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RESEARCH NOTES

MICROBIAL MAT DEPOSIT IN PEDDASETTIPALLE, CUDDAPAH BASIN

Abstract: Microbial mat occurring on the dolomitic limestone at Peddasettipalle area in the Cuddapah basin is described with respect to its morphology and relation to the underlying carbonate rock. Between two stages of lime deposition, a microbial mat grew over the muddy surface giving cohesion to the sediment and restraining erosion. The mechanism of formation of microbial mat layering is discussed. Shallow, lagoonal, slightly reducing to oxidising environment of deposition is suggested for the dolomitic limestones in the study area.

Keywords: Microbial mat, Algal Stromatolites, Cuddapah Basin, Andhra Pradesh.

Introduction: A biostratigraphic zonation of the proterozoic (particularly Riphean-Vendian) time, on the basis of the stromatolitic assemblages preserved in the contemporary shelf - carbonate sequences in different parts of the world, has been worked out by many workers. According to Glaessner (1983), the organic remains in the proterozoic sequences throughout the world represent algal dust and/or remains of primitive meta-zoan forms. Considerable data has been collected on the organic remains in the sedimentary basins of India in general and Cuddapah basin in particular (Vaidyanadhan, 1961; Bhaskara Rao and Gururaja, 1978; Mehdi *et al.*, 1980; Gururaja and Chandra, 1987 and Basu *et al.*, 1988) on the morphology with an attempt at correlation, though their significance in terms of environment of deposition has been brought out only by some.

The study area is located 1 km north of Peddasettipalle village (Lat. 14° 43′; Long. 78° 48′; 7 km from Mydukuru, in Mydukuru-Badvel Road, Cuddapah Dist.) in the Cuddapah basin, where microbial mats are present on the dolomitic limestones in the southeastern slope of the temple hill Δ 1522 (Toposheet No. 57 J/14). The areal extent of the microbial mats is approximately 100 sq mts. The microbial mats are mostly in the form of filaments and layering of these filaments within the carbonate rock is noticed. Several criteria now taken to identify the microbial mat in this area, such as false cross lamination, preferred silt concentration in carbonate laminae and mechanical strength of carbonate rock during penecontemporaneous deformation have not been used previously to recognise microbial mat activity in the sediments.

This study has attempted to determine the depositional environment of carbonate rock and significance of interlayering of microbial mat, in the study area.

Microbial Mat Morphology: Dolomitic limestone surface is covered by wavy laminations which vary from a few millimeters to several centimeters in thickness. These laminations are easily distinguishable by their yellow to reddish colour, which commonly stand out in contrast to the carbonate rock. These laminations are indicators of cyano- bacterial mat origin (Fig.1). Dolomitic limestones, fine grained and linked to the filamentous frame work created by the microbial activity have been observed elsewhere. The cohesion and plasticity of these upper laminations may have been produced by the filamentous frame work of a superficial microbial mat. The contact between microbial mat and the underlying carbonate rock corresponds to an interface which could be easily detached. These filaments contain fine grained unidentifiable bioclasts. Several microbial mats (layers) are observed

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Fig.1. Massive dolomitic limestone mostly covered with microbial mat showing a bundle of micro-reliefs

