Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12320, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12320
EGU General Assembly 2008

Initial results of ANDRILL's Southern McMurdo Sound Project drillcore AND-2A: early Miocene to Recent paleoclimate and geological history of the Victoria Land Basin, Antarctica

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ANDRILL's Southern McMurdo Sound Project (SMS) completed the AND-2A drillhole (77°45.488 S; 165°16.613 E) from a floating sea-ice platform (8.5 meters thick), over 380 meters of water, reaching a total depth of 1138.54 mbsf, and recovered an excellent quality core with 98% recovery through the cored interval. One objective was to recover a history of ice-proximal paleoenvironmental variation during the middle Miocene, which has long been held as a fundamental step in development of the Cenozoic cryosphere. Interpretations of deep-sea oxygen isotope records suggest the middle Miocene encompassed a change from a period of warm climatic optima, approximately 17.5 to 14.5 Ma, to the onset of major cooling between c. 14 to 13 Ma, and the formation of a quasi-permanent ice sheet on East Antarctica. The AND-2A drillcore recovered several distinct stratigraphic intervals separated by disconformities: (a) an early Miocene interval (1138.54 up to c. 800 mbsf) of an expanded section through an interval previously recovered during the Cape Roberts Project; (b) a 600 meter-thick middle Miocene interval (800 to 223 mbsf), which includes an expanded section through two middle Miocene climatic optima, is truncated by a disconformity that spans c. 7 m.y.; and (c) a late Pliocene to Recent interval (223 to 0.0 mbsf) that is thinner but correlative to parts of the Late Neogene section recovered by the

ANDRILL MIS Project in drillcore AND-1B. Shallow marine deposits dominate the lower SMS section until c.1.5 Ma when the basin deepened rapidly in response to volcanic loading by Mt Erebus. Early and middle Miocene strata record repeating lithological changes that reflect variation in sea-level, glacial proximity, and climate fluctuations during the interval between c.20 and 14.5 Ma. Sediments deposited close to or beneath grounded glaciers (likely flowing from East Antarctica) alternate with fine-grained marine sediments, providing clear evidence for cycles of ice advance, followed by substantial retreat during climate transitions to warmer conditions. Fossils preserved in these strata suggest the persistence of warmer-than-present conditions over an extended period. The western Ross Sea during the middle Miocene resembled the modern climate conditions of southern Patagonia, southwestern New Zealand, and southern Alaska. An unexpected absence of fossil diatoms in many of the fine grained lithologies suggests that the coastal marine environment was dominated by high sediment input, with substantial river run-off, coastal turbidity, and meltwater input. The SMS Project achieved a nearly continuous downhole logging program, completed a hydrofracture experiment with associated in-situ stress measurements for the Antarctic Plate, and further developed core visualization and data management technology. An excellent chronostratigraphy for the AND-2A drillcore, developing from combined biostratigraphy, magnetostratigraphy and radiometric dating of common tephra and volcanic materials, will provide age control for the drillhole and the network of seismic lines in the western Ross Sea.