THE PALEOENVIRONMENTAL SIGNIFICANCE OF THE MID AND LATE CRETACEOUS BIOHERM SEQUENCES TIRUCHIRAPALLI, CRETACEOUS, SOUTH INDIA

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In the Tiruchirapalli Cretaceous of Tamil Nadu in south India reef deposits and their associated facies of Middle Aptian age have been examined. The published data provide useful information about the paleoclimatic zonation in which India positioned in Cretaceous . Maximum accumulation, of about 2600 m of sediments, has been recorded near Ariyalur.

The Uttatur Group crops out in the western margin of the basin and it ranges from Aptian to Early-Mid Turonian age. The lower age determination has been supported by the occurrence of belemnites collected near the reef and determined by Peter Doyle. The reef developed along the margin of an open bay of the Tethys Ocean. The bioherm has been very little affected by chemical solutional action or the nearby terrestrial and beach deposition. These fan shaped terrestrial and beach deposits are synsedimentary with the reef and demonstrate that they are the product of nearby erosion of an arid region. Erosion of the source area of these sediments was predominantly dominated by physical factors. Therefore, as would be expected, feldspars remain fresh, uncorroded, and primarily poorly rounded reflecting a fanglomerate origin. This carbonate biohermal bodies consist of hard, massive, commonly reddish, but also pure, white limestone. Laterally it is associated with stratified calcareous sandstones that interfinger with marly sandstones.

The pure biohermal limestone is composed primarily of calcareous and silicious sponges, a variety of scleractinid corals, and calcareous algae crusts. The sponges grew as crust-like and lumpy shaped colonies. Their internal structures, with canal system and oculi, are quite well preserved. Nevertheless, during diagenesis the majority of the internal sponge networks have been recrystallized and replaced by microsparitic cements. The cygoms, however, often are still recognizable. Most sponges represent lithistid demosponges, e.g., *Megamorina*. Their spicules are tetracrepide in shape and comprised a solid network. Hexactinellid silicious sponges are also present with the scleri commonly merging with each other. The cygoms of these networks have four small holes which are co-ordinated in rectangular organization. Calcareous sponges occur more rarely and are documented in such genera as *Pharotoronidor*. These spicule systems are commonly welded into tufts. Hadromeride sponges are represented by crustosponges as *Calzichondrilla crustans*. *C. crustans* were originally precipitated as a high magnesium calcite skeleton. Scleres in this taxa grow irregularly within the sponge body. Reitner (1992) has observed this species in reefs of the Middle Albian in northern Spain. He is responsible for the characterisation and identification of the Indian species recovered by us.

In addition to the sponges, thin layered coral colonies grew with small sized polypars and are typified by microsolenide or eugyride corals. Algae are present as solitary red algae and green algae, exemplified by acecularians, solenoporaceans, and pyctonoporideans, and

as thin layered calcareous alagae as *Ethelia alba*.

Fairly deep water reef growth in the area occurred along a coastal, high energy, wave battered shoreline. The active fault created this coastline enabled the development of a vertical sequence of some 150 m of pure reefoid limestone. This sequence is exposed in the quarries of the Damia Cement Ltd. Additional smaller reefs, often without visible hermatypic organisms, grew into smaller or larger pure limestone accumulations forming mud-mound morphologies. These may be observed in well exposed outcrops some 20 km to the northeast in a quarry near the village Veppur. They, likewise, are interpreted to have been developed along a rocky shore of the Indian continent. Reef growth near Dalmiapuram documents repeated tectonic activity and evidence of earthquake which caused these massive biohermal build-ups to break up and form large downslope slump blocks. Thus large reef origin boulders are interbedded with offshore sediments composed of hard sandy limestone and intercalated softer, silt-rich calcareous sandstones. Laterally these reefoid limestones also grade into siliciclastic littoral deposits. The reefs have been protected and developed lagoonal environments typically containing nerineid gastropods.

The coastal sandy limestones and calcareous sandtones typically became cemented during early diagenesis. Some of these early diagenetic rocks apparently formed beach rocks. On this hard substrate benthic organisms like oysters, chamacean bivalves, rudists, brachiopods and bryozoans lived. These taxa, subsequently, were bored and acted as a substrate for epifaunal organisms. Local gravel pockets also acted as environments where regular sea urchins dwelled. Two of the species of epifaunal encrusting bryozoans are comparable to the modern species from the northern Mediterranean Sea. These bryozoa settle on plane surfaces such as those found on oysters and brachiopod shells. Other bryozoan taxa trap sediment under their basal disk, and, therefore, develop long confluent budding zones, similar to those documented in the sediment trapping species that are extant in the modern Gulf of Aquaba. They stabilize the sediment by means of symbiotic or commensal algae (pers. com .Dr.J. Scholz).

When analyzed from a perspective of the small number of species comprising the reef, the predominance of the sponges and algae, and the small sized crustose corals, these data can be interpreted as evidence for a non-tropical origin. Rudists which are common constituents of the tropical environment during the medial Cretaceous times are here represented by only a single species (*Sphaeerulites indica* Stolizcka). This species resembles the single forms present in central and northern Europe which occur in a moderately warm sea. The European specimens are not well enough preserved to be comparable in detail with those recovered from South India. Interreef areas at Dalmiapuram are typified by high energy, terrestrial fanglomerate which consist of fresh crystalline debris which have been eroded into the different beaches. These fanglomerates contain beach rock debris which should indicate warm arid conditions.

Paleogeographic reconstruction of South India during the Mid to Late Cretaceous indicate that the reef growth observed in Dalmiapuram took place in a region that had separated from its original position near the Antarctic continent and rotated to the west. The interpretation indicates that the continent did not separated from Gondwana very far to the north at this time. Thus, the sea washed it shores near the peninsula of Dalmiapuram as well as the beaches to the west where reefs could grow along the shoreline. The faunal composition of these reefs supports the paleoclimatic "reconstructions" in which India was located south of the tropical belt during the Cretaceous. The tropical belt at this time was dominated by rudist reefs which normally resided in an arid area of moderate warm climate. Mid Cretaceous condition did not change significantly up to the end of the Cretaceous. The interpretation is supported by the comparison and close relationship demonstrated by correlation of the Santonian

faunas of the Indian Ocean coast of South Africa (Umzamba Formation) with that of the Trichinopoly Formation exposed in Garudamangalam just west of Dalmiapuram.The Bryozoan remains of Ariyalur sediments of Maastrichtian compare favourably to those found at the type Maastrichitan section in the Netherlands. These reefs do not bear any resemblance to the coeval rudist facies found in the then tropical regions of either Central and South America (Peru to the Antilles) or those of Mediterranean Europe.

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