JOURNAL GEOLOGICAL SOCIETY OF INDIA
Vol. 30, Oct. 1987, pp. 305 to 308

SOME UNUSUAL STRUCTURES IN THE TALCHIR GROUP, TALCHIR GONDWANA BASIN, ORISSA

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Abstract

Some unusual structures resembling algal nodules are described from the limestones of the Talchir Group, Talchir Gondwana basin, Orissa. The external form of these structures and the petrography of the enclosing limestones points to an algal origin.

Introduction

Reports on the occurrence of limestones with nodular forms in the Talchir Group are rare. In the present paper some unusual structures resembling algal nodules are described. The structures are confined to coarsely-crystalline limestones that occur in a thick sequence of shales. The external form of these structures and the petrography of the enclosing limestones are described. The origin and palaeoclimatic significance have been discussed.

Location and Geological setting

The area studied (Fig. 1) falls within the Survey of India Toposheet No. 73 H/1. It is located around Bedasar village (20°52'30" : 85°4'0"), along the southern boundary of the Talchir basin and can be easily approached from Angul town (20°50'10" : 85°5'20") situated about 8 km southeast of the area.

The Talchir Group in the present area is represented by a thick sequence of sedimentary rocks best exposed along the Narindrajhar river Section (Fig. 1). The stratigraphic section from A to B along the Narindrajhar river is composed of (1) interbedded siltstones and shales (12 m), (2) interbedded marlstones and shales (20 m), (3) shales with nodular limestones (15–20 m), (4) interbedded red sandstones and shales (15-20 m), and (5) coarse grained sandstones (8–10 m). All these rocks strike NE-SW and dip uniformly towards northwest at low angles ranging from 5–10 degrees. The shale and limestone unit under study forms a lenticular mass within the sequence and extends for a strike length of about 50 m.

Gross lithology and structures

The rock unit under study is dominantly composed of shales which are grey to dark in colour, fine-grained, faintly laminated and have the character of breaking down into thin, angular fragments because of the development of a series of close-spaced fractures. Limestones associated with the shales are buff to brown in colour and are composed of coarsely-crystalline granular and fibrous calcite.

The limestones in this part of the succession generally occur as a number of ellipsoidal nodules (Fig. 2) of various dimensions and resemble flat-lying elliptical to semi-circular discs. They occur as isolated nodules within the surrounding shales and, sometimes, many of them laterally coalesce together to form beds of limestone. The simple forms are confined to bedding layers of the shales and rarely exceed 5 cm in height and 30 cm in diameter. The upper surface consists of laminations,

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1-3 mm thick, disposed around a nucleus (Fig. 3) resembling the growth of laminated structure around a fragment. Bedding within these nodules consists of thin, irregular and wrinkled laminations. Smaller forms, 3-8 mm in diameter, with three to four concentric laminations (Fig. 4) can also be observed. In addition to the above, there are certain mound-shaped forms which are irregularly spaced isolated bodies of limestone that rise from the base to about 50–70 cm and cut across the surrounding evenly layered shales. Some of them are conical with a pointed top, while others have a narrow base and a broad top.

All these forms are, in many respects, identical to the oncolites and algal stromatolites described by Govinda Rajulu and Gowda (1968, p. 1063) from the Kaladgi basin, and algal buns described by Kruger (1969, p. 1053) from the Otavi Series of Southwest Africa.

