample were processed using standard micropaleontological techniques. Depending on the hardness of the sample, the reagents like water, hydrogen peroxide and sodium carbonate (anhydrous) were used. The samples were soaked for about 12- 24 hrs and are heated depending upon the disintegration of the sediment. They are then washed through ASTM 230 sieve mesh and are transferred to a china bowl for drying in a hot air oven. The dried samples are passed through a series of ASTM mesh to obtain different size fractions. The foraminifera obtained are well preserved and have diverse assemblages. They are then studied under a stereozoom microscope and the foraminifers were separated.

3. RESULTS AND DISCUSSION

From the processed samples, ninety eight species of foraminifera were identified of which eighty nine species are benthic and nine are planktic foraminifera. The classification proposed by A. R. Loeblich Jr. and H. Tappan (Foraminiferal genera and their classification – Published by Van Nostrand Reinhold Company, New York-1988) [11] is followed in the present study. Specific identifications were made after comparing the present fauna with those described and illustrated by various workers from the Cretaceous region of the world [12,13,14,15, 9,3].

3.1 Foraminiferal Assemblage

The identified species are as follows:

3.1.1 Benthic foraminifera

Ammodiscus cretaceus, Ammodiscus planus, Anomalinoides indica, Conorboides minutissima, Dentalina basiplanata, Dentalina catenula, Dentalina cylindroides, Dentalina marginuloides, Dentalina nana, Dentalina trujilloi, Dentalina xiphioides, Dorothia filiformis, Eouvigerina uttatturensis, Frondicularia aclis, Frondicularia filocincta, Frondicularia goldfussi, Gaudryina tailleuri, Gavelinella baltica, Gavelinella cenomanica, Gavelinella intermedia, Gavelinella rudis, Gavelinella simionescui, Globulina lacrima, Globulina prisca, Glomospira charoides, Glomospirella gaultina, Gyroidinoides depressa, Gyroidinoides globosa, Gyroidinoides nitidus, Haplophragmoides kirki, Haplophragmoides sp., *Lagena globosa, Lagena hispida, Lagena sulcata, Lenticulina alexanderi, Lenticulina circumcidanea, Lenticulina gaultina, Lenticulina grata, Lenticulina navarroensis, Lenticulina nodosa, Lenticulina nuda, Lenticulina ovalis, Lenticulina polygona, Lenticulina rotulata, Lenticulina saxocretacea, Lenticulina secans, Lenticulina stephensoni, Lenticulina sulcifera, Lenticulina warrengoensis, Lingulina nodosaria, Lingulogavelinella albiensis, Lingulogavelinella jarzevae, Marginulina aequivoca, Marginulina bullata, Marginulina compressa, Marginulina directa, Marginulina glabra, Marginulina hamuloides, Marginulina jonesi, Marginulina lineara, Marginulina munieri, Marginulina perobliqua, Marginulina troedssoni,*

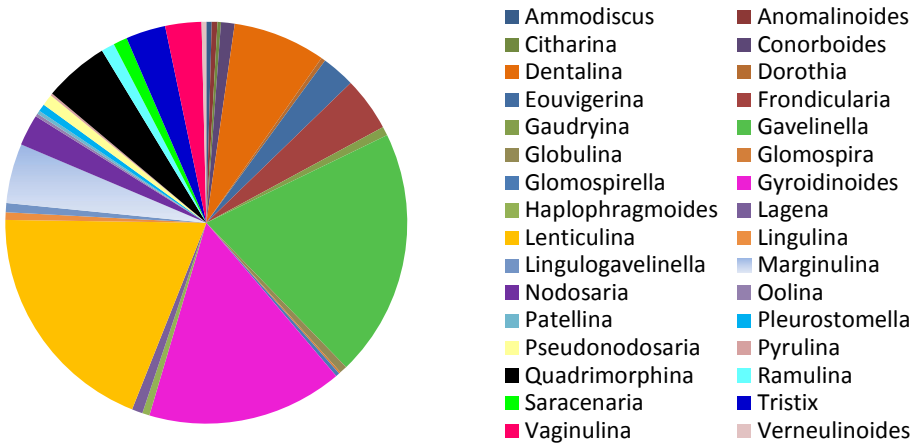

Fig. 3. Percentage wise distribution of Genus

Nodosaria distans, Nodosaria mutabilis, Nodosaria obscura, Nodosaria orthopleura, Nodosaria prismatica, Oolina apiculata, Oolina simplex, Patellina subcretacea, Pleurostomella cullygoodiensis, Pleurostomella nitida, Pleurostomella obtusa, Pleurostomella reussi, Pseudonodosaria cylindracea, Pseudonodosaria manifesta, Pyrulina cylindroides, Quadrimorphina allomorphinoides, Quadrimorphina camerata, Ramulina aculeata, Ramulina globulifera, Ramulina spandeli, Saracenaria frankei, Saracenaria triangularis, Tristix tricarinatum acutangulum, Vaginulina debilis, Vaginulina kochii and *Verneuilinoides chapmani.*

3.1.2 Planktic foraminifera

Globigerinelloides bentonensis, Globigerinelloides caseyi, Globigerinelloides ultramicra, Hedbergella delrioensis, Hedbergella planispira, Planomalina buxtorfi, Praeglobotruncana delrioensis, Praeglobotruncana stephani and *Thalmanninella balernaensis.*

The benthic foraminifera are more in number compared to that of planktonic foraminifera. Among the benthic foraminifera, the species belonging to the genus *Gavelinella, Gyroidinoides* and *Lenticulina* are more in number. Next to them are the species of the genus *Dentalina, Frondicularia, Marginulina* and *Quadrimorphina* (Table 1).

3.2 Age Assignment

The age of the sediment samples are assigned based on the presence of planktic foraminifera. *Globigerinelloides bentonensis, Globigerinelloides caseyi, Globigerinelloides ultramicra, Hedbergella delrioensis* and *Hedbergella planispira* are present in the samples from K001 to K096. As no other key marker planktic species are present in these samples, the age of the samples are assigned as Middle Albian based on the presence of *Hedbergella planispira. Globigerinelloides bentonensis, Globigerinelloides caseyi, Globigerinelloides ultramicra, Planomalina buxtorfi, Hedbergella delrioensis, Hedbergella planispira, Praeglobotruncana delrioensis, Praeglobotruncana stephani* and *Thalmanninella balernaensis* are present in the samples from K097 to K119. The presence of *Planomalina buxtorfi, Praeglobotruncana delrioensis, Praeglobotruncana stephani* and *Thalmanninella balernaensis* indicates a Late Albian age to these samples.

4. SUMMARY AND CONCLUSION

The present work deals with the recording of foraminiferal assemblage from the sediments exposed in the Karai shale, Uttattur Group, Southern India. One hundred and nineteen samples were collected systematically from the study area to record the foraminifera. Well preserved benthic and planktic foraminifera were obtained. Eighty nine benthic foraminifera and nine planktic foraminifera were recorded. Based on the occurrence of the planktic foraminifera *Hedbergella delrioensis, Hedbergella planispira, Praeglobotruncana delrioensis, Praeglobotruncana stephani, Planomalina buxtorfi* and *Thalmanninella balernaensis* the age of the sediment samples are assigned as Albian.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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