

SOME OBSERVATIONS ON THE MIOCENE FORAMINIFERA FROM KACHCHH, WESTERN INDIA

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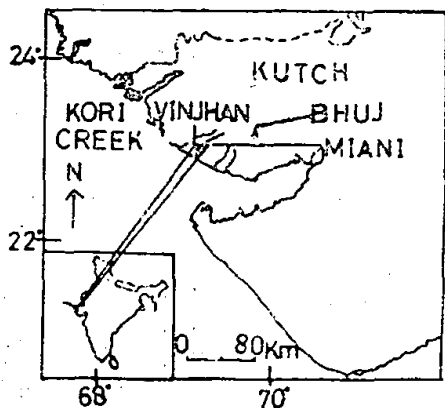
ABSTRACT

The foraminiferal species described from the Miocene sequence exposed at the Village Vinjhan of Kachchh are widely distributed in the comparable successions of the Middle East and Greece. They can be used for inter-regional correlation in the absence of planktonic species.

However, these species as well as other associated index forms need to be studied in different sections of Kachchh for their true stratigraphic ranges. The existing knowledge on the specific composition of foraminifera is not sufficient to provide good stratigraphic correlation with well-studied sequences of the Mediterranean, and major geological events influencing the sedimentary facies in much of the Tethys.

INTRODUCTION

Recent study by the authors in the area near the village Vinjhan of Kachchh, India (Fig. 1) shows that the sequence dated as



F.g. 1. Location map showing the area of study.

Burdigalian and Langhian (Jauhri, 1981) has some foraminiferal species which are

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widespread in the Tethyan region in the rocks of similar age. The sequence has two carbonate units (the Lower and Upper Limestone) separated by an unfossiliferous shale layer. The important fossil foraminifera present in the sequence are *Miogypsina globulina* (Michelotti), *Archaias* sp., *Austrotrilina howchini* (Schlumberger) from the Lower Limestone (also rich in megainvertebrates such as molluscs, echinoids, etc.), and *Archaias malabarica* (Carter), and *Austrotrilina howchini* from the Upper Limestone, Kachchh. The distribution of these species in the sequence is shown in Fig. 2. These species are known in the comparable sequences of the Middle East and Greece and seem to be useful in the inter-regional correlation in the absence of planktonic microfossils.

This note examines the possibility of using these species for determining the stratigraphic position of the Kachchh sequences in relation to coeval successions of the Mediterranean, and points out the

existing problems of precise biostratigraphic correlation of the sequences in the West Coast of India.

BIOSTRATIGRAPHY

In recent years, the Neogene correlations using larger foraminifera have become much precise, and many species have now been related to plankton indices (Haak and Postuma, 1975; Chaproniere, 1981 and Adams, 1984). The species studied in the collection are all characteristic of Tf 1 stage i. e. combined Burdigalian and Langhian stages. The upper Tf 1 includes the *Orbulina* datum which coincides with N8/N9 boundary near 15 m.y. time line. The range of *Miogypsina globulina* has been approximately estimated to be N6-N8 (Raju, 1974), though

in some areas, as Adams (*op. cit.*) suggests, it extends to levels younger than *Orbulina* datum as well as the base of the Tf 2 stage. *Archaias malabarica* has been recorded from the Middle East to the Far East in the strata equivalent of Tf 1 stage. Eames (in Davies, 1975) and Clarke and Blow (1969) regard it as a Middle Miocene marker. One of us (A.K.J., 1981), using data from the Persian Gulf and the Far East, opined that *A. malabarica* appeared in the Late Burdigalian and continued upto the top of the Langhian in the Indian Subcontinent. Pandey (1982) suggests that it appears in N4 and continues upto N14 in western off-shore region of India. He regards it as probably synonymous with *Archaias kirku-kensis* Henson which is also known from Asmari Limestone of Iran. Adams (*op. cit.*) estimated its range from the base of N6 to

