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# Calcareous nannofossils from the Upper Cretaceous of northern James Ross Island, Antarctica: a pilot study

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The Czech scientific expedition to northern James Ross Island, Antarctica has tested the use of calcareous nannofossils as a possible tool for stratigraphic correlation of Cretaceous and Neogene strata. Only a few samples with poor nannofossil content gave useful information for biostratigraphy. The Lower Campanian *Chiastozygus garrisonii* Zone and *Gephyrobiscutum diabolum* Subzone, respectively, was established in the lower part of the Santa Marta Formation, Lachman Crags Member, from the common occurrence of *Gephyrobiscutum diabolum* associated with *Broinsonia parca parca* and *Acuturris scotus.* Deposits of the Late Miocene Mendel Formation yielded exclusively reworked nannofossils from the older Upper Cretaceous deposits. Nannofossils indicate at least two distinct stratigraphic levels: Middle Coniacian and Santonian–basal Campanian, and these must have been sourced from the immediate area. The majority of the marine deposit samples studied were barren of nannofossils, probably due to late diagenetic secondary decalcification.

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## INTRODUCTION

During geological research and mapping by the Czech scientific expeditions to the northern James Ross Island that focused on the immediate area surrounding the Johann Gregor Mendel Czech Antarctic Station situated at about 63°48” S (Fig. 1), attention was paid to the stratigraphic interpretation of Upper Cretaceous and Upper Miocene strata. As the biostratigraphy of this region has been based on palynomorphs and macrofossils (bivalves, ammonites), the aim of this study was to investigate the presence of calcareous nannofossils in the various lithologies and to validate their biostratigraphic significance.

Although most of the deposits studied did not contain any nannofossils, a few samples provided relevant information from both the biostratigraphical and palaeoecological points of view. Given the scarce published data on calcareous nannofossils of the James Ross Basin carried out mainly by Argentine specialists from the University of Buenos Aires, the results of this study represent an important contribution to the knowledge of this area.

## GEOLOGICAL SETTING

Both Lower and Upper Cretaceous strata of the Gustav and Marambio groups (James Ross Basin) are exposed in the mapping area (Fig. 1). In most of the area studied they are overlain by Cenozoic lavas and hyaloclaste breccias (James Ross Island Volcanic Group), and also by the Cenozoic Mendel, Hobbs Glacier and Cockburn Island formations (Nývlt et al., 2011; Pirrie et al., 2011) and Quaternary deposits.

The stratigraphy of the Upper Cretaceous strata of northern James Ross Island has been studied by many authors (e.g., Ineson et al., 1986; Olivero et al., 1986; Pirrie, 1989; Rinaldi, 1992). The Gustav Group of northern James Ross Island comprises the following formations: (1) Kotick Point Formation, characterized by interbedded sandstones and silty mudstones or claystones; (2) Whisky Bay Formation, dominated by coarse-grained deposits, although mudstone- and sandstone-dominated intervals also occur (Ineson et al., 1986). The transition between the Whisky Bay Formation and the overlying (3) Hidden Lake Formation essentially represents the start

