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Microfossil *Bolboforma* (Chrysophyta) from Tertiary glacio-marine sediments of King George Island, West Antarctica

ABSTRACT: The algal microfossil *Bolboforma reticulata* Daniels and Spiegler is recorded from the Oligocene-Miocene glacio-marine sediments of King George Island, South Shetland Islands, Antarctica. The record extends the geographic extent of the species to Antarctica.

Key words: Antarctica, Oligocene-Miocene, micropaleontology (Algae).

Introduction

The genus *Bolboforma* Daniels and Spiegler (1974) is a stratigraphically and paleogeographically useful microfossil which has been recorded from late Middle Eocene to Pliocene strata of temperate to cool regions in both the Northern and Southern Hemisphere (*cf.* Daniels and Spiegler 1974, Rögl and Hochuli 1976, Poag and Karowe 1986, Spiegler and Daniels 1990). Algal (Chrysophyta) affinities of the genus were recently recognized by Spiegler (1987) *see also* Rögl and Hochuli (1976).

At the present time *Bolboforma* is represented by more than 40 species (*see* Spiegler 1987). One of them—*Bolboforma reticulata* is reported here for the first time from Antarctica.

The investigated specimens are housed in the Institute of Paleobiology, Polish Academy of Sciences, Warsaw (abbreviated ZPAL).

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Geological setting

On King George Island the Lower Oligocene glacio-marine sequence of the Low Head Member (Polonez Cove Formation), which contains the specimens of *Bolboforma reticulata*, is exposed at Low Head (Fig. 1, see also Gaździcki

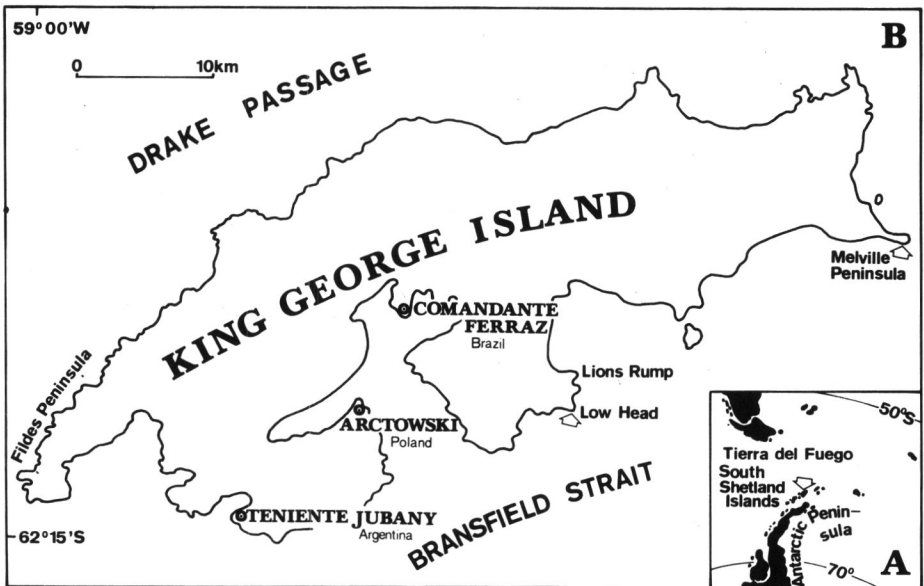


Fig. 1. Position of King George Island (arrowed) in the South Shetland Islands archipelago (A) and location of sampling sites of the Polonez Cove Fm. at Low Head and the Cape Melville Fm. on Melville Peninsula (B)

and Pugaczewska 1984, Pl. 1, Fig. 1a; Pl. 2). The Low Head Mb. (= *Pecten* Conglomerate of Barton 1965) consists chiefly of basaltic conglomerates with intercalations of sandstones and shales up to 20 m thick (Birkenmajer 1987, Porębski and Gradziński 1987). Moreover, the Low Head Mb. is the richest fossil-bearing unit of the formation, containing *Chlamys* coquinas which occur as clusters and thin beds within this unit (Gaździcki 1984). The sedimentological study and the whole biota assemblage confirm a shallow marine, high-energy environment for the Low Head Mb. (Porębski and Gradziński 1987).

