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Artikel: Late Aptian-Early Albian radiolaria of the Windalia radiolarite (type section), Carnarvon Basin, Western Australia
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1. Introduction

During the Late Aptian-Early Albian widespread deposition of radiolarian-rich facies occurred on the Australian continent. Deposition of these sediments coincides with one of the most extensive marine transgressions to have affected Australasia (Morgan 1980; Frakes et al. 1987), and as such, records a significant regional and possibly global palaeoceanographic event. Despite this, Australian Mesozoic radiolaria have been neglected by stratigraphers and palaeontologists. This is even more surprising considering that the presence of radiolaria in Lower Cretaceous rocks has been known since 1893,

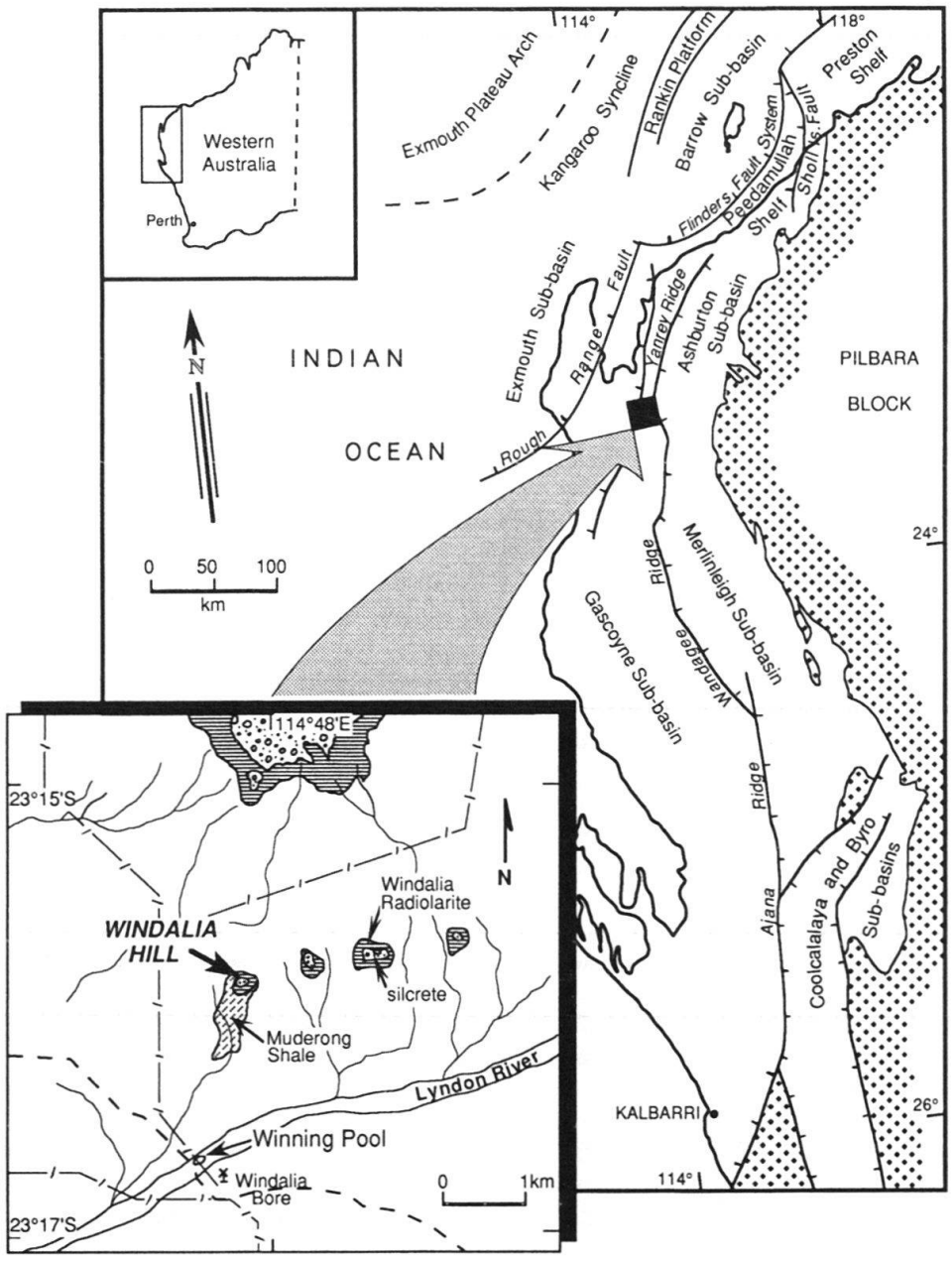

Fig. 1. The Carnarvon Basin, Western Australia – showing major tectonic elements and structural subdivisions, and location of the type section of the Windalia Radiolarite.