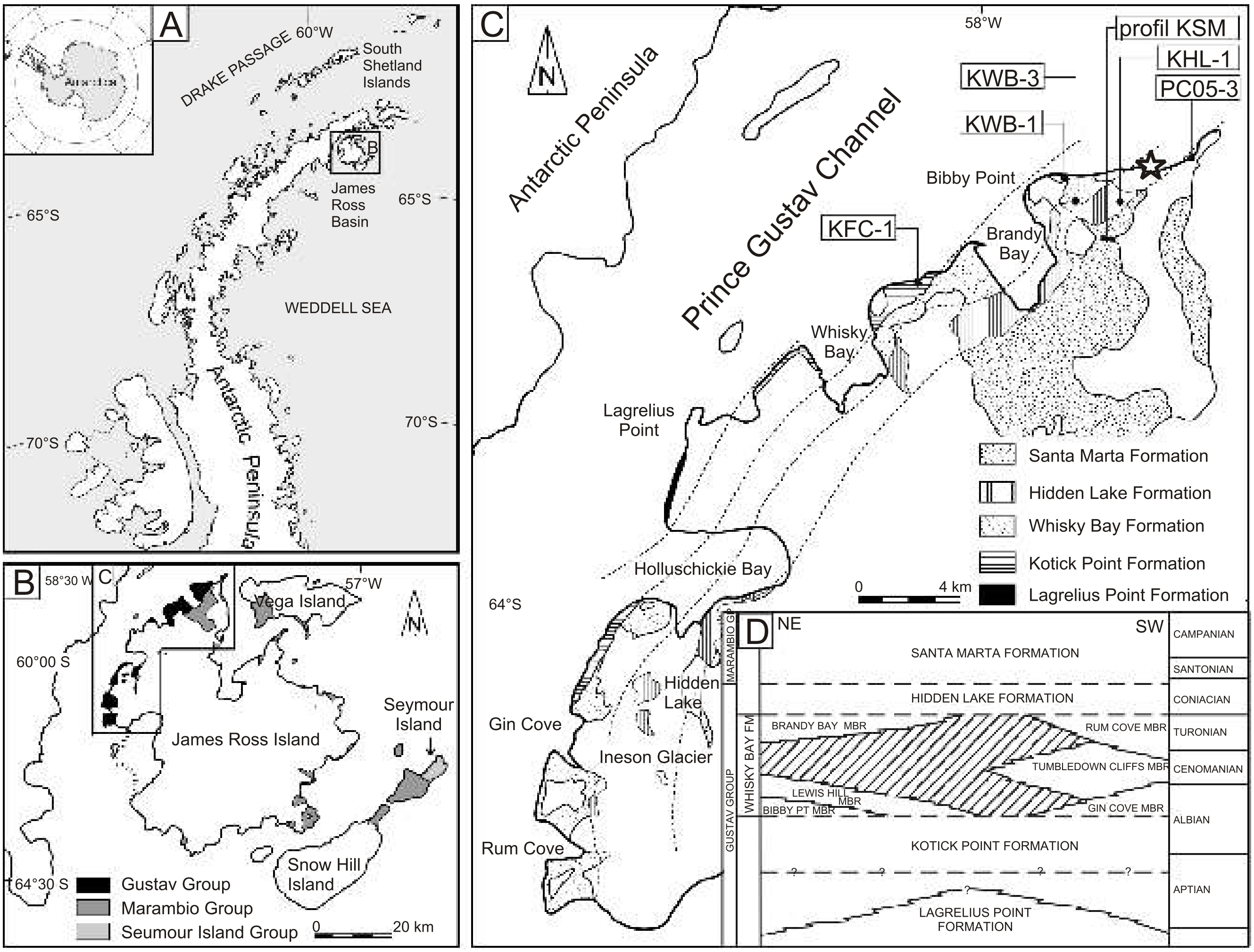


**Fig. 1A – map showing the location of the James Ross Island region; B – geological sketch map of the Gustav, Marambio and Seymour Island groups in the James Ross Island region, based on Crame and Luther (1997); C – geological sketch map showing Cretaceous deposits of northwestern James Ross Island with positions of section and samples tested for the presence of nannofossils. The dashed lines show formation boundaries across sea and ice cover. Based on Ineson et al. (1986). Star indicates the position of the Johann Gregor Mendel Czech Antarctic Station; D – stratigraphic correlation diagram for Cretaceous deposits of northwestern James Ross Island (based on Crame et al., 2006). For geographical location of these sediments see Figure 1C**

of a fining-upwards cycle from the conglomerate-dominated Whisky Bay Formation to the sandstone-dominated Hidden Lake Formation (Whitham et al., 2006). The general fining-upwards trend through the Hidden Lake Formation reflects a decreasing supply of coarse volcanic detritus to the basin, with a progressive decrease in water depth (Pirrie et al., 1992).

The Marambio Group of northern James Ross Island comprises the Santa Marta Formation that was originally defined by Olivero et al. (1986) and subdivided into three members: Alpha, Beta and Gamma. Crame et al. (1991) redefined the Santa Marta Formation and combined the Alpha and Beta members into the Lachman Crags Member. The samples studied (Figs. 1 and 2) belong to the lower-middle part of the Lachman Crags Member (Alpha Member of Olivero et al., 1986). These strata have been interpreted to have been deposited within a mid- to outer-shelf below storm wave base (Pirrie, 1989).

Comparative samples (Fig. 1 and Table 1) were gathered from the basal terrestrial glacigenic deposits (subglacial melt-out tills and lodgement tills) of the Mendel Formation (Nývlt et al., 2011). The Mendel Formation (max. thickness of 80 m) was formed between 5.9 to 5.4 Ma and is represented by glacigenic, glaciomarine and marine sediments deposited during two Late Miocene glacioeustatic cycles (Nývlt et al., 2011). The basal strata of the Mendel Formation overlie volcanic rocks of the James Ross Island Volcanic Group and the Upper Cretaceous Hidden Lake and Santa Marta formations (Fig. 1).

