Material and methods

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.

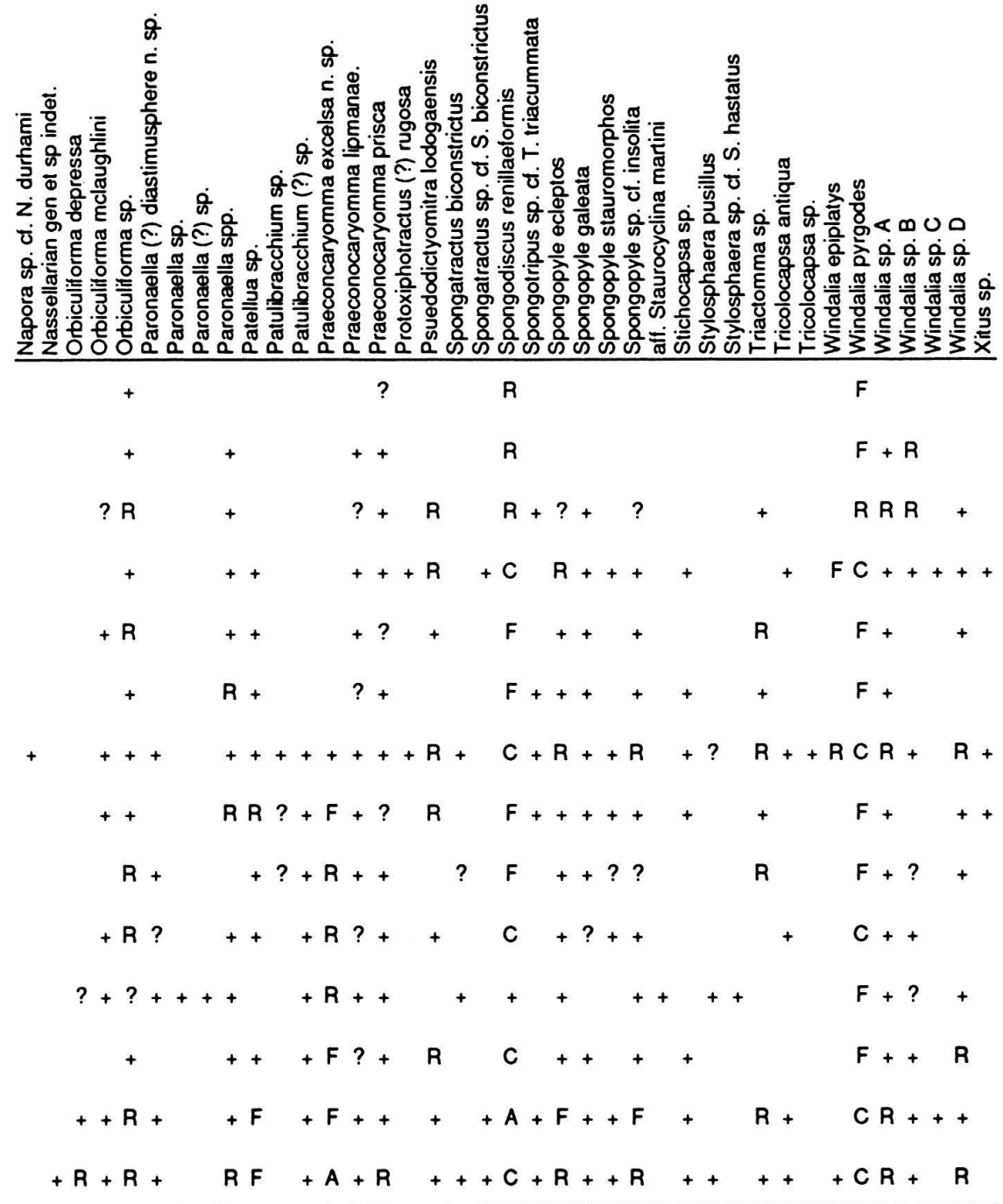
Preservation of the radiolaria ranges from very poor to good. Compaction of the sediment during lithification has resulted in many broken specimens, and preservation of the finer structures of some radiolaria is rare. With many specimens superficial clay still adhered to surfaces after washing the sediment, 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.

Tab. 1. Distribution of radiolaria from the type section of the Windalia Radiolarite at Windalia Hill.

