A NOTE ON THE SILICIFIED OOLITES OF BHANDER LIMESTONE MAIHAR AREA, M. P.

by S. KUMAR, *Department of Geology, Lucknow University, Lucknow-226 007*

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Silicified oolites of the Bhander Limestone are studied. On the basis of the internal structure, they are classified into four types: (*i*) concentric oolites; (*ii*) composite oolites; (*iii*) deformed oolites; and (*iv*) ghost oolites. The primary carbonate oolites seem to have silicified possibly penecontemporaneously. The silicified oolites show evidences of calcitization and the different stages of replacement of chert by calcite rhombs are recorded. In the final stage of diagenesis, the process of dolomitization has also been recorded in which the calcite rhombs are replaced by dolomite rhombs.

INTRODUCTION

THE STUDY of fossil oolites is quite helpful in deciphering the physical parameters and chemical milieu of the depositing medium, and the diagenetic history of the rock. The Bhander Limestone Member of the Bhander Formation of the Upper Vindhyan (Late Precambrian) consists of several horizons of oolitic limestones which have been identified as oomicrites, oosparites and oomicrosparite by Sarkar (1973). She has also studied the deformation of these oolites. Recently, a silicified oolite horizon has been recorded by Singh (1976) from these limestones. This is a thin horizon (24 cm) seen in a more or less unsilicified limestone succession. It shows sharp upper contact and a lower gradational contact. This horizon is quite interesting and throws much light on the diagenetic history of the rock and therefore has been taken up for detailed petrographic investigation. The present paper deals with the study of silicified oolites in the light of diagenetic changes.

GEOLOGICAL SETTING

The silicified oolite horizon belongs to the Bhander Formation of the Vindhyan Supergroup. The Vindhyan Supergroup occupies a vast region in Central India and attains a huge thickness of about 4,000 m. The main lithic types are represented by sandstones, shales and limestones. The rocks are unmetamorphosed and more or less undeformed. The Vindhyan Supergroup is lithostratigraphically subdivided into two groups viz., Semri Group (Lower Vindhyan) and Upper Vindhyan. The Upper Vindhyan is further subdivided into Kaimur Formation, Rewa Formation and Bhander Formation.

Around Maihar township, Satna district, M.P., the Upper Vindhyan rocks are well developed (Fig. 1). The silicified oolites belong to the lower part of the Bhander Limestone Member (Table I). A set of representative samples of silicified oolites has