## PREVIOUS BIOSTRATIGRAPHIC STUDIES

Early biostratigraphic studies focused primarily on the well-preserved molluscan faunas, especially bivalves and ammonites (e.g., Crame, 1981; Olivero, 1981). Subsequent studies of microfossils from the James Ross Island region have clearly shown the potential for establishing biostratigraphic frameworks using foraminifera, diatoms, silicoflagellates and palynomorphs (e.g., Askin, 1988; Harwood, 1988; Huber, 1988). Other preliminary studies on James Ross and surrounding islands have also shown the potential of palynomorphs for local and regional biostratigraphical correlation (e.g., Askin,


**Fig. 2. Slope of Lachman Crags, viewed from the Crame Col (northern James Ross Island), formed by Upper Cretaceous siltstones (Lachman Crags Member, Santa Marta Formation) capped by Neogene basaltic lavas and hyaloclaste breccia**

All samples gathered from this section are marked on the photograph, although, except for KSM 4 and KSM 5, the samples provided no calcareous nannofossils; for more detailed localization of samples see Table 1

Table 1

**Lithostratigraphy, GPS coordinates and abundance (occurrence) of calcareous nannofossils from the samples studied**

| Sample no. | Formation, Member | WGS S | WGS W | Altitude [m] | Nannofossils abundance |
|---|---|---|---|---|---|
| KSM 1 | Santa Marta, Lachman Crags | 63°49’46.5’’ | 57°53’11.1’’ | 285 | – |
| KSM 2 | Santa Marta, Lachman Crags | 63°49’46.4’’ | 57°53’12.3’’ | 274 | – |
| KSM 3 | Santa Marta, Lachman Crags | 63°49’46.1’’ | 57°53’13.6’’ | 264 | – |
| KSM 4 | Santa Marta, Lachman Crags | 63°49’46.0’’ | 57°53’14.8’’ | 254 | +++ |
| KSM 5 | Santa Marta, Lachman Crags | 63°49’45.7’’ | 57°53’16.1’’ | 244 | + |
| KSM 6 | Santa Marta, Lachman Crags | 63°49’45.7’’ | 57°53’18.4’’ | 234 | – |
| KSM 7 | Santa Marta, Lachman Crags | 63°49’45.6’’ | 57°53’20.3’’ | 224 | – |
| KSM 8 | Santa Marta, Lachman Crags | 63°49’45.2’’ | 57°53’22.7’’ | 214 | – |
| KSM 9 | Santa Marta, Lachman Crags | 63°49’45.2’’ | 57°53’24.5’’ | 204 | – |
| KSM 9.2 | Santa Marta. Lachman Crags | 63°49’44.7’’ | 57°53’27.6’’ | 197 | – |
| KSM 10 | Santa Marta. Lachman Crags | 63°49’44.9’’ | 57°53’29.1’’ | 194 | – |
| KSM 10.2 | Santa Marta. Lachman Crags | 63°49’43.5’’ | 57°53’32.7’’ | 189 | – |
| KSM 11 | Santa Marta. Lachman Crags | 63°49’44.5’’ | 57°53’34.8’’ | 184 | – |
| KSM 11.2 | Santa Marta. Lachman Crags | 63°49’44.2’’ | 57°53’35.4’’ | 181 | – |
| KHL-1 | Hidden Lake | 63°48’51.4’’ | 57°52’56.1’’ | 72 | – |
| KWB-1 | Whisky Bay. Lewis Hill | 63°48’56.8’’ | 57°54’55.0’’ | 121 | – |
| KWB-3 | Whisky Bay. Brandy Bay | 63°48’12.8’’ | 57°55’30.8’’ | 62 | – |
| KFC-1 | Kotick Point | 63°51’10.1’’ | 58°04’52.9’’ | 31 | – |
| PC05-3 | Mendel | 63°47’34.3’’ | 57°48’39.7’’ | 3 | +++ |

1983; Olivero and Palamarczuk, 1987; Baldoni and Medina, 1989; Keating, 1992; Keating et al., 1992; Riding et al., 1992; Riding and Crame, 2002).

Cretaceous nannofossils from the Antarctic area including the Falkland Plateau are mentioned by Wind (1979), Huber et al. (1983), Thomas et al. (1990), Wei and Thierstein (1991), Watkins et al. (1996) and Lees (2002). These studies focused not only on stratigraphic interpretations but also on latitudinal changes in nannoplankton assemblages and on the distribution of cosmopolitan, high-latitude and endemic species. Upper Cretaceous nannofossils and their biostratigraphic interpretation from the James Ross Basin have been studied in particular by Argentinian (Concheyro et al., 1991; Robles Hurtado and Concheyro, 1995) and North American palaeontologists (Kulhanek, 2007).

