A lithostratigraphical and chronological study of Oligocene—Miocene sequences on eastern King George Island, South Shetland Islands (Antarctica) and correlation of glacial episodes with global isotope events

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Supplementary Information file S3 – summary palaeontological description of the Polonez Cove Formation

Well over two hundred taxa have been identified from the Polonez Cove Formation (listed in Supplementary Information file S4). They comprise coccoliths (Birkenmajer and Gaździcki, 1986; Gaździcka and Gaździcki, 1985; Birkenmajer et al., 1988), bivalves (Gazdzicki et al., 1982; Gaździcki and Pugaczewska, 1984; Beu, 2009; Hryniewicz and Gaździcki, 2016;), gastropods (Gaździcki and Pugaczewska, 1984; Beu, 2009), foraminifera (Gaździcki, 1984, 1989; Gaździcki and Pugaczewska 1984; Majewski and Gaździcki, 2014), worms (Gaździcki and Pugaczewska 1984; Beu 2009), echinoderms (Hotchkiss, 1982; Gaździcki and Pugaczewska, 1984; Jesionek−Szymańska, 1984; Kroh, 2014) ostracods (Błaszyk, 1987), bryozoans (Hara, 1992; Gaździcki and Pugaczewska, 1984), coral (Gaździcki and Stolarski, 1992), brachiopods (Bitner and Pisera, 1984; Gaździcki and Pugaczewska, 1984; Bitner, 1997; Bitner and Thompson, 1999; Bitner et al., 2009), one diatom (Gaździcki and Pugaczewska, 1984), algae (Gaździcki, 1989b; Warny et al., 2019), palynomorphs including dinoflagellates, spores, and gymnosperm and angiosperm pollen (Warny et al., 2019), and stromatolites (Gaździcki, 2008). Many fossils are reworked (see Supplementary Information file S4). The Low Head Member is the most diverse unit in the Polonez Cove Formation. In addition, fossils have been described from the Chlamys Ledge Member (Gaździcki, 2008; Bittner et al., 2009; Kroh, 2014; Majewski and Gaździcki, 2014), Oberek Cliff Member (Bitner, 1997; Bitner and Thompson, 1999), Bay View and Krakowiak Glacier Members (Warny et al., 2019). Coccoliths are the only age diagnostic fossils in the Polonez Cove Formation, indicating an upper Early Oligocene to Late Oligocene age (Gaździcka and Gaździcki, 1985; Birkenmajer and Gaździcki, 1986; Birkenmajer et al., 1988).

Coccoliths: Although coccoliths are the only age diagnostic fossils in the Polonez Cove Formation, both recycled and in situ forms have been identified (Gaździcka and Gaździcki, 1985; Birkenmajer and Gaździcki, 1986; Birkenmajer et al., 1988). Gaździcka and Gaździcki (1985) indicated an upper Early Oligocene to Late Oligocene age for the assemblage, corresponding to the *Chiasmolithus altus* and *Reticulofenestra bisecta* zones. Birkenmajer et al., 1988) described a further 12 coccolith species. Paleocene to Oligocene forms were

deemed recycled due to poor preservation. The in situ fossils described by Birkenmajer et al., 1988) included four species: *Zygrhablithus bijugatus* (upper Middle Eocene—Late Oligocene), *Reticulofenestra bisecta,* (upper Middle Eocene—early Miocene), *Discoaster deflandrei* (upper Eocene—Middle Miocene) and *Sphenolithus abies* (?Eocene/Oligocene boundary—Early Pliocene). An Early—Late Oligocene age was suggested based on this assemblage (Birkenmajer et al., 1988). Together the in situ coccolith assemblages indicate an upper Early Oligocene to Late Oligocene age for the Polonez Cove formation (Gaździcka and Gaździcki ,1985; Birkenmajer and Gaździcki, 1986; Birkenmajer et al., 1988).

Molluscs: Gaździcki and Pugaczewska (1984) identified 28 bivalve and 11 gastropod species from the Low Head Member. However, many of the taxa were reassigned by Beu (2009), with most taxa only identified to generic level, and many tentative assignments. Some of the originally described molluscs were also reidentified as indeterminate. In addition, Gaździcki et al. (1982) identified one bivalve genus from the Siklawa member, which was subsequently reassigned and described as a new species by Hryniewicz and Gaździcki (2016).

***Bivalves*:** Beu (2009) recognised 14 bivalve taxa from the Low Head Member, namely pectens ?*Swiftopecten* n. sp., "*Chlamys*" sp., *Antarctipecten alanbeui* and *Leoclunipecten gazdzickii*; other bivalves *Antarctolima* sp. Ostreidae Indeterminate, *Nucula* sp., ?*Venericardia* (sensu lato) sp., *Cyclocardia* sp., ?*Glycymeris* (sensu lato) sp., *Retrotapes newtoni*, *Panopea* sp., and two indeterminate taxa tentatively thought to be *Cyamiocardium* and *Cyamiomactra*?. The boring bivalve species *Pholadidea gradzinskii* was also described by Hryniewicz and Gaździcki (2016) from mudstone intervals in the Siklawa member.