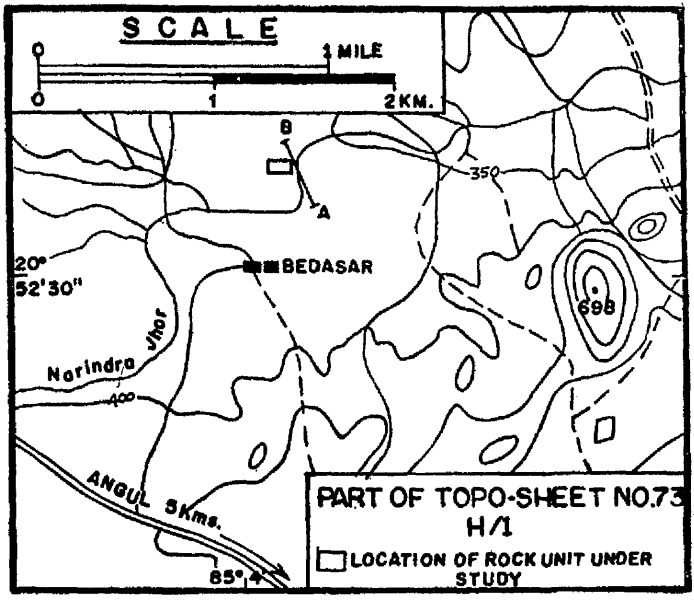

Figure 1. Map showing the location of the rock unit under study.

Petrography

The limestones to which the structures are confined, are greyish-white in colour becoming buff and brown on weathered surfaces. In hand specimens, they are seen to be composed of coarsely-crystalline granular and fibrous calcite. The nodular forms, in many instances, are characterised by 3 to 4 vertically stacked

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EXPLANATION OF FIGURES

Fig. 2. Algal nodules or oncolites in the limestones associated with shales, showing concentric laminations.

Fig. 3. A close-up view of the algal nodule or oncolite showing the concentric laminations.

Fig. 4. Small rounded oncolites in the limestones showing two or three concentric laminations.

