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Stromatolitic microbiota from black chert of Cumbum Formation, Upper Cuddapah, Andhra Pradesh

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Abstract

An interesting assemblage of microbiota consisting of filamentous, coccoid and asteroid forms in a stromatolitic black chert sample from Cumbum Formation of Upper Cuddapah sequence, near Zangamarajupalle, Andhra Pradesh is recorded. The microbiota associated with the columnar stromatolite, is dominated by filamentous forms over the coccoids. All the morphotypes reported here from Cumbum Formation are known from the Gunflint chert of Canada dated to be about 1900 to 2000 m years.

Introduction

The utility of microbiota in the study of the Proterozoic sequence from the view point of understanding the evolution of life on the Earth and also in the biostratigraphic classification of the Precambrian rocks is being increasingly realised; with the result, there has been a spurt of research activity in this field in the last two decades. Gunflint chert, Belcher Group and Dismal Lakes Group of Canada, Bitter Springs Formation of Australia are some of the most thoroughly investigated lithounits which have yielded abundant microbiota, and fairly detailed account on the microbiotas from Transvaal Dolomite of South Africa, Duck Creek Dolomite of Australia and Beck Spring Dolomite of California, USA, are available (Schopf, 1977). In India, Srinivasa Rao (1949), recorded for the first time, algal structures in petrographic thin sections from the rocks of the Tadapatri Formation of Lower Cuddapah sequence exposed near Rayalacheruvu area, Andhra Pradesh. Later, a number of reports of microfossils from Precambrian rocks of India were made, essentially from macerated samples. Recently Schopf and Prasad (Schopf, 1977) have recognised structurally preserved microbiota in petrographic thin sections of black chert associated with domal stromatolites of Vempalle Formation of Lower Cuddapah sequence. The present report of a well preserved microbiota from the columnar stromatolite-bearing black chert sample in the chert-dolomite sequence of the Cumbum Formation of the Upper Cuddapah Group is therefore a new addition to the stromatolitic microbiota from India. The sample was collected by Bhaskara Rao in the course of investigation of Zangamarajupalle (14°46′ : 78°53′ : 57J/13) base metal deposit.

Geological Setting

The geologic succession of the Proterozoic Cuddapah Super group is given below:

Upper Cuddapah	Kistna Group	Srisailam Quartzites Kolamnala Slates Irlakonda Quartzites
	Nallamalai Group	Cumbum Formation Bairenkonda Quartzites
Lower Cuddapah	Cheyair Group	Pullampet (Tadapatri) Formation Nagari Quartzites
	Paphagni Group	Vempalle Formation Gulcheru Quartzite

The Cumbum Formation occurs in the lower part of the Upper Cuddapah sequence separated by the stromatolite-bearing Tadapatri Formation of Lower Cuddapah sequence by over 500 m of sediments; from the stromatolitic rocks of the Vempalle Formation which have yielded structurally preserved microbiota, the stromatolitic horizon of the Cumbum Formation is separated by nearly 4000 m of sediments (Pascoe, 1959).

Lithologically the Cumbum Formation consists of slates within which occur interbedded bands of dolomite, siliceous dolomite and cherty quartzite. Some of the slates are carbonaceous. On weathered surface they however look brownish grey. There is one major band of dolomite which is quite persistent over a long strike distance near Zangamarajupalle. This dolomite band is cherty in its upper part and contains stromatolites. Vertically upwards, the cherty dolomite grades into carbonaceous slates and this transition zone is the host of base metal mineralisation. The microbiota described in this note occurs in the black stromatolitic chert.

The rocks have undergone deformation and trend in north-south to N30°W - S30°E and dip both easterly and westerly directions at 25° to 45°; the rocks have also suffered low grade metamorphism.

Age: The age of the Cumbum Formation is still not clear. Only one radiometric age of a sample of galena collected from a quartz vein cutting the Cumbum Formation near Zangamarajupalle is available (Aswathanarayana, 1962). It has given an absolute age of 1400 m. years which places the Cumbum Formation near Lower Riphean-Middle Riphean contact.

In the course of examination of stromatolites of the Lower Cuddapah sequence, the first two authors came across near Pulivendla, Cuddapah district, columnar stromatolites in the Vempalle Formation and branching columnar stromatolites in the Tadapatri Formation. *Kussiella* is common in both Vempalle and Tadapatri Formations. On this evidence, it may be surmised that Lower Cuddapah rocks are probably Lower to Middle Riphean and the Cumbum Formation as possible Middle Riphean.

Microbiota

An examination of petrographic thin sections of the stromatolitic chert shows distinct banding of alternate light (sediment rich) and dark (organic rich) layers. The rock consists of cryptocrystalline quartz with locally discrete grains and occasionally fine layers of ore minerals. Examination was carried out both in reflected and transmitted light under high magnifications.

