Evidence of long- and short-term responses of the West Antarctic Ice Sheet during the Plio-Pleistocene and their implications: ANDRILL-McMurdo Ice Shelf Project

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Response of ice sheets, especially the West Antarctic Ice Sheet (WAIS), is recognized as a significant unknown in predicting future consequences of global warming. Deeper-time data from 1284m of a sediment core drilled on the NW corner of the Ross Ice Shelf (RIS) are used to assess prior WAIS dynamics and its responses to past climate changes. The core shows WAIS changed from a cold ice sheet less than 13Ma, to being warmer with significant channelized subglacial meltwater prior to ca.7.5Ma, when during interglacials, local rivers flowed to McMurdo Sound. Between 53Ma meltwater decreased and interglacial periods were cooler with diatoms dominating rather than local meltwater. WAIS was dynamic ca.7.5-3Ma with its grounding and calving lines retreating past Ross Island in interglacials; occasionally iceberg calving was absent when termini were mostly terrestrial. Subglacial sediment deformation occurred to ca.10m depth, and glacial advance facies are locally preserved, indicating little erosion occurred during some advances and are used to indicate the ice sheet advance was probably rapid and definitely short-lived. Glacial to interglacial facies transitions are also locally condensed, often lacking retreat packages, and suggest ice sheet retreat was rapid as a response to some past warming events. Volumes of sub-ice-sheet meltwater during glacials and local interglacial meltwater declined through to ca.0.8Ma indicating WAIS was cooling. However, it remained more dynamic than after ca.0.8Ma when it reached its present cold state, inferred from thicker diamictite packages and thin to absent interglacial mudstones.