STROMATOLITES AND THE BIOSTRATIGRAPHY OF THE AUSTRALIAN PRECAMBRIAN

with appendices on pseudofossils from Australian Precambrian iron-formation and greywacke

Volume I

by

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Frontispiece

Top: Stromatolites in the intertidal zone of Shark Bay, Western Australia. The large stromatolites in the foreground are dead but living algal mats (dark grey) bind sediments between these and the dunes. Spade and haversack indicate scale.

Bottom: Algheringa narrina on ripple marks, Pillingini Tuff, Nullagine Basin. This is one of the two oldest known Australian stromatolites (about 2190±100 m.y.). Scale 5mm.

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SUMMARY

A study has been made of Precambrian and Cambrian columnar stromatolites from the Amadeus, Georgina, Nullagine and McArthur Basins and the Antrim Plateau Volcanics. A very detailed field and laboratory study of those from the Amadeus Basin provides the basis for a critical review of stromatolite taxonomy in which it is concluded that taxa with stable, distinct, character combinations can be defined. It is found that the taxonomic significance of morphological features is variable. Modifications suggested for the present classification result in a reduction in the number of taxa and possibly also in the further temporal restriction of some groups. Observation of growing stromatolites and a study of the literature on modern algae and stromatolites allows some biological interpretation of the classification. From the limited data available it is concluded that there are differences in gross plant shape between some algal taxa and upon plant shape depends stromatolite lamina shape; there is a correlation between lamina shape and other morphological features of stromatolites. A brief study of lithofacies relationships shows that different stromatolites occur in identical rocks and similar stromatolites are found in different rocks, supporting the conclusion that more than just the environment of growth determines the shape of stromatolites. The environment of growth of certain Amadeus Basin stromatolites is compared with that at Shark Bay, Western Australia.

The eighteen taxa defined or identified and one tentatively identified are temporally restricted within the Precambrian and Cambrian of Australia. In the Amadeus Basin, eight forms occur in the Bitter Springs Formation, one in the Pertatataka Formation and one in the Pertaoorta Group. In the Nullagine Basin, two forms are known from the Fortescue Group, two from the Wyloo Group and two from the Bangemall Group. One form each is known from the McArthur and Georgina Basins and two from cherts in the Antrim Plateau Volcanics. The diverse assemblage from the upper Bitter Springs Formation is distinctive and very similar to that from the Umberatana Group of the Adelaide Geosyncline; it is unlike that of the lower Burra Group (Adelaide Geosyncline) with which the Bitter Springs Formation is usually correlated on lithological and stratigraphic grounds. Therefore the Umberatana Group and upper Bitter Springs Formation are placed in the same assemblage zone, younger than that of the lower Burra Group. This correlation is more precise than previously possible. The Bangemall Group assemblage (Nullagine Basin) is very similar to that of the lower Burra Group; the correlation of these units is consistent with evidence from isotopic dating.

Of the five taxa from the upper Bitter Springs Formation which are known in the USSR, two are exclusively Late Riphean, two Late Riphean and Vendian and one possibly only Vendian. Correlation with the Upper Riphean is consistent with other geological evidence and provides a more precise relative dating than previously available.

The Bangemall Group assemblage is found in the USSR exclusively in the Middle Riphean (1350±50 - 950±50 m.y.); this correlation confirms a shale dating of 1080±80 m.y. from the Bangemall Group. The Antrim Plateau Volcanics assemblage is most like Vendian assemblages in the USSR. The Georgina Basin Jacutophyton howchini is probably Early Cambrian but in the USSR Jacutophyton is only known from the Middle Riphean. This is considered to be an example of convergent evolution; several others are known but they are greatly outnumbered by the number of temporally restricted taxa without disjunct distributions.

Two of the Nullagine Basin assemblages are Early Proterozoic and different from those of the Riphean. This with a review of other Early Proterozoic stromatolite occurrences confirms the potential of stromatolites for zoning the Early Proterozoic as well as the Riphean.

Several aspects of stromatolite ecology are considered. Besides a study of ecology relevant to the taxonomy, it is found that stromatolites cannot be used to determine tidal ranges but may give clues to past atmospheric composition.

Finally, structures formerly described as fossils (including stromatolites) from Precambrian banded iron-formation of the Nullagine Basin and greywacke of the Pine Creek Geosyncline were

studied. Those from the iron-formation were found to have formed during diagenesis of the previously colloidal sediment. The greywacke structures are tectonically deformed sand volcanoes.