

A STUDY OF STROMATOLITES FROM THE BIJAWARS OF MADHYA PRADESH (INDIA)

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ABSTRACT

In the course of field work the authors came across stromatolites in different localities of the Bijawars in Central India. A systematic study of the morphology of the stromatolites was made to find out whether they show any evolutionary trend and their utility for stratigraphic correlation. As a result of the study it is concluded that some of the form species have a wider stratigraphic range than hitherto believed, stromatolites cannot be used for correlation with reliance, and they seem not to show any evolutionary trend.

INTRODUCTION

Significant advances in recent years have been made in the Precambrian palaeontology of India, especially with respect to the recording of stromatolites from different stratigraphic horizons. Studies on stromatolites have brought to light a number of forms from rocks of Precambrian age from peninsular India and the Himalaya. Within the past few years, they have been reported from the Bijawar rocks by Khan and Das (1968) from the type area—Chhatarpur district, M.P.; by Garalapuri (1968) from the Sidhi Series of the Son Valley; and by Krishna Murty (1972) from the Joga area, Hoshangabad district, M.P. The present paper describes the form species of the stromatolites from some localities of the Bijawar rocks of M.P. An attempt has been made to find out whether there is any time controlled variation in their morphology and their utility in stratigraphic correlation.

GEOLOGIC SETTING

A generalised stratigraphic sequence of the stromatolite-bearing portion of the Bijawar rocks is given below :

- Conglomerate
-Minor unconformity.....
- 5. Ferruginous quartzite
- 4. Ferruginous phyllite
- 3. Cherty quartzite or bedded chert intercalated with dolomitic limestone and slate or phyllite
- 2. White quartzite (gritty and conglomeratic)
- 1. Basal conglomerate
-Unconformity.....
- Metamorphics and granite-gneisses

The various forms of stromatolite are found in an inter-bedded lithology consisting of cherty quartzite or bedded chert interbedded with dolomitic limestone and slate or phyllite. The unit varies within wide limits from one place to another. It may be represented by a single litho-type or one lithotype may be more conspicuous

than the other. The various lithotypes may constitute the lamination or form very thick bands. The unit is characterised by the presence of sedimentary structures like ripple marks, penecontemporaneous deformation and cross-lamination. Generally the rocks show some recrystallisation or none at all. The stromatolite-bearing siliceous-calcareous-phosphatic facies forms an important horizon of the Lower Bijawar sequence. It is significant to mention here that a careful qualitative analysis of the stromatolite-bearing rocks reveals that they contain small amounts of phosphate. The unit seems to be economically interesting and a detailed prospecting may yield some valuable phosphate deposits.

DISTRIBUTION OF THE STROMATOLITES

The occurrence of the various form species in the different localities are as shown in the Table given below :

District	Important locality	Form species observed
Eastern part of Bijawar basin in the type area—Chhatarpur district.	1½ miles S. W. of Dahi (Sheet No. 54 P/10).	<i>Collenia undosa</i> Walcott and <i>Collenia frequens</i> .
Western part of the Bijawar basin in the type area—Chhatarpur district.	S. W. of Malera at 102/4 milestone on Chhatarpur-Sagar road.	<i>Collenia columnaris</i>
Narsinghpur district	Chanwarpatha (Topo Sheet No. 55 M/4).	<i>Collenia symmetrica</i> and <i>Oncolites</i> .
East Nimar and Hoshangabad district.	3½ miles NNW of Chandgarh and one mile NW of Jatam. Very well developed at 76°18'25" (Topo Sheet No. 55 B/11) and SE of Joga (55 B/15).	<i>Conophyton cylindricus</i> Maslov.
Jabalpur district	Sleemabad (64 A/6)	<i>Collenia columnaris</i>

DESCRIPTION OF THE STROMATOLITES

A systematic morphological study of the stromatolites was made and the specimens described below are preserved in the Museum of the Department of Applied Geology, University of Saugar.

Collenia undosa Walcott

(Pl. I)

Characters : Similar to Fenton and Fenton (1931, p. 684 and 1937, p. 1947) and Rezak (1957, p. 133). Colonies grow upward to form hemispheroidal bodies by the addition of convex upward laminae. "Laminae coarsely crenulate and rather strongly convex upward with growth and unite laterally with others to form biostromes with striking mammilate surfaces" (Rezak, p. 133). Sizes range from 3-4 cm in height and to 2.5 cm in diameter. Colonies made up of alternating fine and coarse lamellae of dolomitic limestone and chert, with the fine lamellae having 2-4 mm thickness and the coarse ones 5 mm to 1.8 cm.