## MATERIAL AND METHODS

Material for nannofossil study was collected from localities at walking distance from the Johann Gregor Mendel Czech Antarctic Station in the 2004 and 2005 field seasons. Samples were collected from the Kotick Point (sample KFC-1), Whisky Bay (samples KWB-1 and KWB-3), Hidden Lake (sample KHL-1) and Santa Marta (KSM section samples) formations (Figs. 1, 2 and Table 1). Concerning precise sample location, sample KSM 11 (see Fig. 2) was gathered from the level of a prominent concretion horizon, which is 90 m above the base of the Santa Marta Formation (Pirrie, 1987). Positive samples KSM 5 and KSM 4 correspond to levels of 150 and 160 m above the base of the Santa Marta Formation respectively. Further samples (PC05 section, see Fig. 1) were obtained from the recently described Late Miocene Mendel Formation (Nývlt et al., 2011). Nannofossil smear-slides are stored in the collections of the Czech Geological Survey, Prague. Rock samples are deposited in the Czech Geological Survey, Prague.

Nannofossils were investigated in the 2–30 μm fraction by a decantation method using 7% solution of $H_2O_2$. The coarse fraction was allowed to settle for 3 minutes in a 45 mm water column and removed; the fine fraction was saved for slide preparation after 45 minutes. Simple smear-slides were mounted using Canada Balsam and inspected at 1000× magnification, using an oil-immersion objective on a *Nikon Microphot-FXA* transmitting light microscope. Biostratigraphic data were interpreted using the zonation for the Upper Cretaceous of the Southern Ocean by Watkins et al. (1996).

## RESULTS

### SANTA MARTA FORMATION

Calcareous nannofossils were present in two of 14 samples taken from the KSM section (Fig. 2 and Table 1), in samples KSM 4 and KSM 5.

#### KSM 4

The smear-slide contained predominantly inorganic material. Calcareous nannofossils (ca. 1–5 specimens per one field of view of the microscope) formed a minimal proportion of the fraction and the preservation is very poor. Small placoliths (ca. 2–4 μm) of *Gephyrobiscutum diabolum* (small, placoliths extended along the longer axis, ca. 1–2 specimens per one field of view of the microscope; Fig. 3A1–A4) predominate; other nannofossils are scarce and preserved mostly as fragments. This assemblage contains low numbers of stratigraphically significant species such as *Acuturris scotus* (one specimen), *Broinsonia parca parca*, *Eiffellithus eximius*, *Broinsonia* cf. *dentata*, *Lucianorhabdus maleformis-quadrifidus* and *L.* ex gr. *cayeuxii* (two specimens; Fig. 3). Specimens of the genus *Prediscosphaera* are small in proportion, including miniature specimens (2 μm) resembling *P. bukryi* (Fig. 3J). These species are accompanied by *Eiffellithus turriseiffelii* (two specimens), *Ahmuellerella octoradiata*, *Arkhangelskiella cymbiformis* (“large” and broadly elliptical placoliths with a relatively narrow outer rim), *Biscutum ellipticum*, *Biscutum magnum* (one fragment), *Broinsonia enormis*, *Calculites ovalis*, *Cribrosphaerella ehrenbergii* (one specimen), *Cyclagelosphaera rotaclypeata*, *Gartnerago obliquum*, *Kamptnerius magnificus*, *Prediscosphaera cretacea*, *P. spinosa*, *Reinhardtites anthophorus*, *Rhagodiscus angustus*, *Tranolithus orionatus*, *Thoracosphaera* sp., *Vekshinella aachena* (*sensu* Watkins et al., 1996), *Watznaueria barnesiae* (four specimens), *Zeugrhabdotus scutula*, *Z. trivectis*, and *Z. diplogrammus.*

The sample also provided “cubes” of questionable origin that are comparable with those found for example in the Bohemian Cretaceous Basin (Švábenická, 2012).

#### KSM 5

A smear-slide containing calcareous material of inorganic origin and scarce nannofossils (ca. 1 specimen per 10 fields of view of the microscope) of extremely poor preservation. The following taxa were identified: *Biscutum* sp., *Gephyrobiscutum* sp., *Staurolithites laffitei, Prediscosphaera* sp.

Samples taken from the Kotick Point Formation (KFC-1), Whisky Bay Formation (KWB-1, KWB-3) and Hidden Lake Formation (KHL-1) provided no calcareous nannofossils.

### MENDEL FORMATION

Calcareous nannofossils were present in only one of 13 samples taken from the section:

#### PC05-3

Nannofossils form a minimal proportion of the sediment (1–2 specimens per 10 fields of view of the microscope). They are badly preserved and mostly fragmented. Strong etching is obvious especially on placoliths (the central fields are usually missing) and holococcoliths (genus *Lucianorhabdus*) show signs of overgrowth. Probable secondary impoverishment of the assemblage was caused by carbonate dissolution as indicated by the relatively high numbers of *Watznaueria barnesiae*.

