SEDIMENTOLOGY OF MIRANJANI ALGAL LIMESTONE MEMBER, NATHIAGALI

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ABSTRACT

Microscopic sedimentological study of the Miranjani Algal Limestone Member of the Hazara Formation (Hazara Slates) of Nathiagali area, District Hazara, is made, following the petrographic classification of limestones of Folk (1959).

Varied association of all three basic constituents of limestones (allochems, microcrystalline calcite and sparry calcite) is met with indicating a diversity of physiochemical conditions.

Mega and microscopic sedimentary structures and composition are used to infer environments of deposition for every thin section and for the unit, as a whole.

Systematics of algal material is not dealt with except for identifying it as "Green Stromatolytic Algae". Ostracodes were met within a thin section which, however, could not be identified.

INTRODUCTION

A light grey limestone sequence with significant algal material is developed within the Early Palaeozoic Hazara Formation (Hazara Slates of earlier workers), in the Nathiagali area. This unit is provisionally referred to as Miranjani Algal Limestone Member till its formalization by the stratigraphic Committee of Pakistan. It is 115 feet thick. Its exact stratigraphic position could not be ascertained as the lower contact of the slates is faulted against the Jurassic Samana Suk Limestone. According to Latif (1970), however, it is developed in the lower part of the Hazara Formation.

The section studied (Grid Ref: 063450, T. Sheet 43 F/8) is exposed along the westernmost path leading to Miranjani Peak (lat. 34°06'15'' N; long. 73°24'22'' E) from the Nathiagali Rest House (lat. 34°4½'N; long. 73°8½'E) and is designated here as the type locality of the member. Samples were taken at every change of lithology as observed under a X.10 hand lens and their characteristics noted. In all, twenty two samples were taken which were later studied in thin sections and the field observations were thus supplemented by laboratory studies. The samples and thin sections are deposited with the Geology Department, University of the Punjab, Lahore.

DISCUSSION

Composition, sedimentary structures and palaeoecologic conditions as depicted by both of these parameters are discussed for every thin section. The thin sections are described in an ascending stratigraphic order.

Thin Section No. I.

The base of the Algal Limestone is marked by an iron-stained pelsparite 10 ft. thick, weathering yellow. Few mica flakes, clay minerals and some finely laminated argillaceous material were observed. The section suggests semi-arid to arid conditions of deposition in shallow waters, of high energy conditions.

Thin Section No. 2.

Micritic limestone showing low energy conditions at the time of deposition, without current action. Sutured contacts of various fractions of lithology indicate penecontemporaneous compaction.

Thin Sections No. 3 & 4.

Intrabio-oosparite* showing high energy agitated conditions as is evident also from truncations of ooliths (Fig. 1) and presence of intraclasts. The length to breadth ratio of intraclasts (Fig. 2) also suggests the same. Some penecontemporaneous compaction is suggested by sutures.

Thin Section No. 5.

Intrabio-oomicrite suggests abnormal conditions as evident from juxtaposition of low and high energy constituents. It can be explained either as a reult of incorporation of trickling micrite into the interstices of ooliths which were being formed in high energy conditions, or the incorporation of reworked ooliths from some nearby high energy conditions into the low energy micritic depositional interface. The former explanation is acceptable as no reworking of ooliths (Fig. 3) was discernable.

Thin Section No. 6.

Biolithite with algal pisolites showing chaotic arrangments of algal encrustations indicate periodic conditions of growth of algae. This is a manifestation of the fact that ooliths can be formed in low erngy conditions as evident from the accentricity, irregular shape and the chaotic arrangement of algal laminations, truncating each other.

Thin Section No. 7.

Micritic carbonate rock indicating deep water low energy conditions without any current activity. Veins of clastic material suggest dessication with resulting drifting

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* Deviation from the procedure of nomenclature, as proposed by Folk (1959), is made and all the allochems are mentioned for a better appraisal by the readers.

of original material into mud cracks. A lot of solution is evident from sutured boundaries between dense and loosely packed horizons.

Thin Sections No. 8, 9 & 10.

Biolithite with parallel laminated green stromatolytic algae (Fig. 4) indicates shallow oxygenated water of comparatively high salinity. Burrows show that the material had enough consistency to retain the walls of the cavity.

Thin Section No. 11.

Wavy lamination of algae indicates a tendency of algae to convex upwards responding to deeper waters than those during the deposition of rock of thin sections No. 8, 9 and 10. Biolithite rock suggets autochthonous growth in low erngy oxygenated conditions.

Thin Section No. 12.

Biointramicrite: This association suggests either of the two conditions as expressed under the section number 5. In the present case, second choice is favoured by the presence of bird's eye structure which suggests under-water cracking. Fossils indicate conditions favourable for life.

Thin Section No. 13.

Intraoosparite suggests high energy condition while the coarse grain of the rock shows less transporation as is also evident from the angularity of grains.

Thin Section No. 14.

Intraoosparite is a manifestation of high energy agitated shallow water conditions. The absence of any alignment of intraclasts shows high energy conditions while absence of sorting suggests dumping.

Thin Section No. 15.