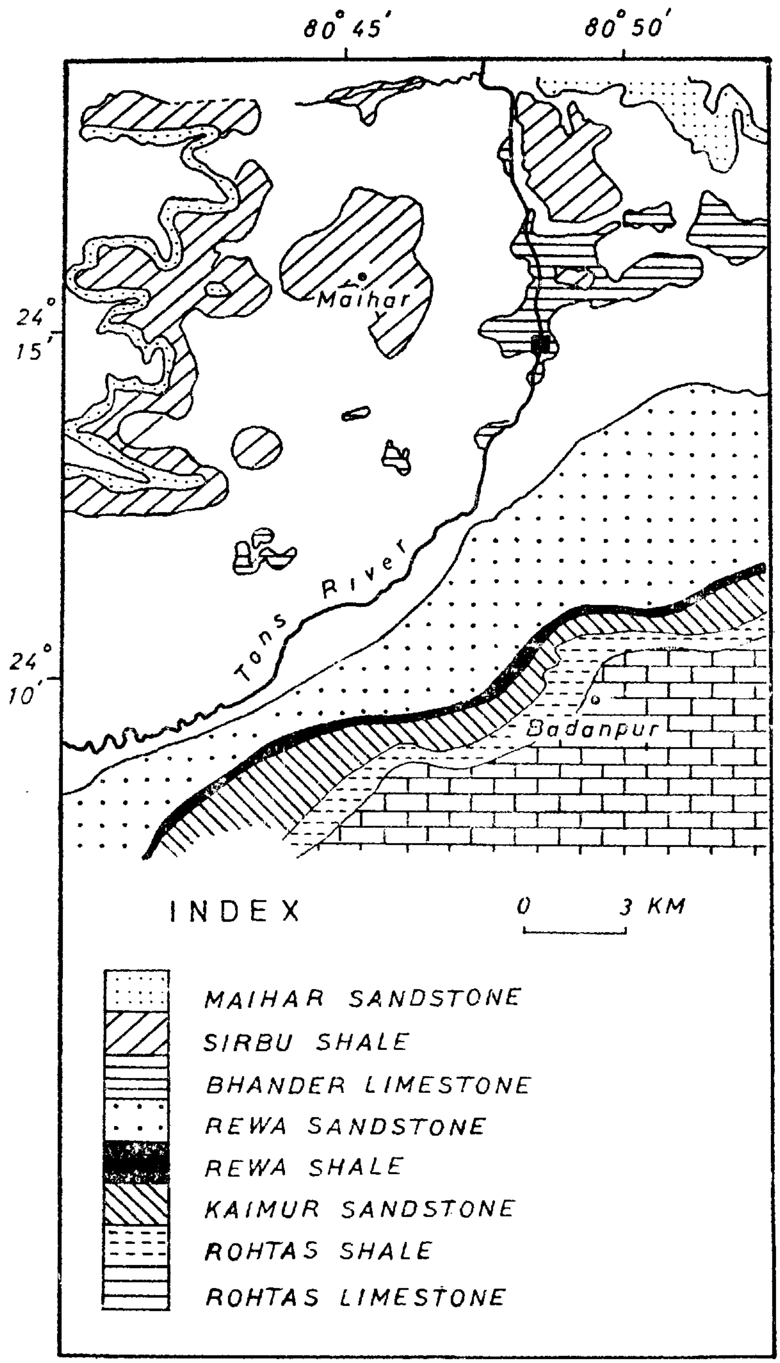


FIG. 1. Geological map of Maihar area, Satna district, M.P. Square marks the locality of silicified oolite horizon (After G. V. Rao 1949 in Awasthi 1964).

TABLE I

Stratigraphic succession in Maihar area, Satna district, M. P.
(After G. V. Rao 1949 in Awasthi 1964)

Upper Vindhyan	Bhander Formation	Maihar Sandstone Sirbu Shale Bhander Limestone
	Rewa Formation	Sandstones Shales
	Kaimur Formation	Sandstones
Lower Vindhyan (Semri Group)	Rohtas Limestone	Shale Limestone

been collected from the Tons River section, Maihar area, M.P. The litholog of the Tons River section is given in Fig. 2.

Method of Study — The present study is based on microscopic observations supplemented by Alizerine Red — S staining for calcite and dolomite identification as suggested by Friedman (1959).

Silicified Oolites — The oolitic horizon is about 24 cms thick. In hand specimen it appears as black chert with conchoidal fracture. The oolitic nature can only be seen in the thin section under the microscope (Plate I—1). It shows a sharp upper contact with overlying micritic limestone. The upper contact also shows well developed ripple marks. However, the lower contact is gradational with oomicrite in which a few silicified oolites are also seen floating in calcitic matrix. On the basis of the internal structures, the silicified oolites have been classified into the following types :

1. Concentric oolites
2. Composite oolites
3. Deformed oolites
4. Ghost oolites.

1. *Concentric Oolites* — These are made up of crypto-crystalline to microcrystalline chert and show well developed concentric layers with or without nucleus (Plate I—1, 5). They are circular to elleptical in outline with equatorial diameter ranging from 0.19 mm to 0.42 mm. The average equatorial diameter is 0.35 mm.

2. *Composite Oolites* — These are similar to concentric oolites except that an arm of one of the oolites encompasses one or more oolites. The equatorial diameter ranges from 0.34 mm to 0.64 mm with an average of 0.48 mm.

3. *Deformed Oolites* — These are similar to concentric oolites in all the respects except that these show penecontemporaneous deformation (Plate I—1). The deformation of silicified oolites is quite similar to the deformation described and explained by Sarkar (1973) from the carbonate oolites of the Bhander limestones. She has considered the deformation as synsedimentary and contended that the deformed