The *B. reticulata* has been also recognized in the Lower Miocene glacio-marine strata of the Cape Melville Formation on the top of the Melville

Peninsula plateau in the Crab Creek area (Fig. 1, *see also* Birkenmajer, Gaździcki and Wrona 1983, Fig. 2; Gaździcki and Wrona 1986, Fig. 6). The formation (about 200 m thick) is represented by clay-shales with siltstones, sandstones and marly intercalations and is very rich in well preserved marine fossils (Birkenmajer, Gaździcki and Wrona 1983). Moreover, the whole biotic assemblage suggests a deeper, outer shelf environment (*cf.* Gaździcki *ed.*, *et al.* 1987).

Both glacio-marine sequences of King George Island containing *B. reticulata* also yield ice-rafted dropstones of Antarctic continent provenance which provide geological evidence for the Tertiary glacial events known as the Polonez and Melville Glaciations (*for details see* Birkenmajer 1987, 1989 *this volume*).

Material and mode of preservation

More than thirty samples (usually up to 1 kg) from the Oligocene-Miocene glacio-marine sediments of King George Island were washed on a 50 μm sieve and the foraminifers and other microfossils picked out. Among them, five specimens of *B. reticulata* were found in the samples A-11 (3 specimens) and CC (2 specimens).

The sample A-11 from the Low Head Mb. (*cf.* Fig. 1, *see also* Gaździcki 1989, Fig. 3) represents the *Chlamys* conglomerate which is rich in fossils and contains mixed faunas, including elements from different habitats (Gaździcki and Pugaczewska 1984). The maceration of about 10 kg rocks of the *Chlamys* conglomerate in Glauber salt yielded 3 specimens of *B. reticulata*. Associated microfossils are represented by calcareous nannoplankton (Gaździcka and Gaździcki 1985 *see also* Birkenmajer, Dudziak and Tokarski 1988), rich benthic and rare planktonic foraminifers (Gaździcki 1989) as well as ostracods (Błaszczuk 1987). The presence of planktonic foraminifer species *Globigerina angiporoides* Hornibrook in this assemblage and the results of studies of the $^{87}\text{Sr}/^{86}\text{Sr}$ isotope ratio on stromatolites from the studied sequence, suggest that the Low Head Mb. is of Early Oligocene age. (*cf.* Gaździcki 1989).

The sample CC from the Crab Creek area on the top of the Melville Peninsula (*cf.* Fig. 1) represents marly shales of the upper part of the Cape Melville Fm., dated as Early Miocene (*see* Birkenmajer 1987, 1989 *this volume*). Associated fossils include diatoms, radiolarians, benthic foraminifers (Birkenmajer and Łuczowska 1987), as well as solitary corals, gastropods, bivalves and homolodromid crabs (*cf.* Gaździcki *ed.*, *et al.* 1987).

The specimens of *B. reticulata* from the sample CC (Pl. 1, Fig. 1—2; 4) which represent a deeper, outer shelf environment for the Cape Melville Fm., are very well preserved, in contrast to the abraded specimens (*cf.* Pl. 1, Fig. 3)

from the shallow-marine, high-energy environment of the Low Head Mb. (sample A-11).

Daniels and Spiegler (1974) *see also* Poag and Karowe (1987) reported that *Bolboforma* specimens have a monocrystalline calcitic test (*i.e.* composed of a single calcite crystal). It should be noted that the EDAX analysis of the *B. reticulata* specimens from King George Island also shows the presence of silica in the test. The most probable explanation for the presence of silica is the replacement of primary mineral of the test (*cf.* Szczechura 1986).