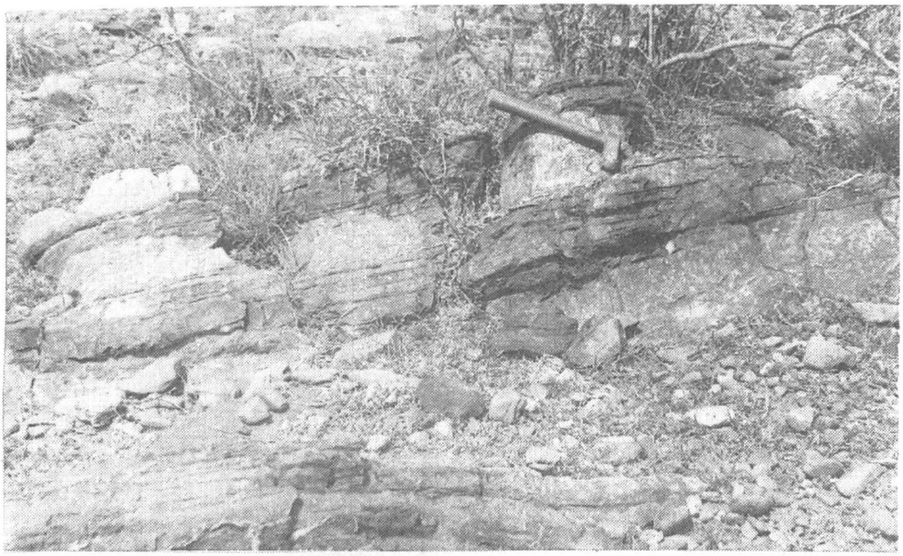

Fig.2. Succession of microbial mats (black) in the study area. Each mat is underlain and overlain by dolomitic limestone

within the carbonate rock in vertical section (Fig.2). The microbial mat of each layer is limited to the upper laminations and never extends to the underlying carbonate rock. The rock column (vertical) present between two successive microbial mats varies from 1 cm to several centimeters reaching up to 30 cms. These interlayered microbial mats show essentially flat morphology and not any domal or columnar structures. These mats have undergone strong compaction due to fluid loss after burial, unless they experienced early cementation. Bacterial degradation of organic matter causes further volume loss of a burried microbial mat. Therefore any previously present surface relief would be strongly reduced after burial.

Discussion: Gebelein (1969) demonstrated that thick microbial mats of flat morphology form in subtidal areas of Bermuda and that flat mats formed in areas of low sediment movement and slow currents, whereas domal mat structures formed in areas of increased current velocities. A microbial mat colonized on the deposited carbonate mud and before it occupied the whole area, it was covered by the next carbonate sediment package. This mobile filamentous micro- organisms would move upwards and establish a new mat on the newly deposited carbonate mud surface, leaving behind the sheaths and dead filaments. This new mat would expand laterally until it was covered again by carbonate material. This happened repeatedly in the study area giving rise to layers of microbial mat in the carbonate rock. This explanation was given by Schieber (1986) in describing the microbial mat colonies in dolomitic clayey shale beds in mid-Proterozoic basins. Presence of such microbial mat deposits indicates that sedimentation was episodic rather than continuous, and also implies that the sedimentation surface was protected from erosion by bottom currents.

Water movement may be inferred from the alternate filling and emptying of the local depocentre in the study area. When covered by water, the microbial mat tends to become disconnected from the muddy carbonate bottom due to the buoyancy of gas bubbles produced in the mat. The mat grows when submerged and slides downslope. When water retreats, tearing and crumpling takes place. Fluctuating water depth and shear stress caused by flowing water are necessary to detach the mat from its substrata. Each period of muddy sedimentation ended with the colonization of the surface by a microbial mat. Movement of microbial mat occurs when the lagoon is emptying and drying due to water run off or evaporation. The association of silt and carbonate material can be explained by the particle trapping property of the mucilaginous mat. The filamentous matrix of microbial mat act as an ecological membrane at the sediment water interface, causing abrupt changes in several environmental parameters, such as oxygen, Eh, sulphide concentration and light intensity (Bauld, 1981). This property of microbial mat allows the formation of strongly reducing sediments immediately below the living surface layer. Microbial mats in the Proterozoic occupied the subtidal environments. These observations are very useful for interpreting the shallow lagoonal slightly reducing to oxidising environmental conditions of deposition of carbonate sediments at Peddasettipalle area in the Cuddapah basin and provide a good documentary inventory of biosedimentary structures which can be used to recognise paleo-environments in other basins.

Conclusions: It is considered that subaqueous flat microbial mats were widespread and that occasional storms mobilized carbonate mud in marginal areas and spread it out over the mats. These filamentous micro organisms move upward and form mats on the newly settled carbonate layers. Recurring deposition of storm layers on microbial mats was probably responsible for the intimate interlayering and the stripped appearence of this facies. The microbial mats may have acted as a membrane that separated strongly reducing sediments below from oxygenated waters above. Shallow, lagoonal, slightly reducing to oxidising environment of deposition is suggested for the dolomitic limestones of Peddasettipalle area, in the Cuddapah basin.

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