Remarks : Hitherto this form has not been reported from the Bijawars.

Occurrence : Associated with *Collenia frequens* Walcott at about 1½ miles S. W. of Dahi, Chhatarpur district, M. P.

Collenia frequens Walcott.

(Pl. I—2)

Characters : Resembles the form described by Rezak (1957, p. 133). Colonies grow upwards from a surface on the substratum by the addition of convex upward laminae. Laminae smooth, strongly convex to flattened. The cylindrical colonies stand at angles of 50° to nearly vertical to the bedding surface. Colonies form 3-6 cm in diameter and 7-15 cm in height.

Remarks : Krishna Murty (1972, p. 182) has recorded this form species from the Bijawars of the Joga area, Hoshangabad district, M. P.

Occurrence : 1½ mile—S. W. of Dahi (Topo Sheet No. 54 P/10) Chhatarpur district, M. P.

Collenia columnaris

(Pl. I—3)

Characters : Individual colonies columnar standing almost at 85° to the bedding planes. The colonies generally have a height of upto one metre and have a width of 2-2.5 cm. Individual colonies welded together by lime-mud. Transverse section nearly circular to oval. Laminae thin, uniformly convex occasionally slightly undulant, count 6-8 per cm and the degree of convexity varies between 1 : 3 and 1 : 2.

Remarks : This has been recorded from the Aravalli Group in the Udaipur district, Rajasthan by Banerjee (1971, p. 351) ; from the Kaladgis in the Bijapur district, Karnataka by Viswanathiah and Gowda (1970, p. 382) ; from the Lower Vindhya of Mirzapur district, U. P. and from the Calc Zone of Pithoragarh, U. P. by Valdiya (1969, p. 8) ; and by Murty (1970, p. 54) from the Raipur Series of the Chhattisgarh basin.

Occurrence : S. W. of Malera (102/4 milestone on Chhatarpur-Sagar road) in the Chhatarpur district, M. P. and also around Sleemnabad (Topo Sheet No. 64 A/6) in the Jabalpur district.

Collenia symmetrica

(Pl. I—4)

Characters : Resembles very well with the characters given by Rezak (1957, p. 134) and Fenton and Fenton (1937). Depressed hemispheroidal individuals having a diameter of 3 cm to 12 cm, and one-half cm to 3 cm in height, subcircular in plan and occur in groups. Laminae smooth to very finely crenulate, flattened centrally and down folded at the margins.

Remarks : This has been recorded from the Lower Shali Limestone of Mahasu district, H. P., the Gangolihat dolomites, Pithoragarh and from Thalkedar Limestone of Almora district by Valdiya (1969, p. 11) ; by Krishna Murty (1972, p. 182) from the Bijawars of the Joga area, Hoshangabad district, M. P. ; and by Banerjee (1971, p. 352) from the Aravalli Group of Udaipur district, Rajasthan.

Occurrence : Chanwarpatha (Topo Sheet No. 55 M/4), Narsinghpur district, M. P.

Oncolites

(Pl. I—5)

Characters : Oncolites have also been observed in the bluish grey dolomitic and phosphatic cherty limestone with spangles of white mica. On weathered surfaces the oncolites stand out prominently ; the intervening calcareous material between the subellipsoidal bodies having gone in solution. Generally they are subellipsoidal or subconical in shape, rarely they are irregular and broken. The forms correspond to SS-C of Logan *et al.* (1964). The largest specimen has a diameter of 7.5 cm. They are non-nuclear generally. However, it is possible that grains of sand or sparry calcite could have served as nucleus. The concentric laminae range in thickness from 0.1 mm to 6 mm and differ considerably in regularity. The laminae is composed of the same material as the enclosing rock.

Remarks : Krishna Murty (1972, p. 184) has recorded oncolites from the Bijawars of the Joga area, Hoshangabad district, M. P.

Occurrence : Chanwarpatha, Narsinghpur district, M. P.