	TAXA	Acaeniotyle diaphorogona	Acaeniotyle longispina	Acaeniotyle sp. cf. A. diaphorogona	Acaeniotyle (?) sp. A	Acaeniotyle (?) sp. B	Actinommid gen. & sp. indet	Actinomma (?) pleiadesensis	Alievium (?) sp. A	Alievium (?) sp. B	Amphipyndax stocki	Angulobracchia crassa	Arachnosphaera exilis	Archaeocenosphaera euganea	Archaeodictyomitra sliteri	Archaeodictyomitra vulgaris	Archaeospongoprunum carrierensis	Archaeospongoprunum diversispina	Archaeospongoprunum klingi	Archaeospongoprunum sp. cf. A. tehaemaensis	Archaeospongoprunum sp. cf. A. praelongum	Archaeospongoprunum sp.	Artocapsa ultima	Crucella messinae	Crucella sp.	Cyrtocalpis operosa	Dicanthocapsa sp. cf. D. ancus	Gonglyothorax cephalocrypta	Haliomma sp.	Hemicryptocapsa sp. cf. H. simplex	Histiastrum aster	Holocryptocanium barbui barbui	Mesosaturninus hueyi group	Mita sp.	Napora dumitricai
WINDALIA RADIOLARITE	WIND 24		+	+			+	R				+	A		+					+				+						+				
	WIND 23	+	+	+	+		R	R			?	+	C		+					+	+			+						+				
	WIND 21	+	+				R	R		?	+	+	C		+	+		?	?	+		?		+		+				+		?		
	WIND 19	+	R	R	+	+	R	C		+	+	+	A	+	+	+		R		+	+			R		+	+			+		+		
	WIND 17	+	+			?	R	F			+	+	A	+	+					+	+			R		+				+				
	WIND 16	?	?	R			R	F			+	+	A	+	+		R			+			+	R			+							
	WIND 15	R	R	R	+	+	R	C		+	+	+	A	R	+	R	+	+	+	R	R	+	+	F	?	R	+	R	+		+	+		+	+
	WIND 13	+	+	+		?	F	F			+	R	A	+	+	+				+	+			F		+				+				+
	WIND 10	+	+	+		+	F	F	+			+	A	+	+	+	+			R	+			R		+		+						
	WIND 9	+	+	+			F	C			+	+	A	+	+					+	R		+	R		+	+							
	WIND 8	+	+		+	?	+	+	+		+	+	C				+	+		?	?	+	+	+		?					?	+		
	WIND 7	+	R	R		?	F	C			+	R	A		+	+				R	R	+		F		+		+		+				
Muderong Shale	WIND 5	+	R	R	+		C	A			R	+	A	R	+	+	+			+	+	+	+	R		R	+	R		R		+		
	WIND 4	R	R	F	+	?	C	A		+	R	R	A	R	+	+	?			+	R	+	+	R	+	R	+	R	+	R	+			

Species abundance is defined as follows:

A = abundant	– more than 30 specimens per 300
C = common	– 15–29 specimens
F = few	– 3–14 specimens
R = rare	– 1–2 specimens
+ = very rare	– fewer than 2 specimens per 1000
? = doubtful identification	


Napora sp. cf. N. durhami
Nassellarian gen et sp indet.
Orbiculiforma depressa
Orbiculiforma mclaughlini
Orbiculiforma sp.
Paronaella (?) diastimusphere n. sp.
Paronaella sp.
Paronaella (?) sp.
Paronaella spp.
Patellua sp.
Patulibracchium sp.
Patulibracchium (?) sp.
Praeconcaryomma excelsa n. sp.
Praeconcaryomma lipmanae.
Praeconcaryomma prisca
Protoxiphotractus (?) rugosa
Psuedodictyomitra lodogaensis
Spongatractus biconstrictus
Spongatractus sp. cf. S. biconstrictus
Spongodiscus renillaeformis
Spongotripus sp. cf. T. triacummata
Spongopyle ecleptos
Spongopyle galeata
Spongopyle stauromorphos
Spongopyle sp. cf. insolita
aff. Staurocyclina martini
Stichocapsa sp.
Stylosphaera pusillus
Stylosphaera sp. cf. S. hastatus
Triactomma sp.
Tricolocapsa antiqua
Tricolocapsa sp.
Windalia epiplatys
Windalia pyrgodes
Windalia sp. A
Windalia sp. B
Windalia sp. C
Windalia sp. D
Xitus sp.