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Role of the Antarctic ice sheet in Plio-Pleistocene climate evolution: Implications from ANDRILL-McMurdo Ice Shelf Project drilling

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Although Antarctica's ice sheets presently contain the world's largest terrestrial water reservoir, their influence on Late Cenozoic sea-level and climate remains poorly known from direct evidence. Here we present a climate record constructed from the upper the 600m of a sediment core recovered by drilling from the northwest corner of the Ross Ice Shelf. Our record shows the long term evolution of the West Antarctic Ice Sheet (WAIS) from a small, dynamic, body with terrestrial margins during the Early Pliocene (5-3-Myr), through to its present large, cold and more persistent state (0.8-0-Myr). Well-dated, cyclic variations in the sediment cores link the extent of the WAIS to orbital-scale climate cycles. We find that the WAIS became less responsive to orbital influences as it expanded and cooled through the Late Cenozoic. We provide evidence of a significant change in thermal regime in the Late Pliocene, coincident with a global cooling step in oxygen isotope records and onset of major northern hemisphere glaciations. At this time WAIS transitioned towards a cold polar state; ephemeral terrestrially-based ice margins were replaced by marine termini and the development of ice shelves (e.g. Ross Ice Shelf). We propose that interhemispheric coupling of polar ice sheets, controlled by northern hemisphere glacio-eustasy, accounts for much of the orbital variability of the ice sheets since 2.5-Myr. A further expansion of the WAIS and the establishment of the present ice sheet occurred across

the Mid-Pleistocene Climate Transition (MPT; 1-0.8-Myr). Thereafter, open-marine conditions may not have occurred in the Ross Embayment.