PR91-83

NORTHERN TERRITORY GEOLOGICAL SURVEY

TECHNICAL REPORT

RESULTS OF SAMPLING WALLARA Nº 1: EDIACARIAN ACRITARCH BIOSTRAT. OF THE CENTRALIAN SUPERBASIN.

Department of Mines and Energy

MACQUARIE UNIVERSITY

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NEW SOUTH WALES : 2109 : AUSTRALIA
TELEPHONE : (02) 805 7111 EXTN. 8357
TELEGRAPH & TELEX : MACUNI AA122377
FACSIMILE No. 02 / 805 8428

Ediacarian Project

18th June 1991

Dr Peter Sneep
Department of Mines and Energy, NT
P.O. Box 2655
ALICE SPRINGS, NT. 0871

Dear Peter,

Enclosed, as promised, are the lists of samples which Clive Calver and I collected from cores at your Core Store. There are some minor modifications (mainly tidying up the lithological descriptions), otherwise it is similar to the list you printed out.

I'd like to thank you once again for all the wonderful co-operation we received from you and your staff, in particular for making the vehicle available for our collecting trips. I would also like you to pass on a special thanks to Ernie Kilgariff at the core store. His help was invaluable, and to have access to such well-curated material speeded up our task considerably.

The Wallara #1 core looks particularly impressive and should provide us with extremely valuable data. - It must be one of the most complete sections of the Pertatataka Formation

available and will be a valuable reference section for many years to come. I hope you will be able to transfer the core trays into the shed before too long to prevent the core deteriorating. Much of it is shale, which will probably expand and crumble with repeated wettings, and we noticed that some of the numbers on the trays were already fading and becoming illegible.

We will keep you informed of the progress of our work, and will submit copies of any papers published as a result of our studies. I have also made a note to send you a copy of my thesis when it is ready.

Thanks again for all your help.

Yours Sincerely

Kathleen Grey

KATHLEEN GREY.

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June 3rd 1994

Peter Snepp
Northern Territory Geological Survey.

Dear Peter,

As promised Steve Grant is returning a box of unprocessed core and some processed residue from my thesis work. Malcolm has retained a small amount of material for further processing by an MSc student who should follow up some of my work.

I return to Perth on June 24th and will be back at GSWA on August 1st. I'm trying to complete the photography before I leave and will get as much as possible written up before I start work again. I estimate that I am about 3 months away from finishing, so it's a bit unfortunate that I couldn't get a further extension to get everything completed.

I've enclosed a copy of my GSA conference abstract to update you on progress. My results generally tie in with Clive Calver's, although one or two areas of dispute remain. I'll send relevant parts of the thesis once it is completed.
Thanks for making material available and for all your help.

Kath Grey,

EDIACARIAN ACRITARCH BIOSTRATIGRAPHY OF THE CENTRALIAN SUPERBASIN

Kathleen Grey
School of Earth Sciences Macquarie University NSW 2109
(current address: Geological Survey of Western Australia 100 Plain St. EAST PERTH WA 6004)

Summary - Neoproterozoic acritarchs show good potential for biostratigraphic zonation because of their complexity and taxonomic diversity. Palynological studies were designed to complement ongoing investigations of the tectonic framework, lithostratigraphy, sedimentology, general palaeontology and isotope geochemistry of the Centralian Superbasin (comprising the Amadeus, Officer, Georgina, Ngalia and Savory Basins). Studies focussed on Supersequence 3, the interval between the end of the Marinoan glaciation and the sandstones straddling the Proterozoic/Cambrian boundary.

INTRODUCTION

The discovery of acritarchs in the Neoproterozoic Pertatataka Formation of the Amadeus Basin (Zang and Walter, 1992), prompted a more widespread analysis of their biostratigraphic potential as part of an investigation of the Ediacarian of Australia being carried out at Macquarie University. Over 1000 drillcore and field samples were processed from the Centralian Superbasin and coeval Adelaide Geosyncline. At least 50 well-defined acritarch species and another 50 morphological variants of less certain status have been documented so far, mainly from the Rodda beds in Munta-1, Ungoolya-1, Observatory Hill-1, and Lake Maurice West-1 (Officer Basin), the Arcoona Quartzite in SCY W1a (Stuart Shelf), and the Pertatataka Formation in Rodinga-4 and Wallara-1 (Amadeus Basin). Field sections, particularly those of the proposed global statatype for the Ediacarian System in the Flinders Ranges, were barren. However, the drillholes can be tied to the Flinders Ranges sections by means of several important marker horizons, such as the Acraman impact ejecta horizon.

ACRITARCH BIOSTRATIGRAPHY

Systematic documentation of the assemblages recognized is in progress. A few species have been recorded elsewhere, e.g. *Tanarium irregulare* and *Tanarium conoideum* from the Khamaka Formation in Siberia (Moczydlowska et al. 1993), and some genera have widespread geographic and stratigraphic distributions. Several taxa have previously only been found in thin sections of chert. However, many species are new, and specimens are present in sufficient numbers to allow statistical analysis of taxonomic characteristics.