Intramicrite suggets abnormal conditions. One is to choose either of the two inferences, as given below, from such association. Either the deep calm water basin of micritic realm was receiving high energy components (intraclasts) or a sudden pulsation of the high energy depositional interface resulted in trickling of micrite.

Thin Section No. 16.

Originally intramicrite as thin section No. 15 but washing has replaced the micrite with sparry cement. Well-defined boundaries of voids filling show vigorous shaking and not ripping of the sedimentary interface.

Thin Section No. 17.

Pelintramicrite: (Refer to section No. 15). Pellected fabric reveals churning action of the organisms.

Thin Section No. 18.

Oosparite with half-moon ooliths (Fig. 5) suggets currents of too low intensity to drive or overturn the grain so that precipitation of $CaCO_3$ continued only on one side. Sparry cement shows washing phenomenon. Presence of articulated ostracodes indicates optimum conditions for the growth of organisms.

Thin Section No. 19.

Intramicrite: refer to section No. 15.

Thin Section No. 20.

Pelmicrite indicates low energy and deeper water conditions. The green faecal pellets (Fig. 6) suggest oxygenated waters of very low salinity allowing flourishing growth of organisms. Detrital sand (Fig. 6) and other terrigineous material show influx of this material from nearby basin of deposition. Flow structure indicates bioturbation phenomenon, in the sense that living organisms were responsible for creating turbulance in otherwise calm malieu of deposition.

Thin Sections No. 21 & 22.

Oosparite, representing the top of the Algal Limestone, indicates high energy conditions. The aligned needles (Fig. 7) of material derived from the erosion of the slates of the Hazara Formation indicate that the current velocity was great enough to erode the slates. The presence of mechanical bridges also favours this inference. The length to breadth ratio of flakes of slates suggests only a transporation of a few hundred yards.

CONCLUSION

The deposition of the Miranjani Algal Limestone Member commenced in certain areas of the subsiding geosynclinal tract of the Hazara Formation. This development was due to the absence of this subsidence in those areas which gave rise to a, by and large, shallow basin with concomitant prevalence of lagoonal conditions. The depositional interface was repeatedly going under shallower and deeper waters which were sometimes calm and quiet, and agitated at others. Processes of bioturbation, solution, dumping of material, under-water cracking, and shaking of the depositional interface are amply indicated at different levels. Flakes of the slates towards the top of the Algal Limestone indicate penecontemporaneous erosion of the slates and their incorporation into the limestone. Further, the water was warm and saturated enough to initiate precipitation of $CaCO_3$ and was oxygenated as well, which led algae to grow. Generally speaking, the conditions were not much optimum for the growth of organism.

To conclude, the Miranjani Algal Limestone member was deposited in near-shore shoals to slightly off-shore lagoonal conditions.

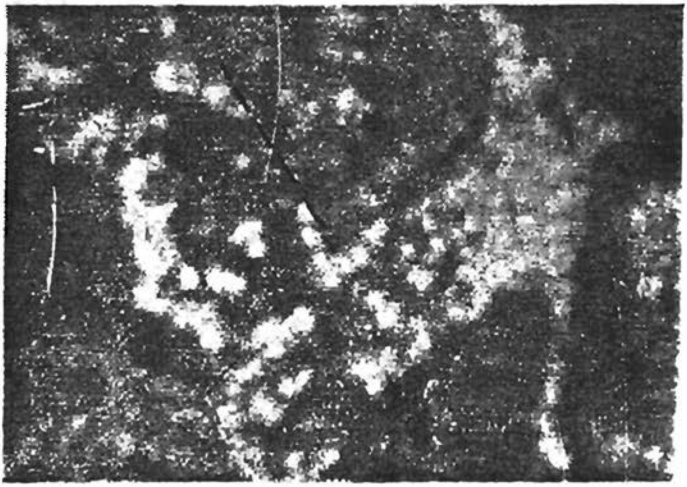

Fig. 1. Intrabio-oosparite: Broken ink line shows truncation of oolith. × 33

Fig. 2. Intrabio-oosparite: Intraclast marked as I showing length to breadth ratio. × 33

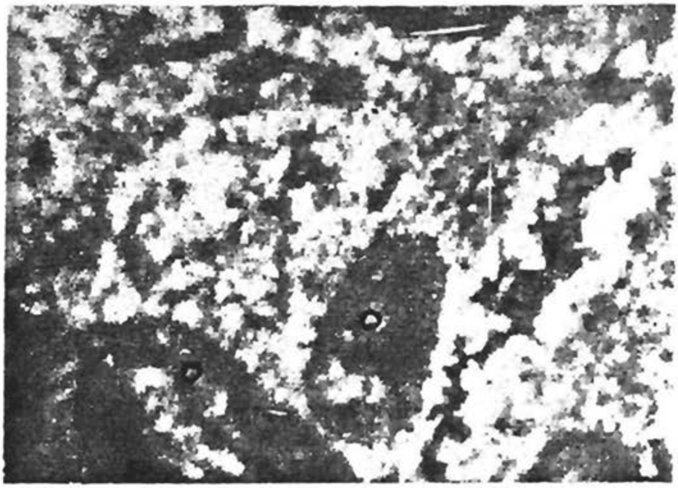

Fig. 3. Intrabio-oomicrite: Untruncated ooliths, marked as O, in micritic cement. × 33