The assemblage is formed of the following species (Fig. 4): *Arkhangelskiella specillata*, *Prediscosphaera cretacea*, *P. ponticula*, *P.* cf. *grandis* (*sensu* Burnett, 1998), *Kamptnerius magnificus, Lucianorhabdus quadrifidus, L. maleformis, L.* cf. *inflatus* (fragments), *Quadrum gartneri*, *Q. intermedium*

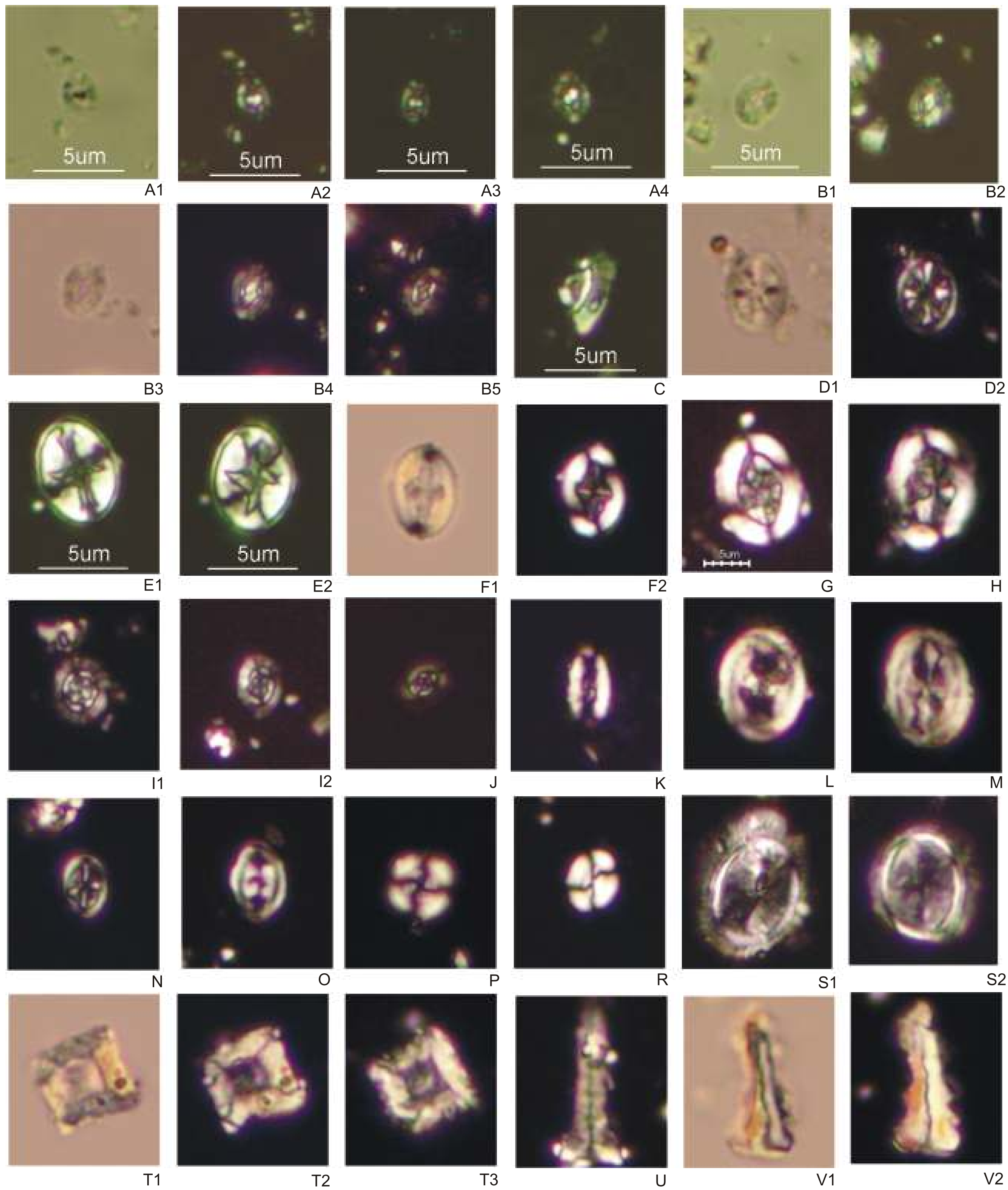


**Fig. 3. Calcareous nannofossils of the Santa Marta Formation, James Ross Island, Antarctica, sample KSM 4, Lower Campanian**

