Geophysical Research Abstracts,
Vol. 10, EGU2008-A-09666, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-09666
EGU General Assembly 2008

West Antarctic Ice Sheet dynamics and its long- and short-term responses: Implications from ANDRILL-McMurdo Ice Shelf Project drilling

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An unknown in predicting consequences of global warming is response of ice sheets, especially the West Antarctic Ice Sheet (WAIS). Deeper-time data from 1284m of sediment core drilled on the NW corner of the Ross Ice Shelf (RIS) are used to assess past WAIS dynamics and responses to climate changes. Ice cores provide records of atmospheric changes; this geological record constrains variations in past ice volume. 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 5-3Ma 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 WAIS erosion was insubstantial and glacial maxima were probably short. Glacial to interglacial facies transitions are also locally condensed, often lacking retreat packages and suggests ice sheet retreat was rapid. 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. These diamictite to stratified glacimarine transitions are similar to LGM deposits including local lift-off glacimarine facies. During this cold period WAIS likely remained large even during interglacials, with the RIS remaining at least at Ross Island.