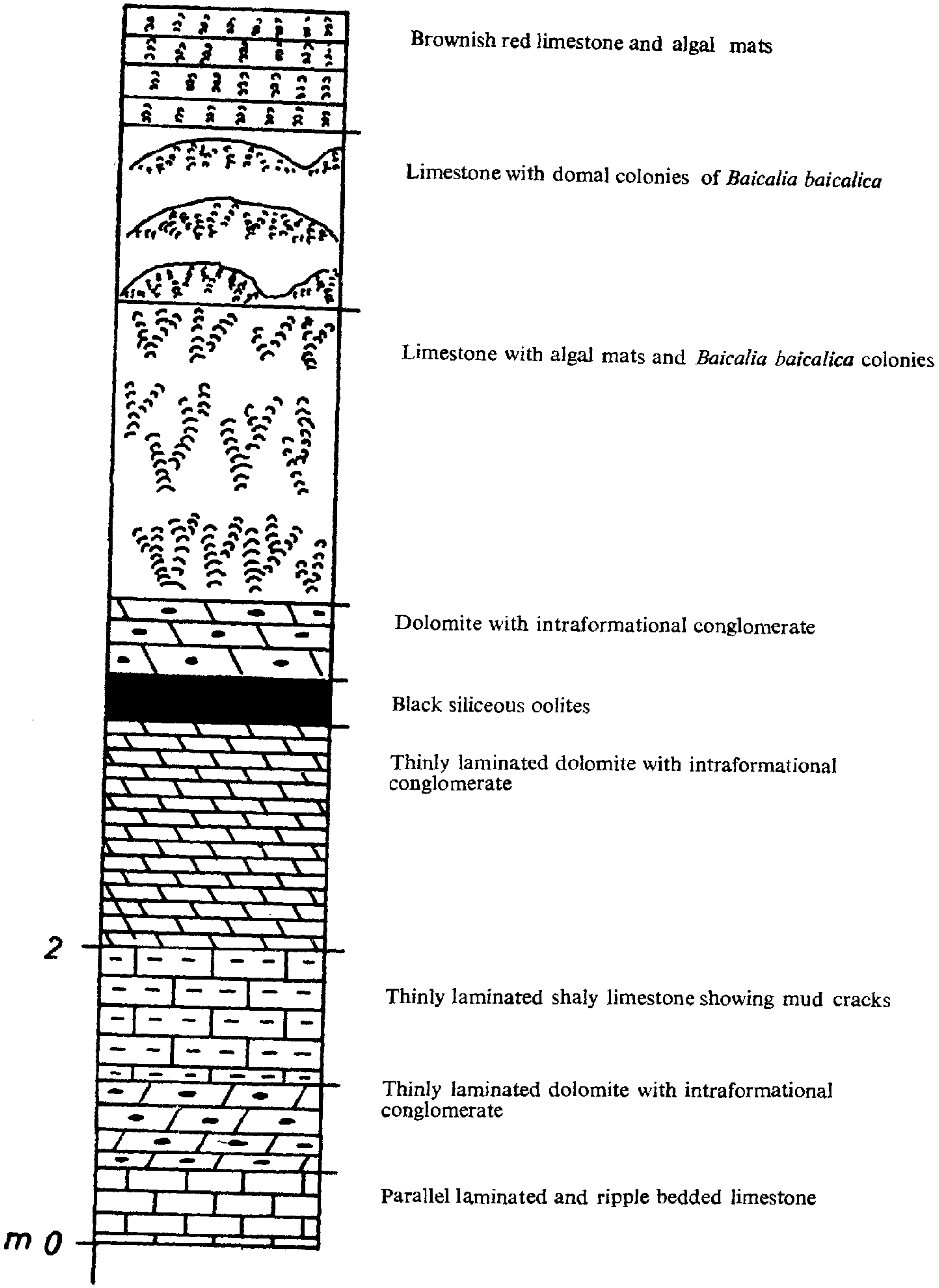
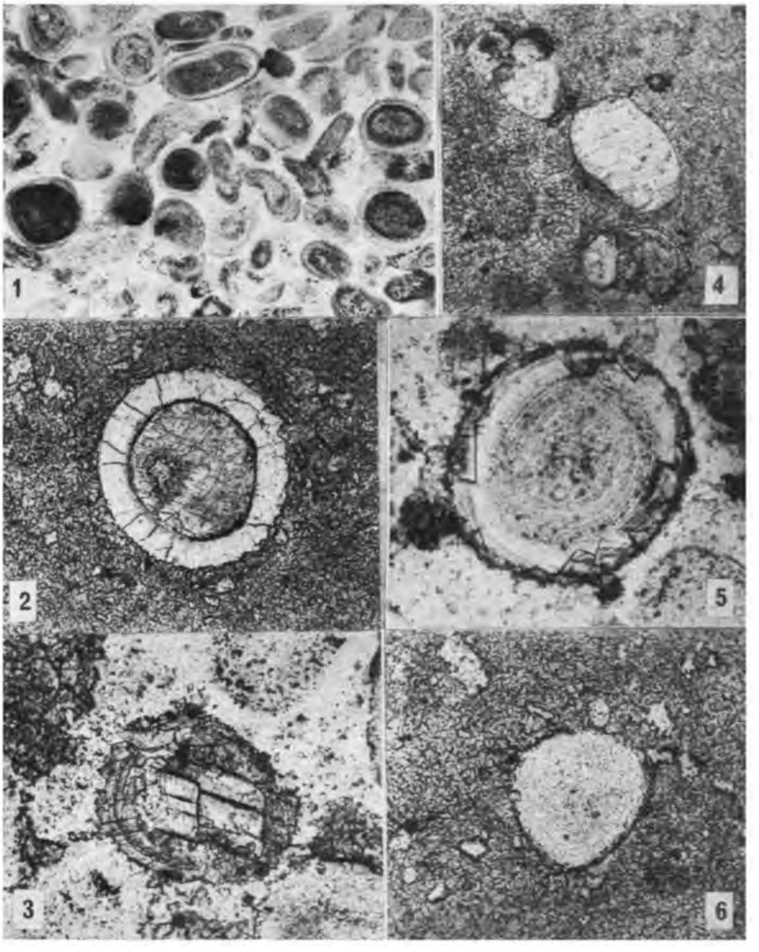