**A1**–**A4** – *Gephyrobiscutum diabolum*, A1 – PPL, A2–A4 – XPL; **B1**–**B5** – *Gephyrobiscutum* cf. *diabolum*, B1, B3 – PPL, B2, B4, B5 – XPL; **C** – *Biscutum magnum*, fragment, XPL; **D1**, **D2** – *Ahmuelerella octoradiata*, specimen in PPL and XPL; **E1**, **E2** – *Eiffellithus eximius*, specimen at 0° and 15°, XPL; **F1**, **F2** – *Broinsonia dentata*, specimenn in PPL and XPL; **G** – *Broinsonia parca parca*, XPL; **H** – *Arkhangelskiella* ex gr. *cymbiformis*, XPL; **I1**, **I2** – *Prediscosphaera cretacea*, XPL; **J** – *Prediscosphaera bukryi*, XPL; **K** – *Rhagodiscus angustus*, XPL; **L** – *Reinhardtites anthophorus*, XPL; **M** – *Vekshinella aachena*, XPL; **N** – *Staurolithites laffittei*, XPL; **O** – *Tranolithus orionatus*, XPL; **P** – *Cyclagelosphaera rotaclypeata*, XPL; **R** – *Watznaueria barnesiae*, XPL; **S1**, **S2** – *Kamptnerius magnificus*, XPL; **T1**–**T3** – ?Polycyclolithaceae, "cube" of questionable origin, specimen in PPL and XPL; **U** – *Acuturris scotus*, XPL; **V1**, **V2** – *Lucianorhabdus* ex gr. *cayeuxii*, specimen in PPL and XPL; PPL – plane polarized light, XPL – cross polarized light; for magnification see Figure 3A, if not indicated otherwise

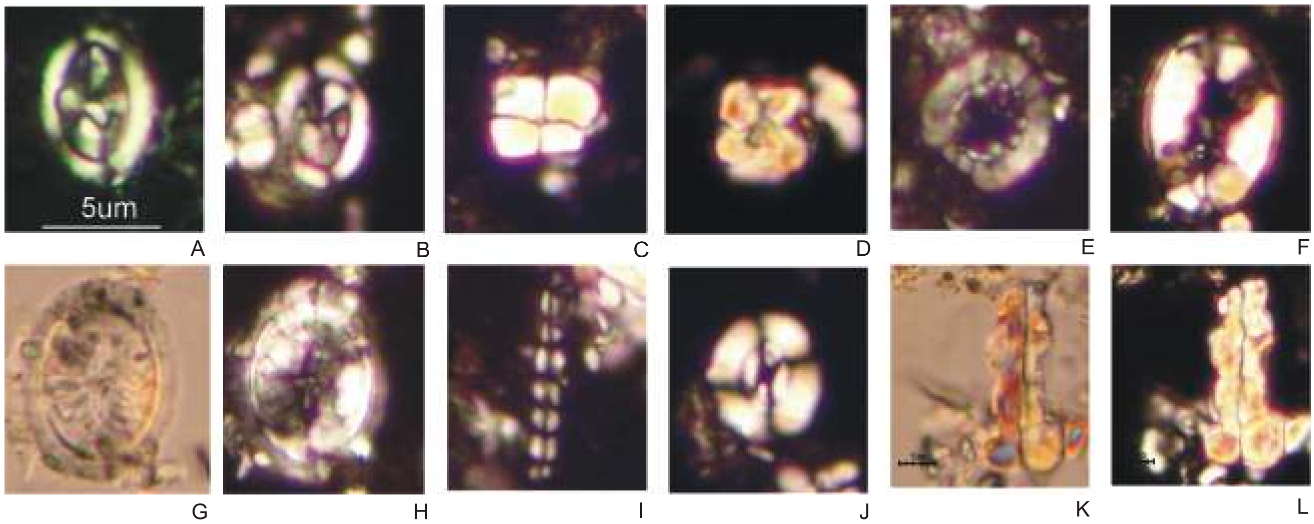


**Fig. 4. Reworked calcareous nannofossils from the Upper Cretaceous strata into the glacigenic Miocene deposits of the Mendel Formation, sample PC05-3**

**A** – *Arkhangelskiella* sp., XPL; **B** – *Broinsonia enormis*, XPL; **C** – *Quadrum gartneri*, XPL; **D** – *Micula staurophora*, XPL; **E** – *Prediscosphaera* sp., central area of specimen strongly corroded, XPL; **F** – *Eiffellithus eximius*, XPL; **G**, **H** – *Kamptnerius magnificus*, specimen in PPL and XPL; **I** – *Microrhabdulus attenuatus*, XPL; **J** – *Watznaueria barnesiae*, XPL; **K**, **L** – *Lucianorhabdus quadrifidus*, specimen in PPL and XPL; PPL – plane polarized light, XPL – cross polarized light; for magnification see Figure 4A

(5 and 7 segments), *Manivitella pemmatoidea, Microrhabdulus attenuatus, Gartnerago obliquum, Broinsonia enormis, Micula staurophora* (three specimens), *Eiffellithus eximius* (specimen with strongly etched central field with cross), *Retacapsa* sp. (outer rim).