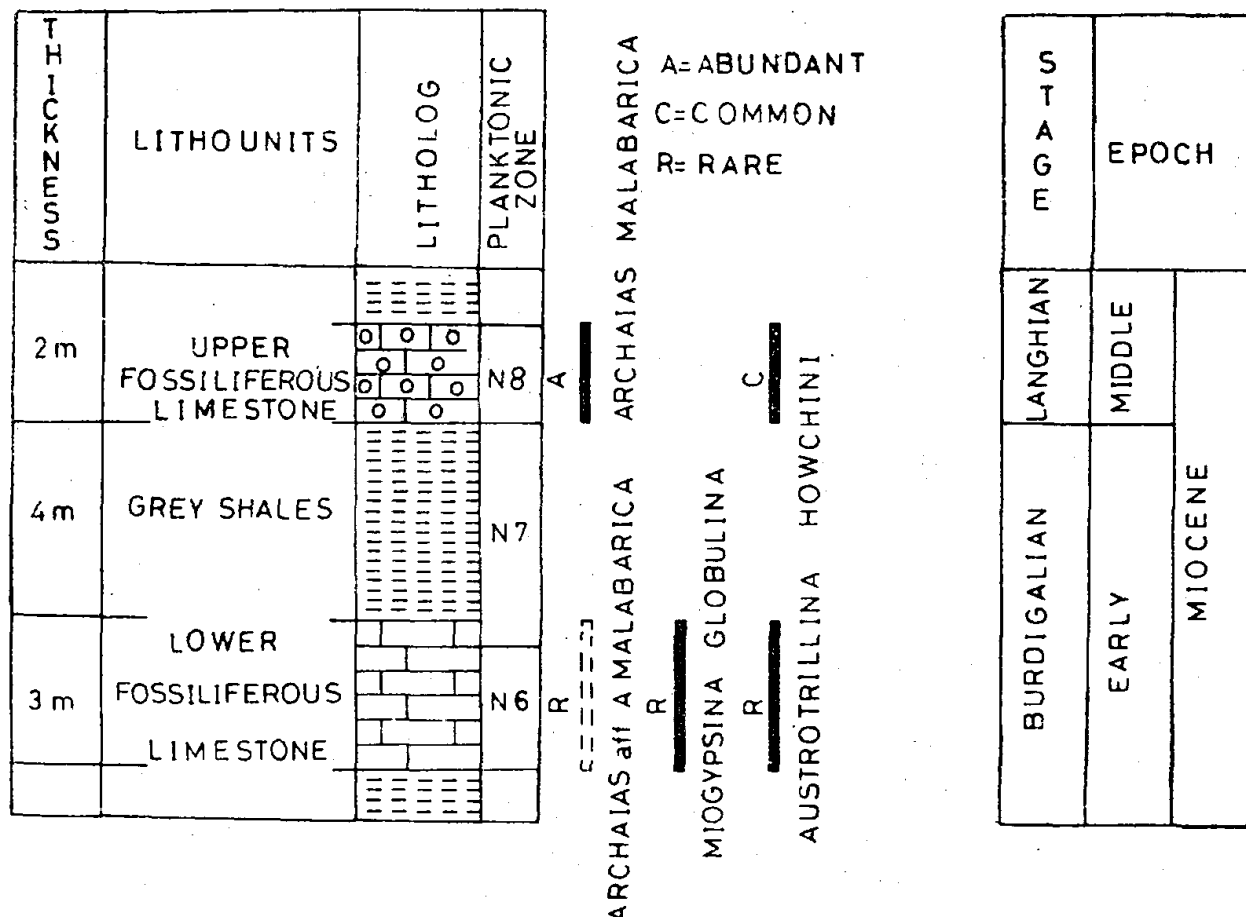


Fig. 2. Biostratigraphic Position of the Vinjhan Miocene sequence with vertical distribution of important species larger foraminifera.

the base of N9. Its stratigraphic position has been reviewed by Banner and Highton (1989) in their redescription of this species (as *Pseudotaberina malabarica* (Carter). They noted that in the Quilon beds of Kerala State (the type locality) its level of occurrence is immediately subsequent to the *Globigerinatella insueta* zone equivalent and is slightly younger than the planktonic foraminiferal zone N8 (Middle Miocene); see Rasheed and Ramchandran (1978). Taking its all other occurrences into consideration, they conclude, "*Pseudotaberina malabarica* appears to characterise carbonate inner-shelf palaeoenvironments of Tt 1 age in much of the Tethys, and this interval has been correlated with planktonic zones N 6-9 (Upper Burdigalian to Langhian, latest Early to earliest Middle Miocene, sensu Berggren *et al.* 1985) or with zones N 9-11 (upper Langhian or lower Serravallian, early Middle Miocene, *op. cit.*). Older occurrences have yet to be proved". *Austrotrillina howchini* is now regarded as ranging from N 6 to the top of N 9.

Based on the above information about the stratigraphic ranges of these species, it would appear that the Vinjhan Carbonate sequence is of Burdigalian to Early Langhian in age. Though precise biostratigraphical correlation of the lower and upper limestone units of this sequence with planktonic zones is not possible at present, the lower macro-invertebrate-bearing Limestone unit containing *Miogypsina globulina*, rare *Austrotrillina howchini* and some forms of *Archaias* may range from the N 6 to N 7, and the upper Limestone with *Archaias malabarica*, and *Austrotrillina howchini* is approximately equal to N 8.

A look at the geographic distribution of these species shows that they are known from some equivalent carbonate successions in the Mediterranean region (Upper Asmari Limestone, Iran; and the carbonate succession at Kos, Greece). Adams *et al.* (1983) presented biogeographic data about these species (*Austrotrillina howchini*, *Archaias malabarica* and *Miogypsina globulina*) in the Mediterranean and the Indian Ocean regions. The record of *A. malabarica* from

Syria (Henson, 1950) has been invalidated by them, though his other records seem to be valid. If we accept Pandey's (*op. cit.*) view of *Archaias kirkukensis* Henson as junior synonym of *A. malabarica*, its presence in upper Asmari Limestone would be established.

