STROMATOLITES IN METAMORPHOSED DOLOMITIC LIMESTONE ON KARLSØY, TROMS, NORTHERN NORWAY*

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Preliminary descriptions are given of the appearance and geological setting of two types of stromatolite found in 1974 in biotite- or garnet-grade regionally metamorphosed dolomite. Correlations with the Late Precambrian stromatolitic Porsanger Dolomite of Finnmark and with certain marbles in southern Troms and Nordland, including the Fauske Marble Group, are tentatively suggested.

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Stromatolites were found in 1974 in regionally metamorphosed dolomitic limestone at two localities on the island of Karlsøy, Troms, northern Norway (Fig. 1). The identification was simultaneously confirmed on the basis of photographs by Dr. H. J. Hofmann and Dr. C. Downie. The structures are most numerous at locality 2, but the largest individuals were seen at the first observation site, locality 1 (Fig. 1).

According to Dr. Hofmann at least two types of stromatolite are represented. The one observed mainly at locality 1 takes the form of closely spaced columns or mounds. These were recognised in the field when concentric lines picked out by concentrations of dark grey graphite were seen in the white dolomite (Fig. 2). In longitudinal section these structures are seen to taper. The largest diameter observed was about 45 cm. The other type, which is most abundant at locality 2, is 'more openly spaced and consists of smaller, digital, branching columns or pseudocolumns' (Hofmann, written communication). This type was recognised by the presence of alternating laminae of dark grey graphitic marble and pale or white dolomite (Fig. 3). Diffuse deformed individuals of this type were observed in loose blocks at the first locality and the impression afterwards is that they were probably common along most of the shore section between localities 1 and 2, but were not recognised as probable organic structures before the well-preserved ones on the joint surface shown in Fig. 3 were found.

The marble varies considerably in appearance being white, fine to medium grained crystalline, pale grey apparently cryptocrystalline, patchy white to

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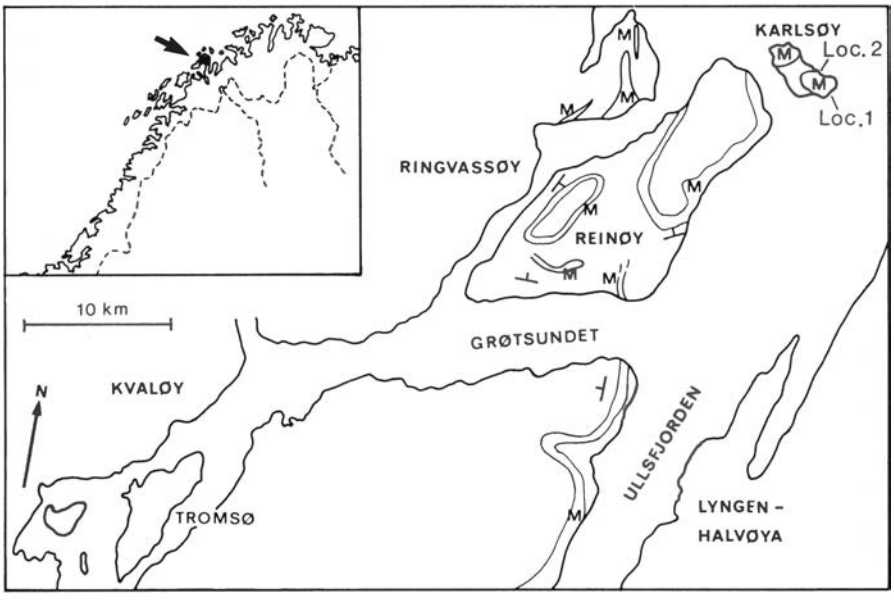

Fig. 1. Map showing the stromatolite localities and the distribution of the Karlsøy marble (M) in northern Troms.

dark grey or black, fine to medium grained crystalline, and black, medium grained. The stromatolites were found in the third variety, which is most widespread. Flat-pebble conglomerate, indicative of current action and typical for stromatolite-bearing limestone (e.g. White 1969, Vidal 1972), is common in parts of the marble on Karlsøy. The imbrication pattern of this conglomerate, the relationship between the conglomerate and the stromatolite columns, evidence from scarce examples of cross-bedding, and the direction of growth shown by relatively well-preserved stromatolites consistently shows that at least the lower part of the marble on Karlsøy is facing upwards.

The marble, which consists predominantly of dolomite (nearly 100 % of the carbonate in X-ray analysed specimens) + calcite ± graphite ± tremolite, crops out on the flanks of a late, NNE-SSW trending antiform. It is closely jointed, but frequently displays no trace of schistosity, especially in the eastern half of the island where the stromatolites were found. Nevertheless, study of the same marble, schist and psammite sequence on Ringvassøy and Reinøy (Fig. 1) has proved at least one set of large- and small-scale, tight or isoclinal, sub-recumbent folds refolded by large- and small-scale tight to open, overturned and upright folds. Small-scale folds correlateable with these sets occur in all the lithologies on Karlsøy. These folds are assumed to be of Caledonian age.

The micaceous and quartzitic schists underlying the marble contain quartz, biotite, muscovite, chlorite, epidote, albite or oligoclase,and sometimes garnet and (actinolitic?) amphibole. An early fine grained schistosity is preserved

Fig. 2. Cross-sections of columnar stromatolites in marble near Korsneset, Karlsøy, Troms, Norway.