FIG. 2

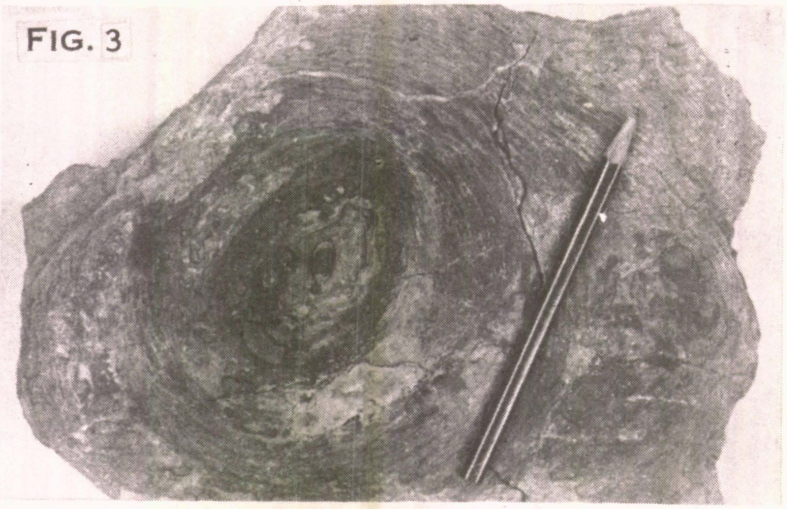

FIG. 3

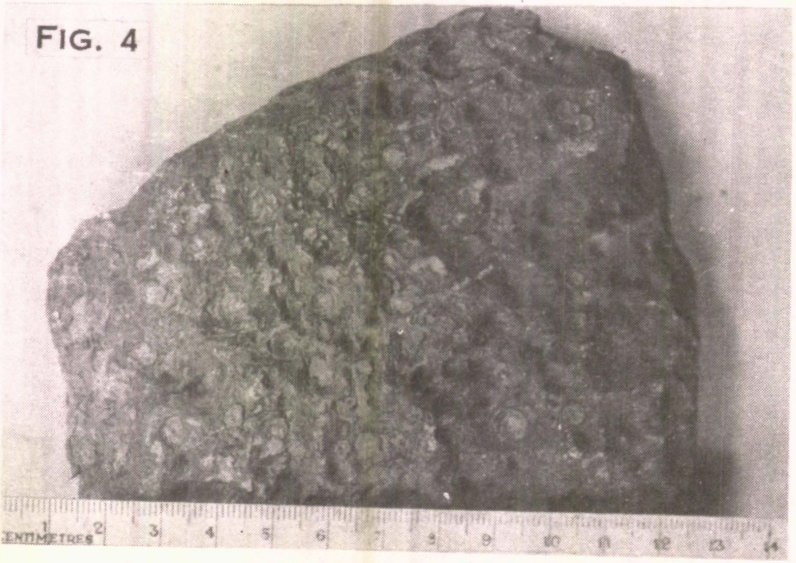

FIG. 4


FIG. 5
100 μ

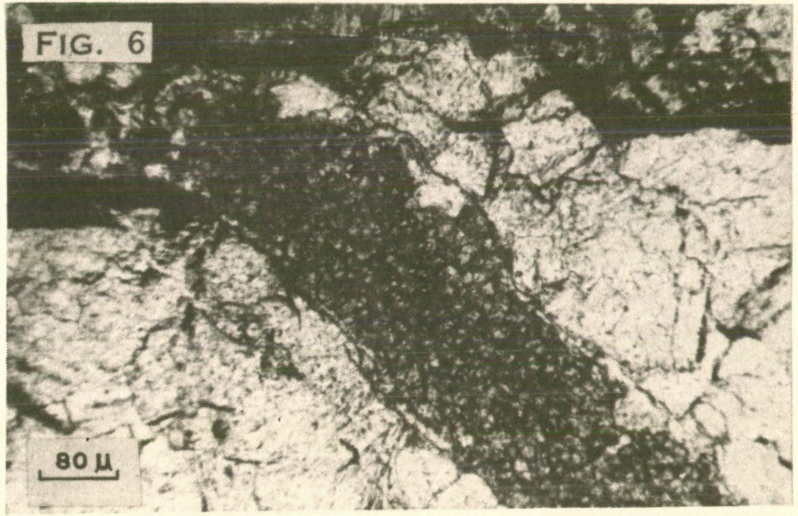
FIG. 6
80 μ


FIG. 7
60 μ

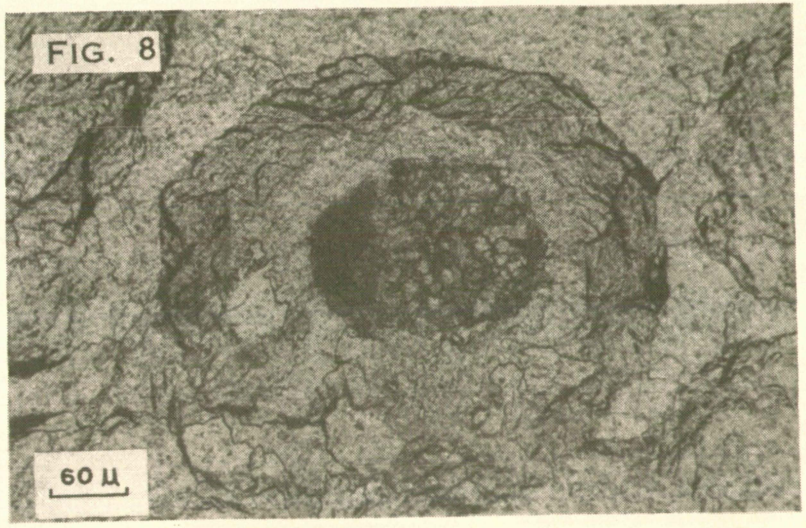
FIG. 8
60 μ

layers of fibrous calcite separated by thin partings of clayey material. Chemical analysis of one sample of limestone from a nodule shows the following composition; SiO_2, 3.10; TiO_2, 0.10; Al_2O_3, 1.60; Fe_2O_3, 0.80; FeO, 0.04; MgO, 0.40; CaO, 51.41; Na_2O, 0.10; K_2O, 0.25; P_2O_5, 0.11; CO_2, 40.50. The calculated percentage of $CaCO_3$ from CaO is found to be 91.75 and the rock can be termed as a limestone.

