Biostratigraphic Zonation of the Stromatolite-Bearing Horizons in the Aravallis of Udaipur District, Rajasthan*

G. BARMAN, K. K. VERMA AND S. N. PURI

Abstract

Prolific development of algal stromatolites occurs in the carbonate sequence of the Precambrian Aravalli Supergroup in the Udaipur District of Rajasthan. Based on the assemblage of the algal stromatolites in the fossiliferous beds of the Aravallis, the authors propose three distinct biostratigraphic units, viz., (i) *Collenia columnaris* Assemblage Zone. (ii) *Collenia baicalica* Assemblage Zone, and (iii) *Oncolite* Assemblage Zone, in ascending order. Of these, *Collenia baicalica* and *Oncolite* Assemblage Zones are highly phosphatic and contain workable deposits of phosphorite (rock phosphate). The *Collenia columnaris* Assemblage Zone is, however, non-phosphatic. These assemblage zones have been recorded in all the phosphorite deposits of Udaipur area, viz., Jhamar Kotra, Maton, Kharbaria, Kanpur, Dakan Kotra, Neemuch Mata and Badgaon. It is, therefore, suggested that the proposed biostratigraphic zonation may be utilised for local as well as regional correlation and for locating new phosphorite-bearing horizons.

Introduction

The Precambrian Aravalli rocks of Rajasthan have attracted the attention of geologists since the discovery of phosphorite in the Udaipur District, Rajasthan. The phosphorite in this area is found to be intimately associated with algal stromatolites and oncolites at Jhamar Kotra (24°28′ : 73°51′), Maton (24°33′ : 73°47′),

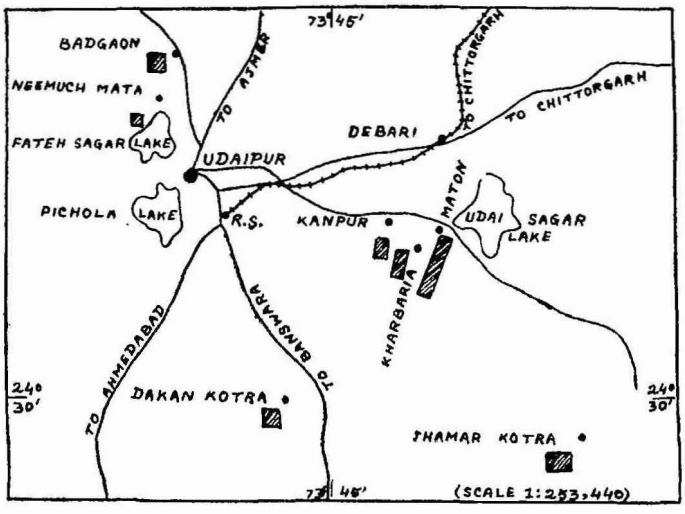

Figure 1. Map of Udaipur area, Rajasthan, showing localities of stromatolite occurrences.

Kanpur (24°34′ : 73°46′), Kharbaria (24°33′ : 73°46′), Dakan Kotra (24°30′ : 73°44′), Neemuch Mata (24°37′ : 73°41′) and Badgaon (24°32′ : 73°33′) (Fig. 1). Contributions regarding phosphorite finds have appeared from time to time (Chaterji 1968; Raja Rao *et al*, 1968; Muktinath *et al*, 1969; Banerjee, 1971 a, b. c; Chaterji and Mukherjee, 1971 and Chauhan, 1973) but, no attempt has so far been made to work out the biostratigraphic zonation which forms an important basis in local as well as

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inter-regional correlation of the beds. Recent studies on the stromatolites and oncolites of Udaipur District, Rajasthan, by the authors have enabled them to divide the fossiliferous beds of the Aravallis into distinct biostratigraphic zones based on stromatolite form-species and oncolites.

The present study forms a part of an intergrated project to study the algal stromatolites from the Aravallis and the Vindhyans of Rajasthan for the purpose of stratigraphic zonation and correlation, palaeo-environmental indicators, and aid to mineral prospecting.

Geology of the Aravallis

The sequence of rock types found in the Aravallis of Udaipur area, as given by Poddar (1965), is as follows:

(iii) Carbonate free sequence of phyllite, interbedded with quartzite.

(ii) Orthoquartzite, arkose, dolomite, siliceous dolomite, subgraywacke, graded bedded graywacke of flysch type, carbonaceous pyritic phyllite, sericite phyllite and slate.

(i) Basal quartz-pebble arkose conglomerate, arkose and quartzite with local basic volcanics and insignificant dolomite.

Stromatolites and oncolites occur in the dolomites of part (ii) of the above sequence, which is otherwise unfossiliferous. These dolomites are fine-grained in texture, bluish grey in colour and are occasionally siliceous. The bands of the dolomitic rocks show pinching and swelling and vary in thickness from 1 metre to 25 metres and can be traced along the strike over distances ranging from 30 to 600 metres.