The structurally preserved microbiotas are confined to these stromatolitic laminae (Fig. 1), particularly in the dark layers. They are light yellow to dark brown in colour. The most dominant types are the filaments which occur aligned parallel and sub-parallel to the stromatolitic laminae. The dark brown coccoids and asteroid type of microfossils form less than 5% of the microbiota.

Acid maceration of the chert using very weak hydrofluoric acid confirmed that the micro-organisms observed in thin sections are dominantly filamentous (Fig. 3) with subordinate coccoids. Both the filamentous and coccoid forms react to the organic stain 'safranin' and corraborate their organic nature.

The following is a brief description of the morphotypes of microbiota identified so far in the chert from the Cumbum Formation.

Filamentous type (Figs. 2, 3 & 4): As mentioned earlier, the filaments form the abundant type (Figs. 2 & 3) and occur as entangled and felt like mass. The filaments are long and vary in diameter from 2 μ m to 6 μ m though filaments with 4 μ m are frequent. At a number of points in the filaments bulbous swellings resembling hetero-

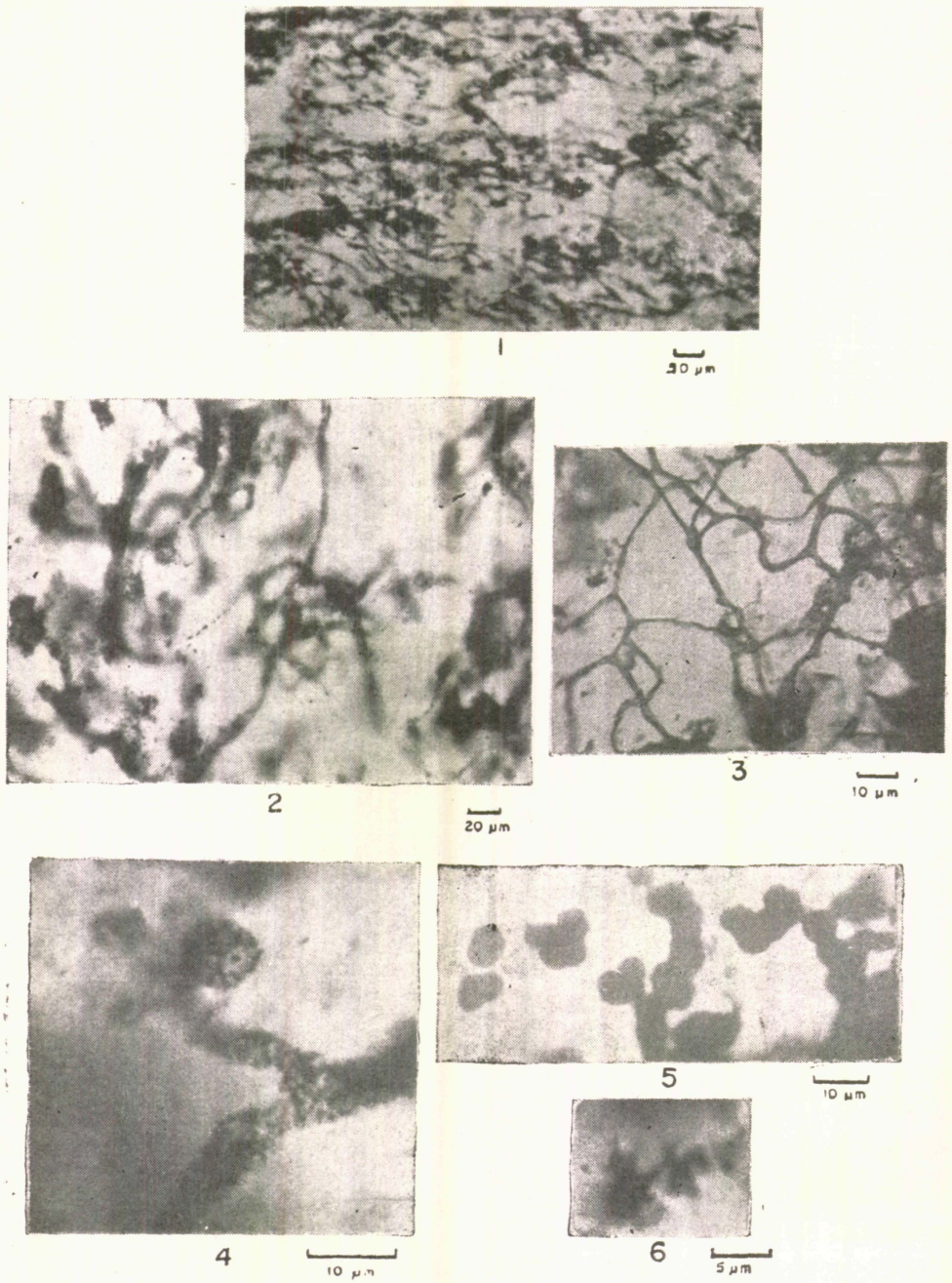

Figure 1. Portion of Stromatolitic laminae.

