

STUDY OF THE AMINO ACIDS AND FATTY ACIDS IN THE STROMATOLITES OF SOMESHWAR AREA IN KUMAUN HIMALAYA

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ABSTRACT

Amino acids, viz., serine, glutamic acid, alanine and cysteine and short and long chain saturated fatty acids, and oleic acid, were detected in the stromatolites samples from Someshwar area in Kumaun Himalaya suggesting the involvement of a possible biologic activity (chemical fossils) in their formation. These stromatolitic structures possess laterally linked hemispheroidal columnar form (type LLH, Logan *et al.*¹⁰), and in cross-section their laminae show round to oval parallel section resembling a concentric vertical structure (type SS-C).

INTRODUCTION

THE stromatolites in the Someshwar area in Kumaun Himalaya occur within a band of cream and grey, cherty and dolomitic limestones which have been correlated with the Deobans (=late Precambrian) (Munshi¹³; Munshi *et al.*¹⁴). Heim and Gansser⁹ and Das⁶ correlated the limestones of neighbouring areas with Krol (Permo-carboniferous). However, others (Auden³; Misra and Valdiya¹²; Valdiya¹⁶) correlated these rocks with much older Deoban Formation (Cambro-ordovician or even late Precambrian). Valdiya¹⁷ assigned a Riphean (Precambrian) age to the stromatolites, present in the east of Almora. However, there are no reports on the presence of organic compounds in these rock types.

The presence of moderate amounts of organic matter in some stromatolites has been taken as evidence for biological activity (Shearman and Skipwith¹⁵), though not all stromatolites are thought to have biologic origin (Cloud⁴). Investigations of hydrocarbons, porphyrins, fatty acids, amino acids and carbon isotope ratios in ancient sediments have suggested basic biochemical similarities between Precambrian and extant organism (for a review see Eglinton and Murphy). Here we report the presence of appreciable amounts of amino acids and fatty acids in the stromatolites of Someshwar area.

MATERIALS AND METHODS

Total lipid and fatty acids were extracted and isolated from the powdered samples by the procedure described earlier (Mattoo and Modi¹¹). The methyl esters of free fatty acids in the total lipid sample were prepared with diazomethane and fractionated by gas-liquid chromatography (Asundi *et al.*²) using a 10% diethylglycolsuccinate column at an isothermal temperature of 190°C. For amino acid analysis, powdered sample was hydrolyzed in 6N HCl and at 105°C for 24 h. After removal of HCl, the hydrolyzed sample was dissolved in 5 ml of phos-

phate buffer, pH 2.2. Amino acids were separated and estimated using an automatic amino acid analyzer connected to an Autolab system.

RESULTS AND DISCUSSION

The morphology of the stromatolites analyzed was simple. Similar samples have been described from nearby areas as *Collenia columnaris* (Valdiya¹⁵⁻¹⁷; Dixit⁷). They show a laterally linked hemispheroidal columnar form corresponding to the LLH type (Logan *et al.*¹⁰). Excepting the cherty material, the rest of the stromatolitic structures gave sky bluish stains when treated with alizarin-S RED indicating a possible ferroan dolomite constitution. In cross-section the stromatolitic laminae showed round to oval parallel sections indicating a concentric vertical structure (Fig. 1), corresponding to type SS-C (Logan *et al.*¹⁰). The basal radii for individual columns, especially those from which the samples were taken, were constant.

