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Late Oligocene marine palaeotemperatures and seawater conditions from bivalve shell geochemistry, King George Island, Antarctica

SAURAV DUTTA[1], VICTORIA PECK[1], MELANIE J. LENG[2], ELIZABETH M HARPER[3], LINDA IVANY[4], SATYA ILINDRA[3] AND ROWAN WHITTLE[1]

[1]British Antarctic Survey
[2]British Geological Survey
[3]University of Cambridge
[4]Syracuse University

The Polonez Cove Formation (King George Island) preserves a rare shallow-marine archive of Late Oligocene glaciomarine sedimentation, dated to c. 26.64 ± 1.43 Ma (Chattian, Oi-2b isotope zone) [1]. The formation has yielded a diverse, predominantly calcite-shelled assemblage including the pectinid bivalve *Leoclunipecten gazdzickii*, solitary corals (*Flabellum*), brachiopods, bryozoa and benthic foraminifera. While deep-sea cores provide insight into Oligocene palaeoclimate records, outcrop-derived geochemical data constraining shallow-marine conditions near Antarctica remain virtually absent for this interval, particularly regarding local seawater composition and the influence of glacial meltwater.

Here, we present $\delta^{18}O$ and $\delta^{13}C$ data from *L. gazdzickii* shells sampled across five lithostratigraphic units. The fragile preservation meant most specimens disintegrated during extraction; carbonate powders were therefore obtained from individually traced fragments rather than intact valves. Shell preservation was assessed through scanning electron microscopy (SEM) of primary microstructures and trace element screening (Mg/Ca, Sr/Ca, Mn/Ca, Fe/Ca). Intra-unit isotopic variability proved markedly heterogeneous: Units 2 and 4 displayed consistent isotopic signatures with $\delta^{18}O$ tightly clustered around +2‰ and +1‰ respectively, whereas Unit 1 exhibit the greatest scatter and the lowest $\delta^{18}O$ values, reaching −8‰. Importantly, the most positive $\delta^{18}O$ values in the high-scatter units (Units 1, 3 and 5) are all between +1‰ and +2‰, comparable to the low-scatter units, indicating a comparable baseline across all units, that presumably approximates fully marine conditions. Negative values are too low to reflect temperature alone and are therefore best explained by episodic influx of isotopically negative meltwater-derived freshwater modifying local seawater $\delta^{18}O$ and salinity. Assuming the most marine $\delta^{18}O$ values reflect fully marine conditions and that Oligocene global seawater was around −0.5‰, preliminary palaeotemperatures of ~10°C are obtained, substantially warmer than modern Weddell Sea conditions ($\delta^{18}O$~+4‰) obtained from our analyses of recent *Adamussium colbecki* shells. Ongoing sclerochronological analysis will further resolve isotopic variation on a seasonal basis.

Additionally, clumped isotope (Δ_{47}) analysis will be conducted to derive palaeotemperatures independent of seawater $\delta^{18}O$ composition, and $^{87}Sr/^{86}Sr$ ratios of the most 'marine' shells will provide independent chronostratigraphic constraints for the sampled units.

[1] Smellie et al. (2021) *Antarct. Sci.* 33(5), 502–532.