However, an alternative view expressed by Raju (personal communication) suggests the Burdigalian age to the Vinjhan sequence. On the basis of the occurrence of *Miogypsina (Lepidosemicyclina) droogeri* Mohan and Tewari (Mohan, 1958) in the bed No. 4 of the Vinjhan sequence given by Tewari (1952), he assigns the Burdigalian age to it. This species, according to him, is Burdigalian in age by way of inference through planktonic occurrences, since it does not occur in Europe or Mediterranean. He is of the opinion that *A. malabarica* occurs in association with *M. globulina* and *M. thecidformis* and may be dated as Burdigalian. We think that Tewari's Bed No. 4 which is characterized by rich foraminiferal and molluscan assemblages possibly corresponds to the lower limestone unit of the present study. However, this matter needs to be further investigated. It is also suggested that these species and the associated index forms should be studied for their true stratigraphic ranges in other sections of the Kachchh region.

IMPORTANT NEOGENE EVENTS

Larger foraminifera are influenced by changes in sedimentary facies which are related to eustatic and climatic changes. Carbonate facies are most suitable to foraminifera and provide the necessary habitats for them. Warm temperatures and sea level highstands favour shallow water carbonate accumulation, while climatic deterioration and major sea level fall have negative effect on carbonates. The understanding of these geological events can be achieved through precisely dated faunal events. The major Neogene sedimentary facies and faunal changes associated with global marine cycles and palaeoclimatic variations have been well dated in the Mediterranean region

(Rogl and Steininger, 1984). Some of their observations important in this context are:

1. The widespread bloom of larger foraminifera in the Mediterranean and the Indo-Pacific regions during the Late Oligocene and Early Miocene corresponds to a highstand, rise in temperature, and the spread of shallow-water carbonate facies (e. g. Asmari Limestone-Middle) near the Palaeogene/Neogene boundary in Zone N4 (about 25-23 m. y. ago).
2. A remarkable radiation and wide distribution of large-sized molluscs in the Tethyan region corresponds with the Early Burdigalian transgression which possibly correlates with zones N 5-N 6 (23.3-20 m. y. ago).
3. Subsequent withdrawal of the sea from the Tethyan margins following the collision of Africa and Eurasia was a well-marked event leading to the first mammal migration from Africa to Europe ("Proboscidean Datum"). It occurred during the Middle-Late Burdigalian, between 20-17 m. y. ago, disrupting the circum-equatorial circulation and giving rise to the cooling of climates in the Tethyan region.
4. The widespread marine transgression, which re-established the marine depositional regimes in middle and eastern Europe and in the Middle East, occurred at the base of Langhian, between 16.8-16.0 m. y. ago. It corresponds to a global rise in sea level and temperature and is possibly correlatable with the first appearance of *Preorbulina* in the sediments of suitable facies.

KACHCHH SEQUENCES

The Neogene shallow-water marine carbonate sequences of Kachchh possibly range in age from Early to Middle Miocene and can be correlated with other coeval carbonate successions in the Mediterranean. Some well-studied sequences of the Middle East (Middle and Upper Asmari Limestone, Euphrates Lime-

stone, etc.) and Greece (carbonates at Kos) have comparable fauna and are well understood in terms of their biostratigraphic position (Adams *et al.*, *op. cit.*; Bigno *et al.*, 1976). The Euphrates Limestone and its lateral equivalents correspond to the carbonate facies deposited in the Early Burdigalian transgression in the Tethyan region, and the Upper Asmari Limestone and the succession at Kos possibly correlate with the extensive marine transgression at the base of Langhian (Rogl and Steininger, *op. cit.*, 1984). It is possible that the Miocene sequences of Kachchh and those in the Mediterranean region may have been deposited under similar palaeogeographic setting—identical marine cycle and climatic conditions. However, the position of the sequences of the west coast of India (especially Kachchh) is not clearly known in respect of these global geological events and planktonic zonation, and their stratigraphic correlation with the Mediterranean counterparts still remains equivocal.

As things stand, the biostratigraphic knowledge of the Oligocene/Miocene sediments of the west coast of India, particularly those of Kachchh, is not precise enough to suggest high resolution correlation with their equivalents of the Middle East and Europe. The information about the faunas of these sediments is not accurate enough to form a good data base. Till date the only useful work on the Neogene faunas of Indian sediments is that of Pandey (1982). However, it needs to be revised, expanded and supplemented with the illustration of specimens of both first and last occurrences of species. It should be ensured that our first and last occurrences are of the same species and we are recording true stratigraphic ranges of the named species in our sections. An effort should be made to distinguish extinction levels due to facies changes from true biological ones. The possibility of planktonic control should be explored, and the important species of *Borelis*, *Cycloclypeus*, *Flosculinella* searched in suitable carbonate facies. The overall effort should be to get true specific composition of the Kachchh faunas, including the proper evaluation of the species present in

the Mediterranean and absent in the Indian formations and vice versa. If the true specific composition of the Indian faunas could be established, it will be possible to introduce much precision in the existing biostratigraphic correlation and use their palaeobiogeographic significance for determining the origin of differences of the foraminiferal faunas in the Indo-Pacific and the Mediterranean regions and understanding the influence of the terminal Tethyan event on the Neogene succession of the Kachchh region.

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