,, 2. Section showing distribution of filaments; note the variation in diameter of the filaments.

,, 3. Filaments separated from sample after acid maceration.

,, 4. Filament with a lateral branch; note the bulbose structures borne on the lateral branch and the reticulate nature of the wall.

,, 5. Coccoid microfossils showing colonial habit.

,, 6. Asteroid forms (? *Eostrion*).

cyst structures are noticed. Most of the filaments are nonseptate and branching and the wall is reticulate (Fig. 4). One such filament on its side branch (about 32 μ m long) bears at the termination bulbous swellings (Fig. 4). This morphotype (Fig. 4) very closely resembles the reproductive unit with oogonia and antheridia like structures as in Vaucheriaceae. The nonseptate and branching habit and reticulate nature of the filamental wall bear close similarity to the form *Archaeorestis* Barghoorn reported from Gunflint Iron Formation of Canada (Barghoorn and Tyler, 1965). In a recent revision (Awramik and Barghoorn, 1977), *Archaeorestis,* on its branching habit, is suspected to be unlike that of blue-green algae but more closely resembling fungal branching as in actinomycetes.

Coccoid type (Fig. 5): These are circular and ovoid in form, dark brown in colour. They generally occur in chainlike colonies. The individual coccoids measure 7 to 10 μ m in diameter. They closely resemble in appearance and colonial habit, *Corymbococcus* Awramik and Barghoorn from the Gunflint chert of Canada (Awramik and Barghoorn, 1977).

Asteroid type (Fig. 6): Three forms have so far been observed in our petrographic thin sections. They consist of a central part with radiating fine filament like projections. They are very small in size and resemble *Eostrion* Barghoorn reported from Gunflint chert of Canada. These are supposed to be of bacterial affinity.

Importance of microbiota from Cumbum Formation: It is interesting to note that all the morphotypes of microbiota present in the Cumbum Formation are known from the Gunflint Iron Formation of Canada dated to be about 1900 to 2000 m years old. A relative abundance of filamentous forms is noticed in the Cumbum Formation when compared to the assemblage reported in the Vempalle Formation (Schopf and Prasad, *in preparation*). An abundance of filamentous sheaths with mucellagenous secretions and the phototactic movements of the filaments are observed in recent environments in the build up of *Conophyton* forms. The abundance of filamentous forms recognised in the fossil Columnar stromatolite from the Cumbum Formation also points that columnar stromatolite may generally have predominance of filamentous forms over coccoids (Awramik, 1976).

Schopf (1977) has stated that the diameter of the filaments as well as coccoids of stromatolitic biota measured and analysed systematically and statistically may provide a clue in using this data for biostratigraphic classification. The rich filamentous and coccoid microbiota present in the stromatolites of Vempalle and Cumbum Formations of Cuddapah Supergroup offer scope to test the utility of this new tool for biostratigraphy.

The excellent preservation of these primitive micro-organisms in the chert indicates that the organisms were embedded in silica which was probably deposited in a gelatinous form.

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Spinel bronzite pyroxenites from Vemparala, Andhra Pradesh

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Abstract

Vemparala in northernmost Precambrian Nellore schist belt is made up of banded quartz-magnetite rocks, quartzites, pyroxene granulites, gabbros and granites. These were subjected to folding and refolding resulting in F_1, F_2, F_3 folds. Spinel-bronzite pyroxenites were structurally emplaced along the crests of F_2 folds and are the first known occurrences in Nellore Precambrian belt.

Introduction

The Precambrian quartz-magnetite rocks from Vemparala and surrounding regions were studied by Foote (1903), Krishnan (1964), and Sastry and Vaidyanadhan (1968). These rocks are confined to the northernmost Nellore Precambrian belt. The southern part is characterised by schists and gneisses and muscovite-bearing pegmatites. The quartz-magnetite rocks and associated pyroxene granulites and granitic gneisses are folded. Gabbros were occasionally found following the F_1 axial plane. They were refolded and resulted in NNW–SSE (F_2) and NNE–SSW (F_3) cross folds plunging NNW and NNE respectively. The F_2 cross folds are accompanied by spinel pyroxenite and granitic intrusions. The spinel pyroxenites occur at two places in Eddalakonda and these were earlier referred and indicated as hypersthene magnetites (Sastry and Vaidyanadhan, 1968, Fig. 3). The mineralogical and petrological data on spinel pyroxenites are presented.

Petrography and mineralogy

The spinel pyroxenites are very coarse and are composed of bronzite (80-85%), clinopyroxene (5-8%), spinel (4-6%), magnetite (2-4%) and amphibole and garnet