Biostratigraphic zones

As indicated earlier, the biostratigraphic zones are based on the distribution of stromatolite form-species and oncolites. The biostratigraphic zones proposed are as follows:

(a) *Oncolite* Assemblage Zone (Upper)
(b) *Collenia baicalica* Assemblage Zone (Middle)
(c) *Collenia columnaris* Assemblage Zone (Lower)

A brief description of these assemblage zones is given below:

(a) *Collenia columnaris* Assemblage Zone: This is the lowermost zone and is characterised by the presence of *Collenia columnaris* Fenton and Fenton, *Collenia multiflabella* Razak, *Cryptozoon proliferum* Logan *et al* and *Jurusania* sp. The stromatolites in this zone are biohermal (Fig. 2) and non-phosphatic. The stromatolite-bearing dolomites are grey to buff coloured and are occasionally siliceous. The development of the stromatolites is mainly confined to the siliceous portion.

(b) *Collenia baicalica* Assemblage Zone: This middle zone is characterised by the presence of *Collenia baicalica* Maslov, *Baicalia prima* Semikhatov, *Collenia kusiensis* Maslov, *Collenia symmetrica* Fenton and Fenton, and *Minjaria calceolata* Korolyuk. The stromatolites in this zone are biohermal (Fig. 3) and highly phosphatic in nature. The dolomitic limestones in which these stromatolites occur are bluish grey in colour and are very fine grained.

(c) *Oncolite* Assemblage Zone: This is the topmost zone and is characterised by the presence of *Oncolites,* unattached free floating stromatolites. They occur in dark bluish grey and brownish dolomitic limestones and are highly phosphatic.

These three assemblage zones evidently reflect the specific variation in palaeo-environmental conditions in which they grew.

These three biostratigraphic zones are recognisable in all the areas where work was carried out so far, and significantly at all these places the upper and middle zones are phosphatic. Thus, it is apparent that these zones can be utilized for purposes of local as well as inter-regional correlation and search for new phosphate-bearing horizons in otherwise unknown areas.

Figure 2. A field photograph of algal stromatolites (non-phosphatic) from the *Collenia columnaris* Assamblage Zone at Kanpur, District Udaipur, Rajasthan. (×1/6).

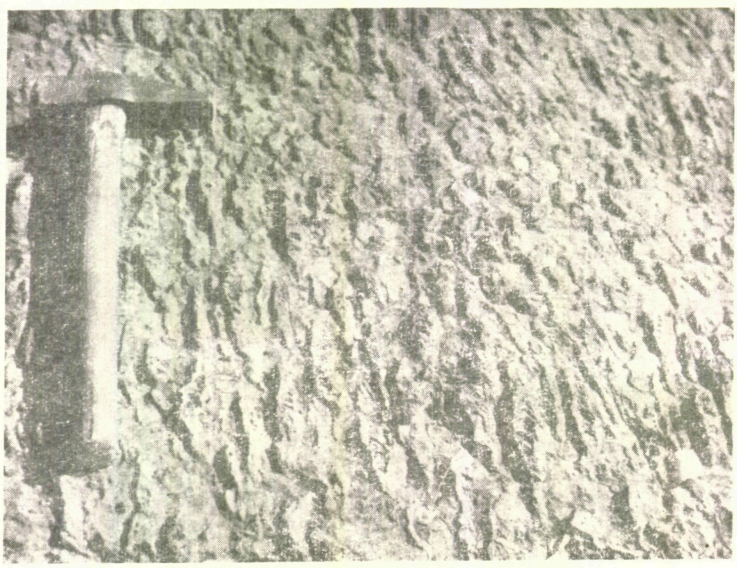

Figure 3. A field photograph of algal stromatolites (phosphatic) from the *Collenia baicalica* Assemblage Zone at Jhamar Kotra, District Udaipur, Rajasthan. (×1/8).

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Determination of mineral formulae and the relationship of ions to crystal structure of bentonites from Kutch (Gujarat)

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Seven samples of bentonite from Mandwi Taluka, Kutch district were chemically analysed. From the chemical analyses obtained, the mineral formulae were calculated by using the method prescribed by Ross and Hendricks (1945). The significance of this method is that it brings out the relationship of ions to crystal structure and provides a way by which some idea of the atomic structure can be visualised without using X-ray diffraction. From the mineral formulae, the b_o length of the montmorillonite unit was calculated by the relation

$b_o = 8.91 + 0.06r + 0.034s + 0.048t$ Å as given by MacEwan (1953), where,

r = number of Al ions in tetrahedral coordination

s = number of Mg ions in octahedral coordination

t = number of Fe ions in octahedral coordination

(per unit cell, in each case).

From this the a_o length can be obtained by the relation $b_o = a_o/\sqrt{3}$.

The Table on the next page presents the calculated mineral formulae and axial lengths of seven samples from different localities

It is concluded from the results that the main mineral constituent of the bentonites is beidellite.