In thin sections, the limestone is seen to be composed of algal calcilutite (Wolf, 1965, p. 115), granular and fibrous calcite. The characteristic feature of algal calcilutite is its relative lack of transparency in thin sections. It consists of light to dark-brown, occasionally light-grey, dense, spongy, cryptocrystalline calcite and exhibits such features as algal filaments, crustations, circumcrusts, oolites, pisolites, stromatolites and pellets. Some of these features are shown in Figs. 5-8. The algal filaments generally occur as minute threads (Figs. 5 and 6) in algal calcilutite. The crustations commonly occur as horizontal to subhorizontal layers of algal calcilutite (Fig. 6) but sometimes, they become very irregular in thickness and shape when they grow on irregular surface. Algal circumcrusts (Fig. 7) are seen to occur as two to three layers of algal calcilutite enveloping an earlier formed grain of coarsely crystalline granular calcite and form an oolite. The algal oolites and pisolites (Figs. 7 and 8) are rounded bodies, consisting of two or more concentric layers of algal calcilutite. The layers, in many instances, are destroyed because of recrystallisation (Fig. 8). The stromatolitic laminae are largely destroyed because of extensive recrystallisation of the limestones, but occasionally, they can be seen as horizontal to subhorizontal laminae. These laminae are generally open-textured because of the presence of algal-bound detrital particles of quartz.

Origin and palaeoclimatic significance

Since the algae responsible for the formation of these structures grow at a depth to which light penetrates, it indicates shallowness of the basin. A theoretical limit of 150–200 feet (45–60 m) of depth has been imposed by Wolf, (1965, p. 159). In addition to trapping the lime-mud drifts, the algae extract CO_2 from the surrounding water in photosynthesis, resulting in the precipitation of $CaCO_3$ and form algal limestones with stromatolitic structures. The lake bottom might have been shallow enough to permit the growth of algae in localised areas to give rise to these limestones. The wrinkled laminations and growth of fibrous calcite together with

EXPLANATION OF FIGURES

Fig. 5. Limestone composed of a pellet of algal calcilutite (dark coloured) and fibrous calcite (light-coloured). Note the algal filaments occurring as minute threads in the algal calcilutite pellet. Polarised light.

Fig. 6. Limestone composed of granular calcite (light-coloured) and algal calcilutite (dark-coloured). The algal calcilutite occurs as horizontal to subhorizontal crustation on the early-formed granular calcite and exhibits thread-like filaments. Polarised light.

Fig. 7. Algal circumcrust, composed of two or three layers of algal calcilutite (dark-coloured), enveloping an early formed granular calcite nucleus and forming an oolite. Polarised light.

Fig. 8. Algal oolite recrystallised to microcrystalline calcite. Algal calcilutite appears as dark discontinuous layers. Polarised light.

the presence of mud cracks in the overlying sandstones suggest desiccation of the basin (Pandya, 1984, p. 246) at a later stage.

The Talchir basin is known to have produced evidences of upper Carboniferous glaciation. But occurrence of algal limestones suggests warm climate. Wolf (1965, p. 167) has shown that algae are limited to waters of temperature between 12°C–20°C, i.e., semi-tropical to tropical areas. Dunbar and Rodgers (1957, p. 42) have shown that in semi-arid climate $CaCO_3$ may become an important fraction of the total lake deposit forming not only laminae but thicker layers, some of them being oolite and algal reefs. In addition to algal limestones, extensive bedded marlstone deposits, red beds, mud cracks and fibrous calcite have been reported by Pandya (1984) from this area which evidently point towards a warm climate and periodic desiccation of the basin. That the Talchir Group of some of the basins was deposited in a warm to semi-arid climatic condition has been shown by Rishi (1971), Ahmad (1975) and Sen and Hatim (1977). The present finding also supports this conclusion.

Acknowledgements: The author is thankful to Sri M. R. Mahapatra, Sri M. S. Sahoo and Sri P. C. Kar of the P. G. Department of Geology, Utkal University, for their help.

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(Received: April 6, 1986; Revised form accepted: Feb. 17, 1987)