when G. J. Hinde described several forms from outcrops at Darwin, Northern Territory. More recently, Lloyd (1963, 1966), Haig & Barnbaum (1978), Ellis (1987) and Ellis et al. (1991) recorded early Cretaceous assemblages from the onshore Canning and Bonaparte (Western Australia and Northern Territory), Surat (Queensland) and Carnarvon (Western Australia, see Fig. 1) Basins respectively. These works (much of which is outdated by significant changes in classification in recent years) still represent the only systematic accounts of the Australian radiolarian fauna from onshore sections.

The Windalia Radiolarite in the Carnarvon Basin, Western Australia, represents one of the best exposed portions of the Australian Aptian-Albian radiolarian-depositional event. It is part of a siliciclastic third-order transgressive marine sequence (Fig. 2), the Winning Group ("Mz4b" following the sequence-based depositional framework of Hocking 1988), that was deposited following plate separation of "Greater India" from Australia in the Valanginian-Hauterivian. It is a neritic water depth hemipelagic sediment deposited within a tectonically-passive coastal epeiric basin, and contrasts with the better known Tethyan radiolarites generally assumed to be deeper water in origin. This paper presents the radiolarian fauna recovered from the type section of the Windalia Radiolarite (Figs. 1 and 3), and represents the first detailed published study of Australian Lower Cretaceous radiolaria. It is not the intention here to detail the Australian mid-Cretaceous radiolarian-depositional event, nor to outline possible depositional models in a regional context. This is the subject of ongoing research, results of which will be reported in a future publication.

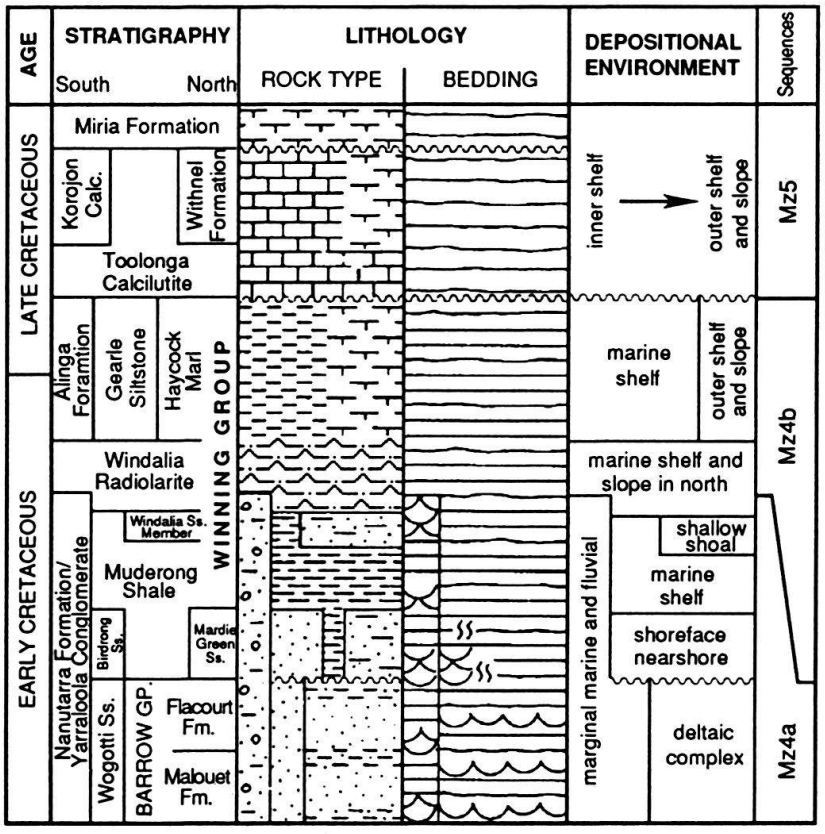

Fig. 2. Stratigraphic column and depositional sequences for Cretaceous sediments of the Carnarvon Basin, Western Australia (after Hocking 1988).

