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Obliquity pacing of Antarctic glaciations during the Quaternary

Christian Ohneiser, Catherine Beltran, Christina Hulbe, Chris Moy, Christina Riesselman, Rachel Worthington, and Donna Condon
University of Otago, Dunedin, New Zealand (christian.ohneiser@otago.ac.nz)

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The frequency of Antarctic glaciations during the Quaternary are not well understood. Benthic oxygen isotope records provide evidence for eccentricity paced global ice volume changes since c. 800 000 years and the ice core records (such as EPICA) also appear to have 100 000 year cycles over the last 800 000 years. However, the benthic oxygen isotope records are a global average – not an Antarctic record. Quaternary, sedimentary records proximal to the ice margin (such as the ANDRILL AND-1B record) are needed to understand better the recent glacial history of Antarctica.

Here we present results from the 6.21 m long, NBP03-01A-20PCA sedimentary record which was recovered from the outer continental margin of the Ross Embayment.

Sediments comprise mud with numerous clasts and paleomagnetic analyses revealed magnetic reversals at 4.21 m, 5.74 m, and 5.85 m depth. These reversals are correlated with C1n-C1r.1r-C1r.1n-C1r.2r geomagnetic reversals which have corresponding ages of 773 ka, 990 ka, and 1070 ka.

Time series analysis of continuous Anhysteretic Remanent Magnetisation (ARM) data, which are controlled primarily by the concentration of magnetic minerals, revealed strong obliquity paced cycles between c. 800 ka and 350 ka. The presence of obliquity cycles prompted us to carry out core scanning XRF and grain size analyses. The archive half was scanned in a itrax XRF core scanner at the Marine and Geology Repository at Oregon State University and high density grain size analyses were conducted at the University of Otago.

We identified obliquity paced cycles in the titanium elemental data over the same period which we suggest represent variations in the terrigenous material in the core. Weaker obliquity cycles are also present in the >2mm grain size fraction which we suggest is controlled by the proximity of the ice shelf front.

We suggest that the presence of obliquity paced cycles in our data series indicate that the Ross Ice Shelf calving line advance and retreat cycles were paced with obliquity until at least 350 ka and that the mid-Pleistocene transition occurred later in the Southern Hemisphere than in the North.