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Heat flow from the AND-1B borehole, ANDRILL McMurdo Ice Shelf Project, Antarctica

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During the austral summer of 2006-2007, the Antarctic Drilling Program (ANDRILL) successfully drilled a borehole, AND-1B, beneath the McMurdo Ice Shelf to a total depth of 1285 meters below the seafloor (mbsf), with 98 percent sediment core recovery for detailed study of climate and ice-sheet history. Several complementary geophysical logs were also collected in this borehole to a depth of approximately 1000 mbsf for a variety of scientific analyses. Among these downhole measurements were three temperature logs recorded over a span of five days after a 60-day period of drilling and circulation had ceased. These temperature profiles generally display a gradual and systematic return to equilibrium geothermal conditions, interspersed with several marked anomalies indicating fluid exchange between the borehole and the surrounding formation and locating distinct zones where mud circulation was lost during drilling activities. A logarithmic decay method (Horner plot) was used to extrapolate the three temperature records to infinite recovery time in order to arrive at estimates of the undisturbed temperature gradient from the seafloor down to 640 mbsf. Below this depth, the temperature logs are too disrupted by the effects of drilling and mud circulation to offer reliable estimates of equilibrium temperature. The average temperature gradient across this upper 640-m section of the borehole is determined to be 76.7 K/km. Representative values of thermal conductivity are computed from mixing models using core descriptions and direct measurements of density/porosity

obtained on core. Relatively high porosities in the range of 50 percent are reflected in relatively low thermal conductivities averaging 1.5 W/mK. These estimates yield a corresponding heat flow value of 115 mW/m^2 for this site. This value of heat flow is comparatively high for the region and may be due to the borehole's proximity to several volcanic centers of the Erebus Volcanic Province and its associated crustal thermal anomaly.