## DISCUSSION

The nannofossil assemblage of the sample KSM 4 (Santa Marta Formation) documents the Lower Campanian, *Chiastozygus garrisonii* Zone (upper part – interval of the *Gephyrobiscutum diabolum* Subzone) *sensu* Watkins et al. (1996). This biostratigraphic interpretation concurs with the previously published biostratigraphical framework based on the molluscan macrofauna and palynomorphs (see Pirrie et al., 1992). From the palaeogeographical point of view, the sedimentary area of James Ross Island region must have had some relation to the Falkland Plateau during the Early Campanian, because both Watkins et al. (1996) and Burnett (1998) regard *Gephyrobiscutum diabolum* as an endemic species of the Falkland Plateau.

The nearly ubiquitous and common species *Watznaueria barnesiae*, in Upper Cretaceous assemblages throughout the world, was found here only in very low numbers. Wei and Thierstein (1991) mentioned its sporadic occurrence in the Maastrichtian of the Kerguelen Plateau. According to Watkins et al. (1996), *W. barnesiae* became sporadic and rare in high southern latitudes (e.g., the *R. parvidentatum* Subzone on the Kerguelen and Naturaliste plateaux in the Upper Campanian) and later also in lower latitudes of the Southern Hemisphere. In addition to scarce *W. barnesiae,* sample KSM 4 provided *G. diabolum* and its short stratigraphic range is correlated with the Lower Campanian (Watkins et al., 1996).

The sporadic occurrence of small specimens of the genus *Prediscosphaera* (a central cross situated along the axes of the elliptic placolith, see Fig. 3J) here mentioned as *P. bukryi* needs further material and study. *P. bukryi* is known from the Albian–Maastrichtian. Its small specimens may be easily mistaken for *P. stoveri* especially in poorly preserved material. *P. stoveri* is mentioned as a bipolar species restricted to high-latitudes. In the North Sea, its first occurrence is placed at the base the base of UC15d$^{BP}$ Subzone, lower Upper Campanian (Burnett, 1998); in the Southern Hemisphere it is first noted in the *Biscutum coronum* Zone, upper Upper Campanian and its common occurrence in the uppermost Maastrichtian was used for definition of the *Prediscosphaera stoveri* Acme Subzone (Watkins et al., 1996). It is interesting that Watkins et al. (1996) did not mention any *P. bukryi* from older Campanian deposits and *vice versa* Kulhanek (2007) any *P. stoveri* from the Maastrichtian of the northern James Ross Basin.

The nannofossil taphocoenose found in sample PC05-3 (Mendel Formation) contains at least two types of nannofossil assemblages:

1. An assemblage with *Micula staurophora* and *Quadrum gartneri*, Middle to Upper Coniacian, UC10 Zone.
2. An assemblage with *Arkhangelskiella specillata, Prediscosphaera* cf. *grandis* and *Lucianorhabdus inflatus* may document the Santonian and ?probably also the lowermost Campanian. Similarly reworked Campanian–Maastrichtian nannofossil taphocoenoses were recovered by Gaździcka and Gaździcki (1994) from the Pliocene *Pecten* Conglomerate of Cockburn Island (about 5 km north-west from Seymour Island).

Nannofossils of Campanian, Maastrichtian and/or Cenozoic age have not been found. The presence of the genera *Lucianorhabdus, Quadrum* and *Kamptnerius* may reflect deposition in a shallow epicontinental sea of normal salinity. According to the summary of lithostratigraphy of the James Ross Basin (Pirrie et al., 1992), reworked nannofossils of Coniacian age most probably come from the Hidden Lake Formation and species of Santonian/?lowermost Campanian age from the lower part of the Santa Marta Formation.

The short-distance transport of the Upper Cretaceous nannofossils rewashed into the Late Miocene Mendel Formation is shown by the fact that both the Santa Marta and Hidden Lake formations crop out in the immediate vicinity of section PC05.

The absence of calcareous nannofossils from the Kotick Point, Whisky Bay and Hidden Lake formations and in part from the Santa Marta Formation is probably caused by partial or total (?) early diagenetic decalcification of the deposits. This is also supported by sporadic findings of calcareous foraminifers in most of the samples studied and by the scarcity of calcareous invertebrate shells in the area studied. In particular, conglomerates, tuffitic sandstones and siltstones of the Kotick Point, Whisky Bay and Hidden Lake formations are almost barren of original calcitic/aragonitic shells. On the other hand, siliceous macrofossils are well-preserved (Vodrážka and Crame, 2011), suggesting that carbonate dissolution played an important role during formation of these strata.

## CONCLUSIONS

A scarcity of nannofossils in the Upper Cretaceous marine strata of the James Ross Basin enabled only preliminary stratigraphic conclusions.

