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A 13 million year history of ice advance and retreat in the Western Ross Embayment – stratigraphic evidence from ANDRILL Site 1B.

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A 1285 m-long core, recovered from ANtarctic geological DRILLing program (ANDRILL) Site 1B, records the 13 million year history of the McMurdo sector of the Ross Ice Shelf. Eleven lithofacies are identified, ranging from ice-proximal diamictite to open-marine diatomite. About 60 glacimarine sediment packages are also recognized, each bounded by a glacial surface of erosion. These packages group into three sequence “motifs” representing distinct styles of glacial-interglacial advance and retreat. These cycles are constrained by a chronology based on biostratigraphic, magnetostratigraphic and argon isotopic markers.

Motif 1 (Pleistocene and Late Miocene) is dominated by thick sub-glacial diamictite, deposited during glacial advance, with occasional thin interbeds of sparsely- to non-fossiliferous mudstone that marks an ice shelf setting during interglacial maxima. The near-absence of subglacial melt-water facies suggests that advance and retreat occurred under cold, polar conditions.

Motif 2 (Pliocene) comprises subglacial to glacimarine diamictite overlain by thin, proglacial deposits and capped with substantial beds of diatom-bearing mudstone or diatomite formed under open-marine conditions. The marked fluctuation between ice-grounded and open-marine phases reflects advance and retreat under conditions

warmer than Motif 1, but without significant subglacial melt water.

Motif 3 (Late Miocene) extends from subglacial diamictite into a thick proglacial succession of stratified diamictite, graded sandstone and conglomerate and/or rhythmically-stratified mudstone. This motif is interpreted as a shift to a warmer style of glaciation characterised by a strong, melt-water retreat/advance phase together with an open-marine phase dominated by terrigenous sediment from the West Antarctic Ice Sheet (WAIS) and possibly local outlet glaciers draining the East Antarctic Ice Sheet (EAIS).

The three motifs appear to represent distinct periods of surface and basal melting forced by climatic oscillations and changes in the thermal regimes of WAIS and potentially EAIS glaciers.