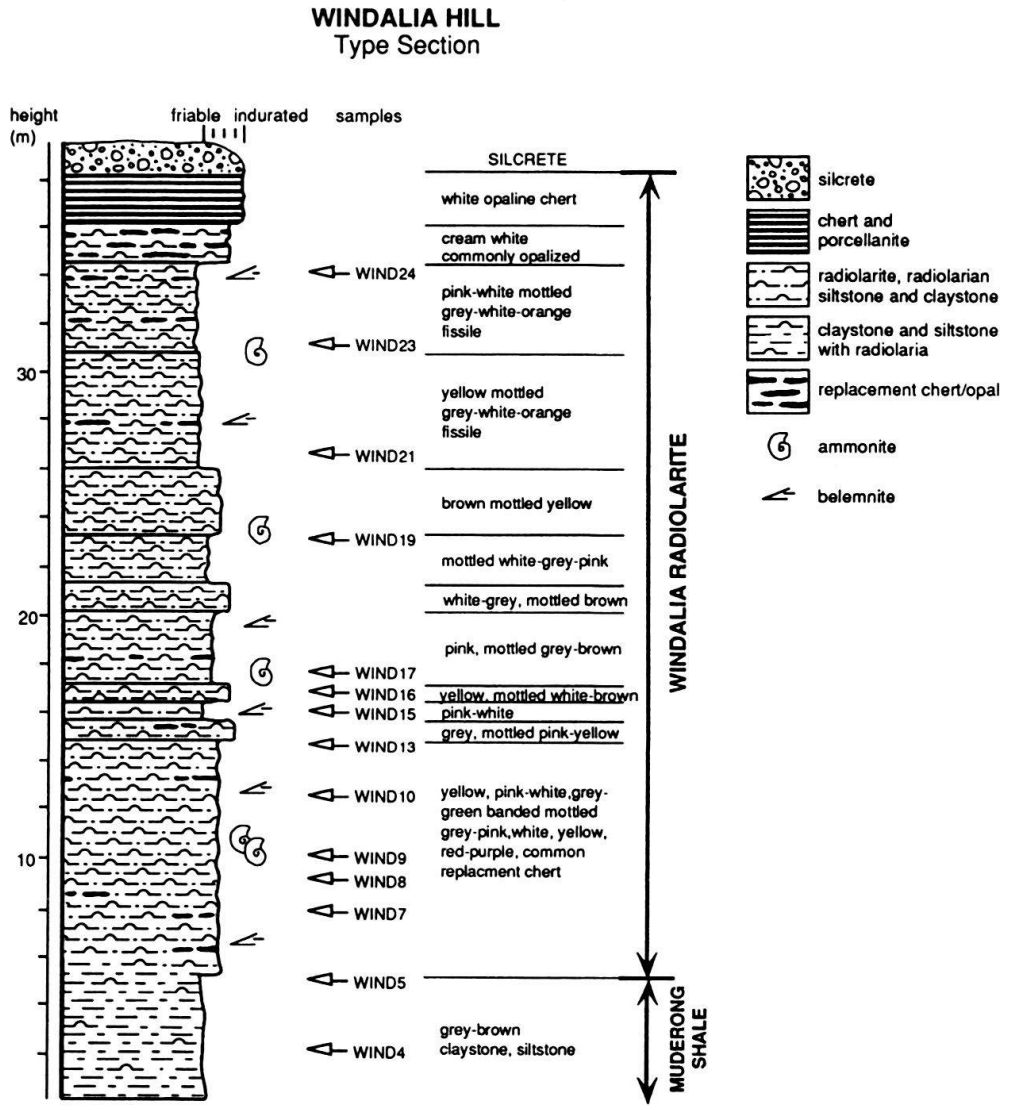

Fig. 3. Lithological column of the type section of the Windalia Radiolarite at Windalia Hill; showing distribution of collected samples used in this study.