The Santa Marta Formation (samples KSM 4 and KSM 5) is correlated with the Lower Campanian. Nannofossils indicate the *Chiastozygus garrisonii* Zone (*Gephyrobiscutum diabolum* Subzone) *sensu* Watkins et al. (1996) according to the common occurrence (acme) of the species *G. diabolum* associated with *Broinsonia parca parca* and *Acuturris scotus*. Moreover, *G. diabolum*, an endemic species of the Falkand Plateau, indicates connection of this palaeoregion with this territory during the deposition of the Santa Marta Formation.

Strata of the Mendel Formation, Upper Miocene, provided only reworked nannofossils from older Upper Cretaceous deposits. Nannofossils indicate two stratigraphic levels (and probably two source areas): Middle Coniacian (*Micula staurophora* and *Quadrum gartneri*) and Santonian–basal Campanian interval (*Arkhangelskiella specillata* and *Lucianorhabdus inflatus*). Reworked Upper Cretaceous nannofossils most probably come from the Hidden Lake and Santa Marta formations. An autochthonous nannoflora was not developed in the glacigenic to marine sedimentary environment of the Late Miocene.

Most of the marine deposits studied of the Gustav and Marambio groups, James Ross Basin, were barren of nannofossils probably due to (?late) diagenetic secondary decalcification.

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## APPENDIX

List of calcareous nannofossils mentioned in the text, in alphabetical order of genera.

*Acuturris scotus* (Risatti, 1973) Wind and Wise in Wise and Wind, 1977
*Ahmuellerella octoradiata* (Górka, 1957) Reinhardt, 1966
*Arkkhangelskiella cymbiformis* Vekshina, 1959
*Arkhangelskiella specillata* Vekshina, 1959
*Biscutum ellipticum* (Górka, 1957) Grün in Grün and Alleman, 1975
*Biscutum magnum* Wind and Wise in Wise and Wind, 1977
*Broinsonia dentata* Bukry, 1969
*Broinsonia enormis* (Shumenko, 1968) Manivit, 1971
*Broinsonia parca* (Stradner, 1963) Bukry, 1969 ssp. *parca*
*Calculites ovalis* (Stradner, 1963) Prins and Sissingh in Sissingh, 1977
*Cribrosphaerella ehrenbergii* (Arkhangelsky, 1912) Deflandre in Piveteau, 1952
*Cyclagelosphaera rotaclypeata* Bukry, 1969
*Eiffellithus eximius* (Stover, 1966) Perch-Nielsen, 1968
*Eiffellithus turriseiffelii* (Deflandre in Deflandre and Fert, 1954) Reinhardt, 1965
*Gartnerago obliquum* (Stradner, 1963) Noël, 1970
*Gephyrobiscutum diabolum* Wise, 1988
*Kamptnerius magnificus* Deflandre, 1959
*Lucianorhabdus cayeuxii* Deflandre, 1959
*Lucianorhabdus inflatus* Perch-Nielsen and Feinberg in Perch-Nielsen, 1986
*Lucianorhabdus maleformis* Reinhardt, 1966
*Lucianorhabdus quadrificus* Forchheimer, 1972
*Manivitella pemmatoidea* (Deflandre in Manivit, 1965) Thierstein, 1971
*Micula staurophora* (Gardet, 1955) Stradner, 1963
*Microrhabdulus attenuatus* (Deflandre, 1959) Deflandre, 1963
*Prediscosphaera bukryi* Perch-Nielsen, 1973
*Prediscosphaera cretacea* (Arkhangelsky, 1912) Gartner, 1968
*Prediscosphaera grandis* Perch-Nielsen, 1979
*Prediscosphaera ponticula* (Bukry, 1969) Perch-Nielsen, 1984
*Prediscosphaera spinosa* (Bramlette and Martini, 1964) Gartner, 1968
*Prediscosphaera stoveri* (Perch-Nielsen, 1968) Shafik and Stradner, 1971
*Quadrum gartneri* Prins and Perch-Nielsen in Manivit et al., 1977
*Quadrum intermedium* Varol, 1992
*Reinhardtites anthophorus* (Deflandre, 1959) Perch-Nielsen, 1968
*Rhagodiscus angustus* (Stradner, 1963) Reinhardt, 1971
*Staurolithites laffittei* Caratini, 1963
*Tranolithus orionatus* (Reinhardt, 1966a) Reinhardt, 1966b
*Vekshinella aachena* (Bukry) Shafik and Stradner, 1971
*Watznaueria barnesiae* (Black, 1959) Perch-Nielsen, 1968
*Zeugrhabdothus diplogrammus* (Deflandre in Derflandre and Fert, 1954) Burnett in Gale et al., 1996
*Zeugrhabdotus scutula* (Bergen, 1994) Rutledge and Bown, 1996
*Zeugrhabdothus trivectis* Bergen, 1994