FIG. 2. Litholog of the Bhander Limestone in the Tons River section, Maihar (Modified after Singh 1976)



1. Silicified oolites. Some oolites are deformed. Ordinary light. *X* 24. 2. Silicified oolite seen in micritic matrix. The central part is replaced by calcite. Ordinary light. *X* 90. 3. Calcitized concentric oolite. Light coloured rhomb in the centre of the oolite is made up of dolomite. Ordinary light. *X* 90. 4. Ghost oolite made up of calcite. Ordinary light. *X* 48. 5. Concentric silicified oolite. The margin of the oolite is replaced by calcite rhombs. Ordinary light. *X* 90. 6. Ghost silicified oolite. No internal structure is preserved. Ordinary light. *X* 90.

oolites are derived from the collapse of spherical oolites due to agitation in water before deposition. The equatorial diameter of the deformed oolites ranges from 0.16 mm to 0.67 mm with an average equatorial diameter of 0.41 mm.

4. *Ghost Oolites* — These are those oolites which do not show any internal structure (Plate I—6). Their equatorial diameter ranges from 0.16 mm to 0.58 mm with an average equatorial diameter of 0.30 mm.

Diagenesis — The oolites have controlled the pattern of the diagenesis and their study is of much help in deciphering the diagenetic history of the limestones. The presumption of the original composition of the silicified oolites is based on the work on recent as well as ancient oolites. In the absence of any evidence to know the original composition of the oolites under study, it is presumed that originally these oolites were made up of aragonite or calcite (Friedman 1964; Swett 1965; and Kahle 1974).

The original carbonate oolites were replaced by silica in two ways :

(1) Rapid replacement in which the original concentric nature of the oolites is well preserved (Plate I—5) and the silica is microcrystalline to cryptocrystalline.

(2) Slow replacement leading to total obliteration of the internal structure (Plate I—6). The silica is fine to medium grained microcrystalline chert.

The silicification is generally restricted to only oolitic horizon. This suggests that the oolites were more susceptible to silicification perhaps due to good permeability resulting in better availability of pore space to circulating solutions with high concentration of silica. The origin of silica solution is not certain but a primary origin is envisaged. Precipitation of primary opaline silica has been recorded in the Coorong lagoon of South Australia in the hypersaline lakes (Peterson & Borch 1965) and primary origin has also been suggested for early cherts of Mississipean Leadvelle limestone, Colorado, by Banks (1970) and for Bitter Springs cherts by Schopf and Blacic (1971).

After silicification the oolites were subjected to calcitization. The replacement starts invariably from the margins but replacement from the centre is also recorded (Plate I—2, 5). In the final stage, the entire oolite is replaced by sparry calcite which generally develops as calcite rhombs (Plate I—4). In few instances entire oolite has been replaced by a single crystal of calcite. Thus the silicified oolite is converted into a ghost oolite made up of sparry calcite.

After calcitization, the process of dolomitization has affected these rocks, in which the calcite rhombohedron has been replaced by dolomite rhombohedron (Plate I—3).

Thus the sequence of authigenic changes is in the following order which accounts for the observed fabric :

(*i*) Silicification;
(*ii*) Calcitization; and
(*iii*) Dolomitization.

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