Age and distribution of *Bolboforma reticulata*

Previous records indicate that *B. reticulata* comes from Upper Eocene to Lower Pliocene strata with the majority of occurrences dating from the Miocene Epoch (Poag and Karowe 1986, Fig. 6; Spiegler and Daniels 1990). Moreover, this species is geographically widespread (Poag and Karowe 1986). The occurrence of *B. reticulata* in the Tertiary glacio-marine sediments on King George Island extends the southern limit of the geographic extent of the species from the western South Pacific Ocean (DSDP Site 592, Lord Howe Rise) to Antarctica.

Systematic paleontology

Family **Bolboformaceae** Spiegler, 1987

Genus *BOLBOFORMA* Daniels and Spiegler, 1974

Bolboforma reticulata Daniels and Spiegler, 1974

(Pls 1—2)

1990. *Bolboforma reticulata* Daniels and Spiegler; Spiegler and Daniels, Pl. 4, Figs 6—11 (*cum syn.*)

Material. — Five specimens, ZPAL Al. VII/1—5.

Dimensions of the test (*in microns*): diameter — 100—120.

Remarks. — The specimens of the *Bolboforma reticulata* recovered in small numbers from the Oligocene-Miocene glacio-marine sediments of King George Island are circular in apertural view (Pl. 1, Figs 2—3), and slightly abaperturally flattened in lateral view (Pl. 1, Fig. 1). They consist of a single spherical chamber with a circular aperture sometimes defined by a collar which is about 30 μm in diameter (Pl. 1, Figs 2, 4). The test surface is ornamented by polygonal reticulations varying in size and shape (Pl. 2, Figs 1—2).

Occurrence. — West Antarctica, King George Island: Low Head Mb. of the

Polonez Cove Fm. (Lower Oligocene) and the Cape Melville Fm. (Lower Miocene). For detail stratigraphic and geographic distributions see: Spiegler and Daniels (1990).

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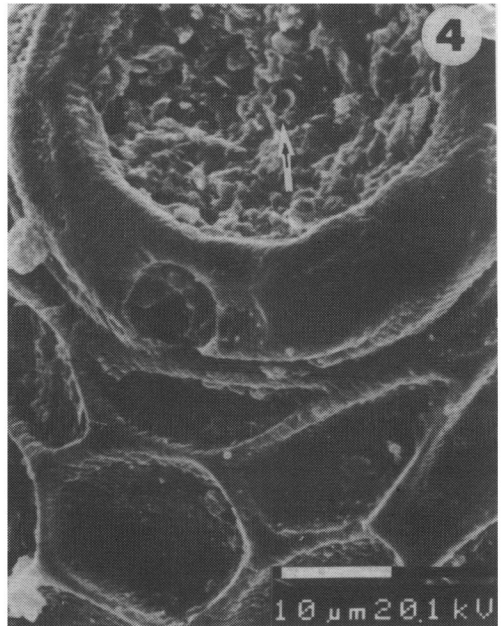
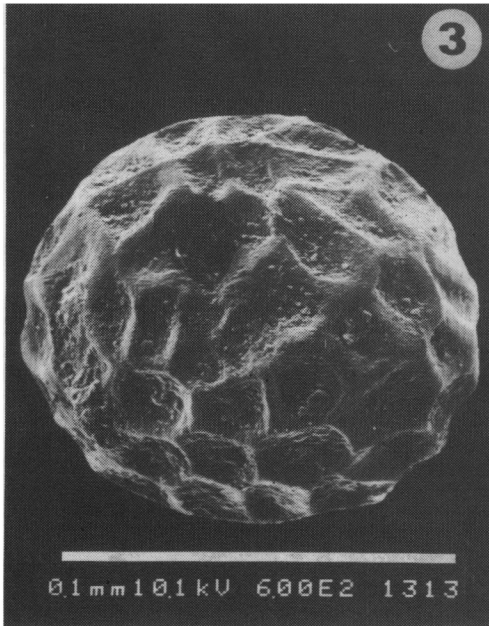
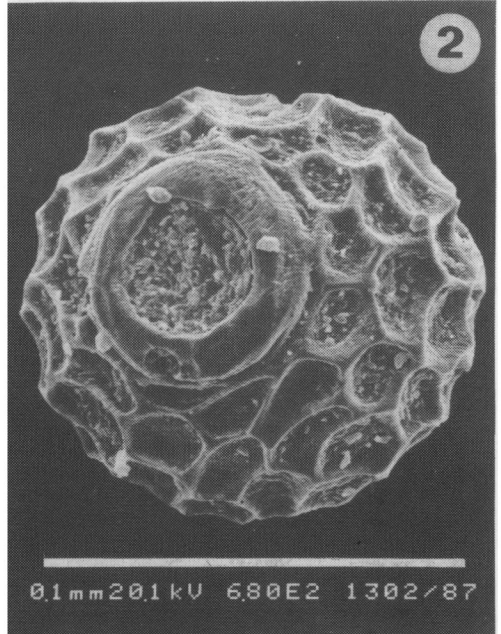
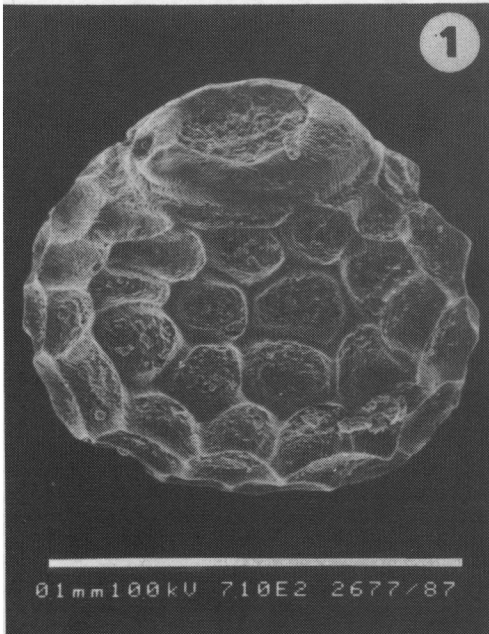
Streszczenie