Previous work

Radiolaria are the dominant fossil group in the Windalia Radiolarite. Despite their abundance and good preservation, relatively few species have been recorded: Chapman (in: Raggatt 1936) listed 3 species from the formation on Winning Station; Crespin (1946) recorded 23 forms from the type section and numerous other localities; Edgell (1952) identified 11 species from outcrops in the Giralia Anticline about 50 km west of the type section; Glaessner (1955) identified 7 species from near Kalbarri in the southern part of the Carnarvon Basin. None of these works illustrated the fauna and their identifications mainly followed the taxonomy of Hinde (1893). The subsequent vast reorganization of radiolarian classification has made many of the previous generic and specific identifications superfluous or, at best, difficult to apply.

The age of the Windalia Radiolarite has been based previously on associated foraminifera and megafossils. Whitehouse (1926, 1927) suggested the Windalia to be equivalent in age to the Tambo Series (Albian) in Queensland based of the presence of similar belemnites. Raggatt (1936) considered the Winning Group to be Upper Albian and equivalent to the radiolarian rocks described by Hinde (1893) from the Northern Territory. Condon (1954) attributed a Late Cenomanian age for the Windalia Radiolarite based on foraminifera identified by Edgell (1952) and on the presence of large discoidal ammonites belonging to the Family Acanthoceratidae. Subsequent foraminiferal studies by Glaessner (1955) and Belford (1959; for the succeeding Gearle Siltstone), and reinterpreted ammonite identifications, which include the Family Aconoceratidae, by Brunnschweiler (1959) place the Windalia Radiolarite within the Late Aptian to Early Albian.

2. Material and methods

Assemblages examined for this study come from the type section of the Windalia Radiolarite at Windalia Hill (Lat. 23°16'S, Long. 114°48'E) on Winning Station (Fig. 1). Only the lower part of the formation is exposed, conformably overlying the Muderong Shale (2 samples of which are used in this study). A detailed lithostratigraphy of the type section is given below and in Fig. 3. A total of 25 samples were collected, of which 14 were analyzed for their radiolarian (and other fossil) content. Selection of samples for processing was based on observed freshness and friability. Sample preparation generally followed standard foraminiferal processing techniques. About 5 cm^3 of sample was broken down to mm-sized pieces and then boiled with sodium pyrophosphate (Calgon™) and a small amount of 10% hydrogen peroxide. Successive drying and retreatments were necessary to assist disaggregation of samples with high clay contents. The sediment was then washed through 150 μm and 63 μm sieves to remove the clay. Final residues were dried and stored in plastic vials.

The 63–150 μm and 150 μm-2 mm size fractions were examined and the fossil residue (radiolaria, foraminifera, sponge spicules) placed on a counting tray and collected into grided cardboard slides. The characteristics of the radiolarian thanatoconoesis for each sample were first noted on a minimum representative count of 300 specimens. The entire residue from each sample was then searched several times for rare taxa and well-preserved forms for illustration. This ensured a better perception of the true distribution of specific radiolaria that may have been unevenly dispersed on the counting tray due to size and/or shape. Qualitative estimates of species abundance are tabulated in Table 1.

Preservation of the radiolaria ranges from very poor to good. Compaction of the sediment during lithification has resulted in many broken specimens, and preservation of the finer structures of some radiolaria is rare. With many specimens superficial clay still adhered to surfaces after washing the sediment, and it was necessary to use vigorous additional cleaning (e.g. ultrasound, reboiling and sieving) to aid determinations. Unfortunately, these techniques resulted in broken specimens. The radiolaria are illustrated by scanning electron micrographs taken with a PHILLIPS SEM 505 at the University of Western Australia and with a CAMSCAN Series 4 SEM at the Université de Lausanne. Specimens were mounted onto SEM plugs using double sided tape and then coated with carbon and gold in a vacuum evaporator. The amount of coating required to prevent "charging" varied with shell type and preservation. Generally, forms with spongy tests (e.g. Spongodiscacea) required a heavier coating than forms having latticed meshwork. Transmitted light identification of some radiolaria was carried out using immersion oil or by preparing strewn slides with molten "Lakeside Cement™". Although these are quick techniques allowing viewing of internal structures, the slides are generally of poor quality and the resulting photographs are not suitable for publication.