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Preliminary Integrated Chronostratigraphy of the AND-2A Core, ANDRILL Southern McMurdo Sound Project, Antarctica

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Abstract - We use all available chronostratigraphic constraints – biostratigraphy, magnetostratigraphy, radioisotopic dates, strontium-isotope stratigraphy, and correlation of compositional and physical properties to well-dated global or regional records – to construct a preliminary age model for ANDRILL SMS Project's AND-2A drillcore (77°45.488'S, 165°16.605'E, 383.57 m water depth). These diverse chronostratigraphic constraints are consistent with each other and are distributed throughout the 1138.54 m-thick section, resulting in a well-constrained age model. The sedimentary succession comprises a thick early and middle Miocene section below 224.82 mbsf and a condensed middle/late Miocene to Recent section above this. The youngest sediments are Brunhes age (<0.781 Ma), as confirmed by a radioisotopic age of 0.691±0.049 Ma at 10.23 mbsf and the occurrence of sediments that have normal magnetic polarity down to ~31.1 mbsf, which is interpreted to be the Brunhes/Matuyama reversal (0.781 Ma). The upper section is punctuated by disconformities resulting from both discontinuous deposition and periods of extensive erosion typical of sedimentary environments at the margin of a dynamic ice sheet. Additional breaks in the section may be due to the influence of tectonic processes. The age model incorporates several major hiatuses but their precise depths are still somewhat uncertain, as there are a large number of erosional surfaces identified within the stratigraphic section. One or more hiatuses, which represent a total 7 to 8 million years of time missing from the sedimentary record, occur between about 50 mbsf and the base of Lithostratigraphic Unit (LSU) 3 at 122.86 mbsf. Similarly, between about 145 mbsf and the base of LSU 4 at 224.82 mbsf, one or more hiatuses occur on which another 2 to 3 million years of the sedimentary record is missing. Support for the presence of these hiatuses comes from a diatom assemblage that constrains the age of the core from 44 to 50 mbsf to 2.06-2.84 Ma, two radioisotopic dates (11.4 Ma) and a Sr-isotope date (11.7 Ma) that indicate the interval from 127 to 145 mbsf was deposited between 11.4 and 11.7 Ma, and three diatom occurrence datums from between 225.38 and 278.55 mbsf that constrain the age of this upper part of Lithostratigraphic Unit (LSU) 5 to 14.29 - 15.89 Ma. Below the boundary between LSU 5 and 6 sedimentation was relatively continuous and rapid and the age model is well-constrained by 9 diatom datums, seven ^{40}Ar-^{39}Ar dates, one Sr-isotope date, and 19 magnetozones. Even so, short hiatuses (less than a few hundred thousand years) undoubtedly occur but are beyond the resolution of current chronostratigraphic age constraints. Diatom first and last occurrence datums provide particularly good age control from the top of LSU 6 down to 771.5 mbsf (in LSU 10), where the First Occurrence (FO) of *Thalassiosira praefraga* (18.85 Ma) is observed. The diatom datum ages are supported by radioisotopic dates of 17.30±0.31 Ma at 640.14 mbsf (in LSU 9) and 18.15±0.35 and 17.93±0.40 Ma for samples from 709.15 and 709.18 mbsf (in LSU 10), respectively, and 18.71±0.33 Ma for a sample from 831.67 mbsf (in LSU 11). The sediments from 783.69 mbsf to the base of the hole comprise two thick normal polarity magnetozones that bound a thinner reversed polarity magnetozone (958.59 - 985.64 mbsf). This polarity sequence most likely encompasses Chrons C5En, C5Er, and C6n (18.056 - 19.772 Ma or slightly older given uncertainties in this section of the geomagnetic polarity timescale), but could be also be Chrons C6n, C6r, and C6An.1n (18.748 - 20.213 Ma). Either polarity sequence is compatible with the ^{40}Ar–^{39}Ar age of 20.01±0.35 Ma obtained from single-grain analyses of alkali feldspar from a tephra sample from a depth of 1093.02 mbsf, although the younger interpretation allows a better fit with chronostratigraphic data up-core. Given this age model, the mean sedimentation rate is about 18 cm/k.y. from the top of LSU 6 to the base of the hole.