Not all variation is biological. Some is the product of degradation, i.e. of changes resulting from decay and decomposition. Preservational differences have been documented because they not only influence perceptions of biodiversity, but also encode data about taphofacies (postmortem environments). Taphonomic variation is particularly noticeable in comparisons of assemblages from the Rodda beds and Pertatataka Formation, highlighting different burial histories between the Amadeus and Officer Basins. Biostratigraphic analysis is not only constrained by taphonomy, but also by facies-related distributions. Other limitations result from intervals of poor preservation in some strata and from erratic taxonomic abundances. Some distinctive species are represented by only one or two specimens, while others occur abundantly but sporadically, e.g. hundreds of specimens of *Octoedryxium truncatum* may dominate a single sample (indicating an algal bloom). Such species may be significant if it can be demonstrated elsewhere that the range is narrow.

In spite of taphonomic and palaeoenvironmental complications, a broad biostratigraphic framework has been deciphered. Several palynofacies have been identified, and can be categorized as: acanthomorph-dominated, leiosphere-dominated, filament-dominated, benthic-mat-dominated or palynodebris-dominated. It is also possible to identify some broad palaeogeographic contraints, with filaments and robust-walled acritarch species dominant in inner shelf environments, and deeper water characterized by abundant thin-walled spiny forms, and forms having complex, ramifying branches. Palynofacies assist palaeoenvironmental determination, and once they have been recognized, a clearer picture of palynomorph evolution emerges.

Biostratigraphically the successions comprise a post-glacial interval that is more or less barren, overlain by a leiosphere-dominated assemblage, followed by an interval of poor preservation, then by an interval of well-

preserved highly diverse spiny acritarchs capable of division into three assemblage zones, and finally by a return to an interval of poor preservation.

The Marinoan is represented by glaciogenic sediments of the Elatina Formation in SCYW1a and the Pioneer Sandstone in Wallara-1, and is overlain in both drillholes by shales probably equivalent to the Brachina Formation. This part of the succession contains a sparse assemblage of fossils of uncertain affinities (possibly fungal), but is mainly devoid of palynomorphs. A rich assemblage of *Leiosphaeridia* spp. occurs in overlying sandy intervals, probably equivalent to the ABC Range Quartzite, in both drillholes. At present it is not clear whether this assemblage is biostratigraphically significant or facies controlled. The overlying interval is more or less barren in SCYW1a and not present in Wallara-1. The extent of the sample gap is uncertain, but the upper Pertataka Formation in Rodinga-1, which is probably equivalent to the Bunyeroo Formation and part of the Wonaka Formation, contains a rich assemblage that can also be traced in the Rodda beds of Munta-1, Observatory Hill-1 and Lake Maurice West-1. This diverse and well-preserved palynoflora can be divided into three assemblage zones. The lowermost is characterized by *Alicesphaeridium medusoidum* and *Gyalosphaeridium pulchrum*, the middle zone is marked by the first appearance of *Mutifronsphaeridium pelorium*, and the upper zone is dominated by several new species with complex morphologies, including apical-horned forms and forms with process-supported membranes. In Munta-1 and Ungoolya-1 part of the succession is replaced by sparse assemblages of degraded filaments and rare, degraded acritarchs that coincide with the 'Canyon-cutting event' of the Wonoka Limestone.

Part of the rich assemblages in Observatory Hill-1 are probably co-eval with the Julie Formation of the Amadeus Basin. The assemblages contain wall structures and morphologies commonly found in Phanerozoic acritarchs, but species are 5 to 10 times the size of their younger counterparts. Moreover, most samples examined appear to be devoid of the acritarchs in the 25 to 50 μm size range that are typical of younger assemblages. The upper three assemblages immediately pre-date first records of the "core" Ediacaran fauna, and the acritarch record in the latest part of the Proterozoic succession, i.e. those parts containing evidence of a metazoan fauna, is poor. However, complex morphologies and large sizes have not been observed in this part of the succession, and the assemblage seems to consist mainly of degraded spheres and rare, small, acanthomorphs. The significance of the size difference and the distribution of the highly complex morphological types typical of the upper Pertataka Formation and Rodda beds requires further assessment because of its possible relationship to the first appearance of the Ediacaran fauna

CONCLUSIONS

Recognition of a tentative zonation for part of the Neoproterozoic will aid hydrocarbon and mineral exploration over a wide area of Australia, and should prove valuable for stratigraphic analysis of Neoproterozoic basins both in Australia and globally. In particular, the Ediacarian of the Centralian Superbasin contains species also found in the Khamaka Formation, a gas reservoir of the hydrocarbon-producing Neoproterozoic rocks of the Siberian platform. Although further refinement of the zonal scheme is required, preliminary indications are that the Late Neoproterozoic is capable of biostratigraphic subdivision in a manner similar to younger Phanerozoic sucessions.

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