W oligoceńsko-miocenijskich utworach morsko-lodowcowych Wyspy Króla Jerzego w Sztetlandach Południowych (Antarktyka Zachodnia) stwierdzono obecność mikroskamieniałości glonowej z gatunku *Bolboforma reticulata* Daniels et Spiegler, 1974 (*zob.* fig. 1, pl. 1—2). Jednocześnie takson ten jest po raz pierwszy sygnalizowany z Antarktyki.

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Added in proof

The preprint quoted here as Spiegler and Daniels (1990) *in press* is submitted to Journal of Foraminiferal Research (D. Spiegler, *pers. comm.*, March 1990).

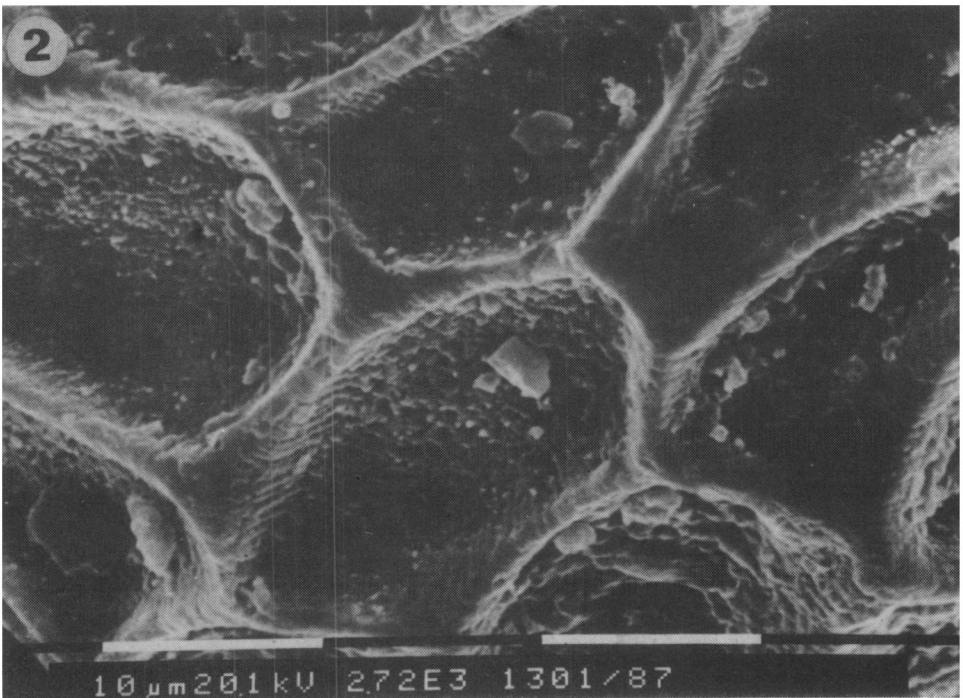
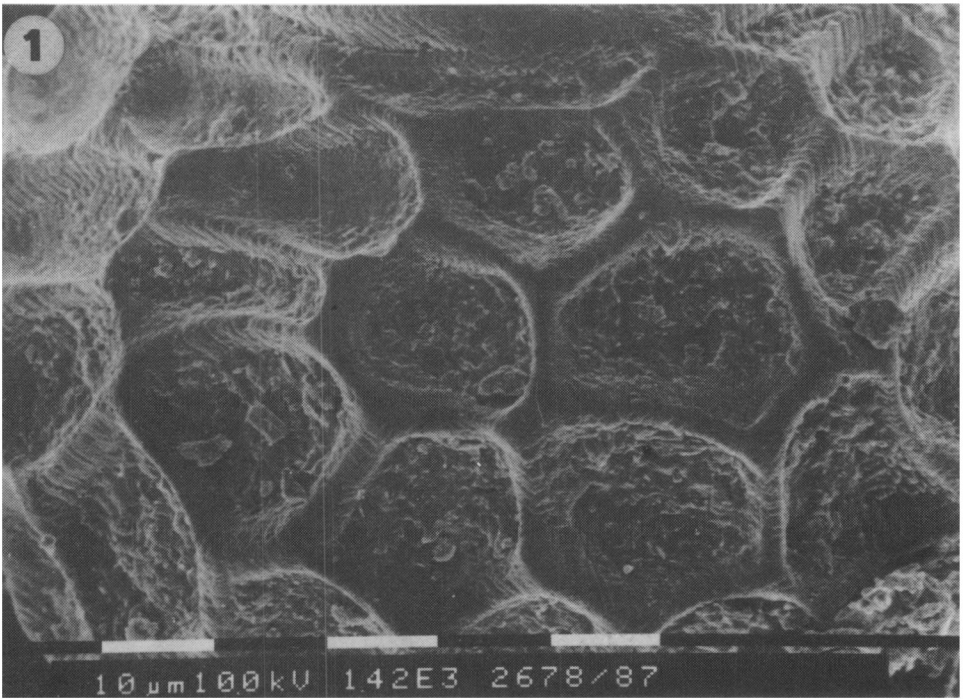


Bolboforma reticulata Daniels and Spiegler, 1974

1 — lateral view, 2—3 — apertural views, 4 — enlarged view of the apertural area (cf. Fig. 2) showing attached coccoliths of the genus *Reticulofenestra* (arrowed)

1—2, 4 — specimen (ZPAL Al. VII/1) from the Early Miocene Cape Melville Fm., sample CC, 3 — specimen (ZPAL Al. VII/2) from the Early Oligocene Low Head Mb. (Polonez Cove Fm.), sample A-11

Scale bar 0.1 mm with the exception of Fig. 4 which is 10 μm



1—2. Fragments of the same test (ZPAL Al. VII/1) of *Bolboforma reticulata* as shows on Pl. 1, Figs 1—2, 4— showing details of polygonal reticulations
Scale bar 10 μm