Gastropods: Beu (2009) recognised 10 gastropod genera, half of which were tentatively assigned. They comprise ?*Falsilunatia* sp., *Prosipho* sp., ?*Xymene* sp., *Trophon* sp., *Chlanidota* sp., ?*Turbo* sp., ?*Obscuranella* aff. *Papyrodes*, *Perissodonta* sp., *Chlanidota* sp., ?*Volutomitra* sp.

Forams: 59 species have been identified in total, i.e. 3 planktonic, 3 agglutinated forms, and 53 calcareous benthic forms (Gaździcki and Pugaczewska, 1984; Gaździcki, 1989*a*, 1984; Majewski and Gaździcki, 2014). They were collected in the Low Head Member, with three species also found from the Chlamys Ledge Member (*Globocassidulina subglobosa*, *Cibicides temperata* s.l., *Pullenia quinqueloba*).

Annelida (worms): Three taxa have been identified from the Low Head Member - *Spirorbis*, *Serpula*, and ?*Rotularia* sp. (Gaździcki and Pugaczewska, 1984; Beu, 2009).

Echinoderms: Fragments of echinoderms from the Low Head Member have been tentatively identified to two genera, i.e. ?*Notocidaris* and ?*Sterechinus* (Gaździcki and Pugaczewska, 1984; Jesionek–Szymańska, 1984). *Polyechinus* was tentatively identified from the Polonez Cove Formation by Hotchkiss (1982). Echinoids have been described from the Chlamys Ledge Member (*Caenopedina aleksandrabitnerae* and ?*Abatus*; Kroh, 2014).

Ostracods: Gaździcki and Pugaczewska (1984) first noted ostracods, which were subsequently described by Błaszyk (1987) into 16 species belonging to 15 genera and subgenera (see Supplementary Information file S4).

Bryozoa: Gaździcki and Pugaczewska (1984) described or figured a total of 49 taxa from the Low Head Member. Hara (1992) recorded 7 bryozoa genera from the White Eagle Glacier

(either Low Head Member or Oberek Cliff Member), and suggested that the palaeoecology of the bryozoan assemblage implied a shallow water environment at a depth of approximately 50 m.

Brachiopods: Only a few badly preserved specimens of brachiopod taxa have been collected from the Low Head Member, these were identified as the terebratulids *Liothyrella* (Bitner, 1997) and *Neothyris*, and the rhynchonellid *Cryptopora* (Bitner and Pisera, 1984, Gaździcki and Pugaczewska, 1984). Bitner and Thompson (1999) reported Rhynchonellid brachiopods from the Oberek Cliff Member but the 2 specimens were too poorly preserved to identify further. Specimens of brachiopods from the Chlamys Ledge Member were identified to Rhynchonellida gen. et sp. Indet, *Liothyrella* sp., *Rhizothyris* sp. and Terebratelloidea gen. et sp. Indet (Bitner et al., 2009). A terebratulid specimen was identified from the White Eagle Glacier locality (either Low Head Member or Upper Oberek Cliff Member) by Bitner (1997).

Coral: Gaździcki and Stolarski (1992) recorded the coral *Flabellum* sp. from the White Eagle Glacier Locality (either Low Head Member or Upper Oberek Cliff Member).

Spores and pollen: Few palynomorphs have been found from the Polonez Cove Formation, and many are reworked, suggesting a depauperate terrestrial vegetation (Warny et al., 2019). There are no age diagnostic taxa (see Supplementary Information file S4).

Algae: The presence of sea-ice-indicative leiospheres highlights the glacial climate associated with the Polonez Cove Formation (Warny et al., 2019). The algal microfossil *Bolboforma reticulata* (Chrysophyta) was described from the Low Head Member (Gaździcki, 1989b). The genus has been recognised from the late Eocene to Pliocene in Northern and Southern Hemisphere temperate to cool areas.

Diatoms: The diatom *Coscinodiscus* was noted from the Low Head Member by Gaździcki and Pugaczewska (1984).

***Stromatolites*:** Reworked Cambrian stromatolites have been noted from the Chlamys Ledge Member, and are thought to occur due to iceberg rafting (Gaździcki, 2008).

Fossils from small Polonez Cove Formation outcrop at Vauréal Peak: *Adamussium* was described from this deposit by Quaglio et al. (2008). They stated that it was the oldest occurrence of the genus (late Early Oligocene), which previously had a distribution of Pliocene and Pleistocene to Recent. From our study, the Polonez Cove Formation is now dated as 26.7 Ma, so a slightly younger Late Oligocene age is indicated. Serpulid tubes, and the brachiopods *Neothyris* and *Liothyrella* were also identified by Quaglio et al. (2008).

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