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ABSTRACTS OF PAPERS FOR PROCEEDINGS OF SYMPOSIUM ON LATE CAMBRIAN CORRELATIONS—MOSCOW:

1. THE BIOSTRATIGRAPHIC SIGNIFICANCE AND BIOLOGICAL AFFINITIES OF MICROFOSSILS FROM A NEWLY DISCOVERED PRECAMBRIAN STROMATOLITIC IRON FORMATION IN WESTERN AUSTRALIA

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The biostratigraphic significance and biological affinities of microfossils from a newly discovered Precambrian stromatolitic iron formation in Western Australia

by

M.R. Walter

Late in 1973 geologists using aeromagnetic maps produced by the Bureau of Mineral Resources, Geology and Geophysics discovered in Western Australia an iron formation with a granular texture, unlike the typical well laminated iron formations of the Hamersley Ranges. The presence of detrital granules indicated a similarity with the Gunflint and Biwabik Iron Formations of the Lake Superior region, which contain stromatolites and microfossils, and led to a search for such fossils here. The iron formation is interbedded with 6000 m of sediments in what is now called the Nabberu Basin.

Unattached stromatolites (oncolites) and microfossils have been discovered in the Nabberu Basin iron formation. The microfossil assemblage is indistinguishable from that in the Gunflint and Biwabik Iron Formations, and includes Gunflintia sp., Eoastrion spp., Kakabekia sp. and Huroniospora spp. These all occur within oncolites. The filamentous forms are frequently arranged with their filaments parallel to the laminae of the oncolites, and are intertwined, and unicellular and rosette-forming forms occur as clusters within masses of filaments. These distributions indicate that most or all of these micro-organisms lived within the oncolite-forming mats, and thus were benthonic.

The biological affinities of these microfossils are not always clear. Some examples of Gunflintia minuta from the Gunflint Iron Formation have been shown by Licari and Cloud to possess enlarged cells (heterocysts) which now occur only in cyanophytes ("blue-green algae"). No such enlarged cells have been found in the Western Australian examples, and they are rare in the Gunflint. Many G. minuta may have been filamentous bacteria. Huroniospora is probably a unicellular cyanophyte. Eoastrion is probably a bacterium, perhaps an iron- and manganese-oxidising form such as Metallogenium. The affinities of Kakabekia are unknown, although a famous extant homeomorph occurs in the soil near the walls of Harlech Castle. The microfossil assemblage is broadly comparable with present day examples of stromatolite-forming cyanophytic and bacterial mats.

The preservation of all the microfossils is as iron oxide replacements and moulds and is not as good as in the Gunflint. Because of this, identification is difficult, but there appear to be at least five species in common between the Nabberu Basin iron formation and the Gunflint (Gunflintia minuta, Huroniospora psilata, Eoastrion simplex, E. bifurcatum, Kakabekia umbellata). In contrast, the only possible microfossils known from the iron formations of the Hamersley Ranges are crude spheres of organic matter (these have been described by LaBerge). Thus the microfossil assemblages vary with sedimentary facies.

The biostratigraphic significance of the similarity of the North American and Western Australian assemblages is not clear, as very little is known about the time ranges of Precambrian microfossils of this type. However, all of these iron-formations seem to be of about the same age. The Nabberu Basin iron formation is older than 1100 m.y. and overlies the Archaean greenstones and granites; consideration of the regional geology leads to the conclusion that the iron formation is similar in age to those of the Hamersley Ranges, i.e. about 2000 m.y. old. The Gunflint and Biwabik Iron Formations are generally considered to be about 1900 m.y. old. The fact that nearly identical microfossil assemblages occur in widely separated rock units of similar ages encourages further investigation of the biostratigraphic usefulness of Precambrian microfossils.

STROMATOLITES OF THE AUSTRALIAN PRECAMBRIAN: USE IN INTRA- AND INTERCONTINENTAL CORRELATIONS

BY

W.V. Preiss and M.R. Walter

ABSTRACT

The authors' earlier work on Australian Precambrian stromatolites, applying the methods of study, classification and binomial nomenclature developed in the USSR, was aimed at testing and extending the Russian biostratigraphic scheme in another continent, and if possible, at using assemblages of stromatolites for intra- and intercontinental correlation. The initial results proved encouraging: analogues of the assemblages characterizing the subdivisions of the Riphean of the USSR were recognized in the major late Proterozoic successions of Australia. Correlations were proposed with the Middle Riphean, Upper Riphean and Vendian and these were supported by the radiometric age constraints then known. It should be pointed out that the assemblages are not identical to those of the USSR. Firstly, none contains all of the elements found in the Russian assemblages, and secondly, the majority of the elements are comparable only at group level, and constitute new forms, most of which have now been formally described.

We present here new data gained since publication of our initial investigations. In particular, new stromatolites have been identified from pre-Riphean sequences; some of these belong to groups previously known only in the Middle or Late Riphean. This has led us to be cautious in the use of stromatolite groups alone for intercontinental correlations. Moreover, the geographic restriction of individual forms poses severe limitations on their potential for correlation. We do not suggest that the biostratigraphic study of stromatolites be abandoned, but urge more systematic description and identification of stromatolites of all ages on all continents to determine the total time ranges of groups, forms and assemblages. In addition,

taxonomic concepts may need to be modified. More accurate radiometric dating of the sedimentary successions is essential to provide an objective framework to which to relate the time ranges, while alternative bio-stratigraphic techniques (e.g. using micro-fossils) will need to be further investigated.

In the Adelaide Geosyncline, in addition to stromatolites previously described from the Burra and Umberatana Groups, Tungussia f. and Linella f. have now been located in the Wilpena Group, just below the fossiliferous Pound Quartzite. Stratigraphic data indicate that these are probably of Vendian age. Acaciella cf. A. australica and Gymnosolen cf. G. ramsayi occur near the base of the Adelaidean succession, well below the Burra Group containing Baicalia burra. This is consistent with the base of the Adelaidean being of Late Riphean age, as is suggested (though not unequivocally) by recent geochronology.

In the Amadeus Basin, Tungussia f. is now known from the Julie Member, immediately underlying the fossiliferous Arumbera Sandstone, and is again of probable Vendian age. It appears to be identical at the form level to the Tungussia in the Wilpena Group of the Adelaide Geosyncline, thus supporting an interbasinal correlation that is often made on lithostratigraphic grounds.

At the south-eastern extremity of the Nabberu Basin (Western Australia), a younger sequence unconformably overlies earlier Proterozoic sediments which are at least 1700 m.y. old (K-Ar ages on glauconite). The younger sequence occurs as isolated outcrops with Acaciella f. indet. and Baicalia cf. B. burra, which is consistent with its inferred late Proterozoic age. The older sequence, with iron formations, contains in carbonate units new forms of Tungussia, Tarioufetia (a stromatolite with a distinctive tufted-acicular microstructure), Anabaria and possibly Minjaria and Kulparia. Such an assemblage might have been correlated with the Upper Riphean were it not for mapping and geochronological evidence to the contrary. The results indicate the caution needed in making such age assignments without either corroborating evidence, or identity (at form level) of stromatolite assemblages.