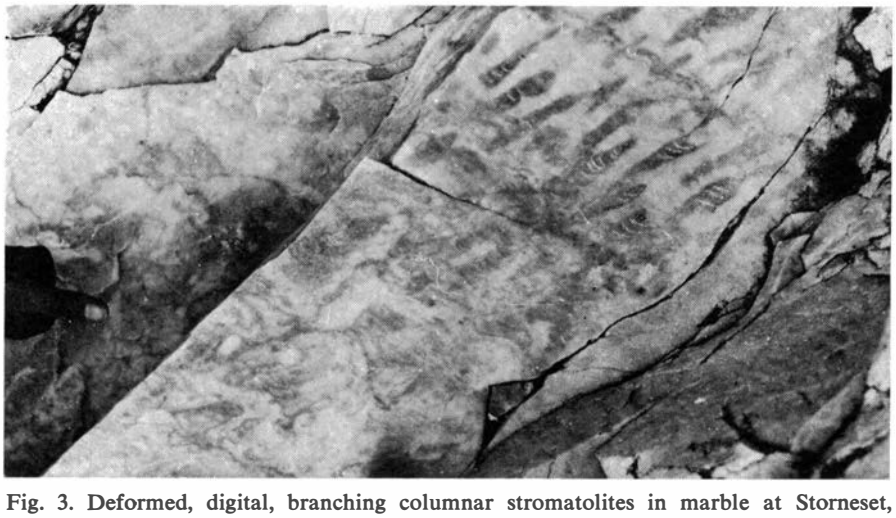

Fig. 3. Deformed, digital, branching columnar stromatolites in marble at Storneset, Karlsøy, Troms, Norway.

as bent inclusion trails in garnets. The amphibole overgrows the present regional schistosity, which is axial planar to the common, tight overfolds. A thin hornblende schist immediately underlies the marble on most of the island. Similar micaceous and quartzitic schists underlie and overlie the marble

at its southerly continuation on Reinøy (Fig. 1). This could indicate a tight overfold closure in the marble on Karlsøy which could help to explain the unexpected preservation of stromatolites in such a metamorphic environment.

The mineralogy shows that the succession has been regionally metamorphosed to the uppermost greenschist or lowermost amphibolite facies. Very few, if any, stromatolite occurrences have been recorded in such highly deformed and metamorphosed assemblages. A similar, but doubtful, occurrence is reported from the Grenville marble in Ontario, Canada (Hofmann 1971, written communication).

Regional significance of the Karlsøy stromatolites

This is the first fossil find in the metamorphosed Precambrian or Lower Palaeozoic rocks of Troms county. Lower or Middle Cambrian archæocyathids are described from a marble on Sørøy, western Finnmark (Holland & Sturt 1970), while Lower Silurian fossils are reported from Magerøy further east in Finnmark (Henningsmoen 1961, Føyn 1967). Middle Ordovician fossils are found in Nordland, some 600 km south of Karlsøy (Nicholson 1966). No stromatolites seem to have been observed in the Lower Palaeozoic rocks of Norway or Sweden. They are, however, abundant in the unmetamorphosed Porsanger Dolomite of eastern Finnmark (Holtedahl 1918, White 1969, Roberts 1974), which is probably Late Precambrian (Upper Riphean) in age. They occur in the same formation on Svalbard (Winsnes 1965), and in Sweden (Vidal 1972). Near Alta, in western Finnmark, stromatolites were recognised by Holtedahl (1918) and Geukens & Moreau (1960) in the somewhat older Precambrian Raipas Group.

The Karlsøy marble has been traced almost continuously southwards through several overfolds to inner Malangen, about 40 km south of Tromsø. On Ringvassøy (Fig. 1), along Ullsfjord (Randall 1959, Munday 1974) and in the Malangen district (Landmark 1973) it is closely associated with one or more conglomeratic and sedimentary breccia horizons. Gustavson (1966, 1972) and Landmark (1973) have correlated the marble and conglomerates at Malangen with similar horizons in southern Troms and northern Nordland and observations made by the author support this match. Both Gustavson (1972) and Landmark (1973) believe that the psephites stratigraphically overlie the marble. Here, it should be remarked that the stromatolitic Porsanger Dolomite is unconformably overlain by the Varangian tillites.

Both Nicholson & Rutland (1969) and Landmark (1973) have suggested a correlation between the above-mentioned marble and psephites in Troms and the Fauske Marble Group of central Nordland. Nicholson & Rutland (1969) show that the Fauske marbles lie in a higher nappe than the fossiliferous Middle Ordovician formation there, and they suggest a possible stratigraphic correlation with a marble which seems to stratigraphically underlie the fossil-bearing rocks.

Nothing definite can be said yet about the age of the Karlsøy marble, although the evidence points to a correlation with the Porsanger Dolomite. The stromatolite forms themselves bear no similarity to those seen in the older Precambrian Raipas rocks, but their general appearance strongly resembles some of the columnar forms in the Porsanger Dolomite. Their very presence strengthens the chances of a pre-Palaeozoic age because stromatolites were much more numerous in Late Precambrian times than afterwards (Hofmann 1973). An attempt is being made to find microfossils within the stromatolite structures and also in specimens taken from other localities of the same marble. Chances of their preservation are not high in view of the metamorphic grade (Downie et al. 1971, Downie, written communication, Hofmann, written communication). Less metamorphosed pelites close to the marble in Ullsfjord may prove more fruitful.

More detailed field work will be carried out on Karlsøy and along a zone stretching over 100 km south and south-west of there, and this will hopefully reveal more concrete information on the age of the rocks concerned.

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