Conophyton cylindricus Maslov

(Pl. I—6, 7)

Characters : Cylindroidal vertical colonies consisting of an array of nested cones, with the columns having a length of more than 20 cm, whereas the apical diameters of some specimens range from 0.5 cm to 2 cm. On vertical sections show secondary silica laminae having 1 cm thickness, basal diameter could not be measured but the transverse sections show 4-5.3 cm diameter. The specimens show interrupted laminae that vary widely in thickness. In transverse sections elliptical to roughly circular in shape. Composed of alternating dark brownish black ferruginous (?) material and greyish white dolomitic limestone laminae, laminae thickness varying from 1-3 mm. The transverse sections tempts one to suggest the form species as *Conophyton Cylindricus* Maslov. However, the definite form species could be given only after a study of the texture of micro-strata.

Remarks : This has a wide geographic distribution and has been accepted as an index fossil of the Lower-Middle Riphean of the U.S.S.R. Valdiya (1969) and Krishna Mohan (1968) have recorded the same from the Fawn limestone horizon of the Semri Series, Mirzapur district, U. P., Raha and Sastry (1973) from the Jaunsar Limestone of the Extrapeninsular region and Krishna Murty (1972) from the Bijawars of the Hoshangabad district, M. P.

Occurrence : 1½ miles N. W. of Chandgarh (55 B/11) and S. E. of Joga (55 B/15), East Nimar and Hoshangabad districts.

DISCUSSION

The study of Precambrian stromatolites in Russia, Australia and India shows that there is a time-controlled change in the morphologic variation of the stromatolite. Walter (1972, p. 30) states that "The known stratigraphic distribution of stromatolites in late Precambrian sequences of the U.S.S.R. and Australia supports the concept that stromatolites changed in time and are biostratigraphically useful, but the recurrence of several late Precambrian forms in the Middle Precambrian of Australia and Canada indicates a need for caution and more data" (italics by the authors).

According to Valdiya (1969) *Collenia columnaris* is a characteristic form species of the Vindhya (Fawn Limestone and Bhandar Limestone horizons) and on this basis and together with radiometric data, he has attempted a correlation of the Vindhya with the Ripheans of the U.S.S.R. The present find of *Collenia columnaris* in the Bijawars which are litho and chronostratigraphically older than the Vindhya poses the question whether

there is actually any evolution in the morphology of the stromatolites and whether their utility for stratigraphic correlation purpose is reliable. The Bijawars have been dated 2780 ± 365 m.y., the Vindhya 1400—550 m.y. or even less (Crawford and Compston, 1970) and the base of the Aravallis not older than between 2500—2590 m.y. (Crawford, 1970). If reliance is to be placed on chrono and lithostratigraphy the find of *Collenia columnaris* in Aravallis (Banerjee, 1971) in the Vindhya (Valdiya, 1969) and Bijawars implies that *Collenia* spanned a wider stratigraphical range than hitherto believed.

Krishna Murty (1972, p. 184) on the basis of *Conophyton* thinks that the Bijawars of the Joga area could be correlated with the Lower Vindhya!

CONCLUSIONS

The implication and significance of the present finds of stromatolites lead the authors to conclude that :

- (1) Some of the form species have a very wide and longer stratigraphic range than hitherto believed, or
- (2) Stromatolites which have been used for stratigraphic correlation cannot be used for that purpose with reliance, or
- (3) There does not appear to be any time-controlled variation in the morphology of the stromatolites. The size and shape, it is probable appears to be more ecologically controlled i.e. by the physical environment rather than the biologic.

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EXPLANATION OF PLATE

PLATE I

1. *Collenia undosa* Walcott. Locality : 1½ miles S. W. of Dahi, Chhatarpur district, M. P.
2. *Collenia frequens* Walcott. Locality : 1½ miles S. W. of Dahi, Chhatarpur district, M. P.
3. *Collenia columnaris*. Locality : S. W. of Malera (102/4 Milestone on Chhatarpur—Sagar road), Chhatarpur district, M. P.
4. *Collenia symmetrica*. Locality : Chanwarpatha, Narsinghpur district, M. P.
5. Oncolites : Locality : Chanwarpatha, Narsinghpur district, M. P.
6. *Conophyton cylindricus* Maslov. Locality : 1½ miles N. W. of Chandgarh, East Nimar district, M. P.
7. *Conophyton cylindricus* Maslov. Locality : S. E. of Joga, Hoshangabad district, M. P.