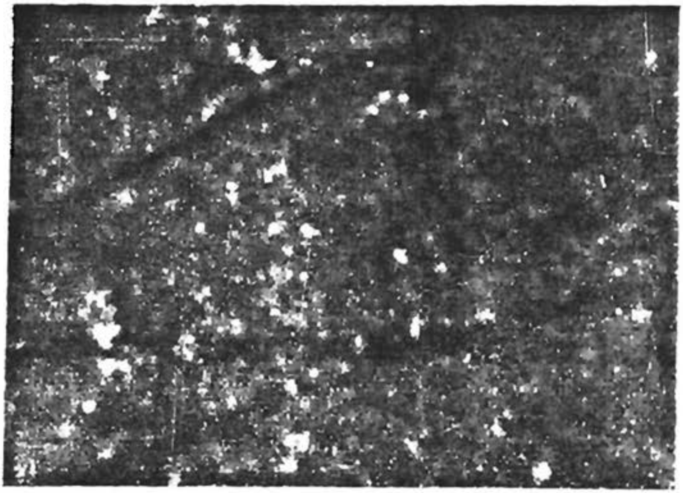

Fig. 4. Biolithite: Dark lines showing parallel laminated green stromatolytic algae. × 33

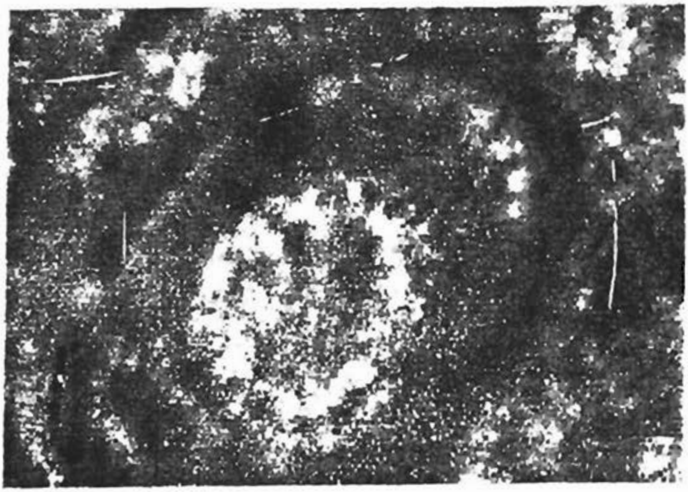

Fig. 5. Oosparite: Showing a half-moon oolith. × 33

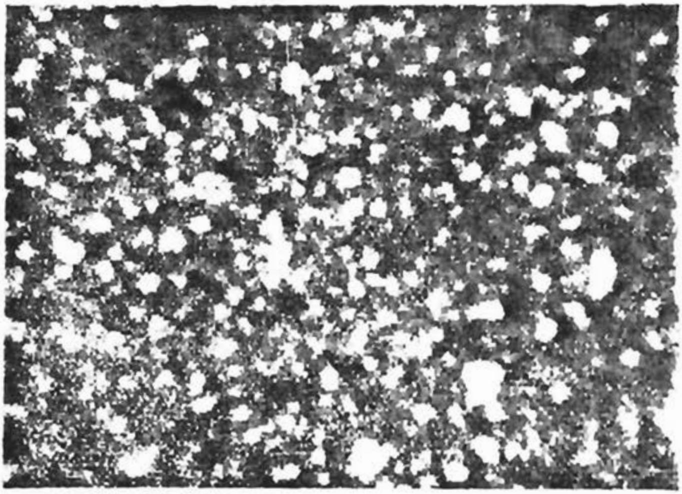

Fig. 6. Pelmicrite: Showing detrital sand (white grains) and faecal pellets (black grains), cemented by micrite (light grey). × 77

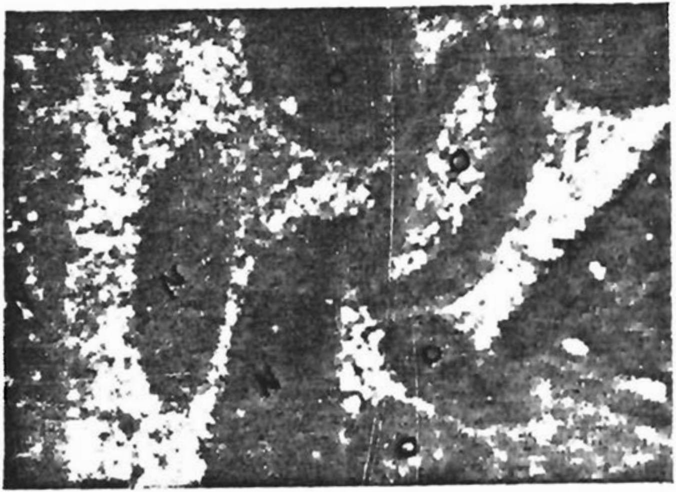

Fig. 7. Oosparite: Showing ooliths, marked as O, and needles of slates, marked as N. × 33

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