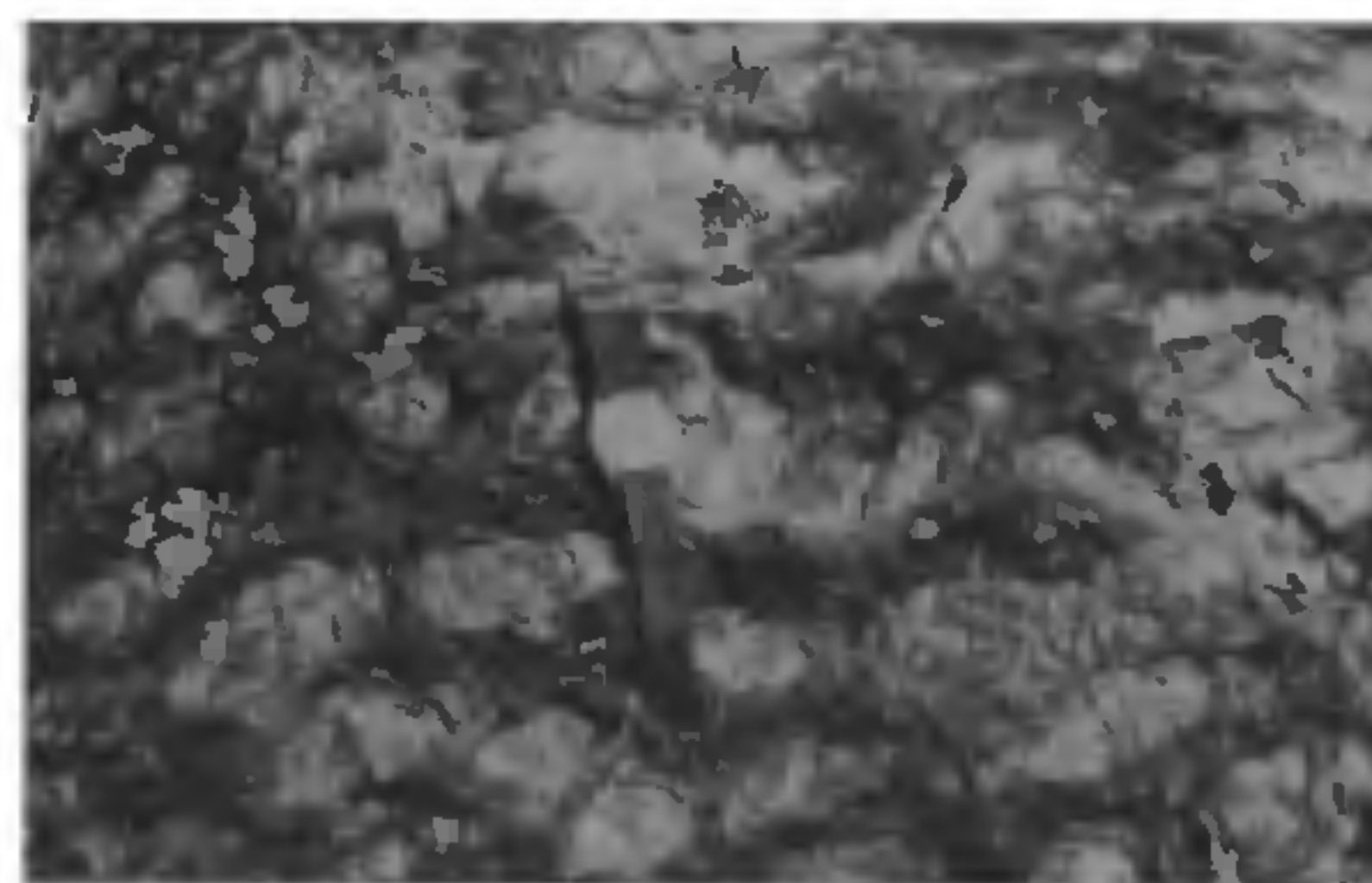


FIG. 1. Stromatolites showing both close- and spaced-lateral linking. Photograph parallel to the bedding. Stromatolites convex towards camera. Camera facing East. Location: 1.5 km NE of Someshwar in Kumaun Himalaya.

Gas chromatographic data in Table I lists the fatty acids that were identifiable. All the fatty acids present had even numbered carbon atoms but the major amounts

were of C_{12} and C_{16} acids. The C_{12} , C_{16} and C_{18} fatty acids were present in both the free and bound forms whereas all of C_{14} was present as free fatty acid and $C_{18:1}$, the only unsaturated fatty acid identified, as the bound fatty acid. No poly-unsaturated fatty acid was detected. Abelson¹ has reported that poly-unsaturated acids disappear quickly in rock sediments while as oleic acid ($C_{18:1}$) seems relatively stable. The presence of very low amounts of $C_{18:1}$ in the samples analyzed may be an underestimate. Furthermore, it appears that the stromatolites are richer in saturated fatty acids than the unsaturated ones. Higher amounts of palmitic and stearic acids in recent and ancient sediments were reported by Cooper⁵. The presence of short-chain fatty acids, viz., C_{12} and C_{14} (Table I) may indicate residual constituents of low forms of life in these rock types. The fatty acid distribution is more like those of ancient fossils.

TABLE I

Fatty acids in the stromatolites of Someshwar area in Kumaun Himalaya

Fatty acid	Free %	Total
C_{12}	36	52
C_{14}	10	09
C_{16}	33	36
C_{18}	15	20
$C_{18:1}$	00	08

Appreciable amounts of four amino acids, cysteine (sulphur containing), serine, glutamic acid and alanine were also detected (Table II). The quantities listed

TABLE II

Amino acids identified after acid hydrolysis of the stromatolitic structures from Someshwar area in Kumaun Himalaya

Amino acids	Concentration, μ moles/g samples
Alanine	0.32
Cysteine*	0.06
Cysteine	0.047
Glutamic acid	0.29
Serine	1.24
Lysine	traces

* as cysteic acid.

represent mean values of two samples analyzed in duplicate. Serine content was highest followed by alanine and glutamic acid. Cysteine content was low but appreciable while only traces of lysine were found. The amino acids detected are syngenetic to stromatolites and are either known from extant organisms or apparently geochemical derivatives of biological amino acids-containing peptides/proteins. The pattern and quantities of amino acids found is interest-

ing and may have some bearing on the type(s) of organism associated with the formation of the stromatolites studied here. From the data it appears that the stromatolites of the Someshwar area may be products of biologic activity possibly of primitive organisms, and provide a new example of ancient sediments containing organic matter of biologic origin. Further analyses dealing with $^{13}C : ^{12}C$ ratio *n*-alkane profiles and isoprenoid data should provide additional evidences to support further our results on the biogenicity of the organic matter in the stromatolites studied.

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