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Palaeomagnetism of the AND-2A Core, ANDRILL Southern McMurdo Sound Project, Antarctica

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Abstract – We conducted initial palaeomagnetic studies on cores from site AND-2A (77°45.488'S, 165°16.605'E, ~383.57 metres water depth). A total of 813 samples were collected that span from the top of the section down to the base at 1138.54 metres below sea floor (mbsf). Samples were collected every one or two metres down the core, with paired (pilot) samples being collected about every ten to twenty metres to allow us to assess the demagnetisation behaviour of the samples using either alternating field (AF) or thermal demagnetisation. With the exception of only a few intervals, AF demagnetisation was observed to resolve a characteristic remanent magnetisation (ChRM) as well or better than thermal demagnetisation. Thermal demagnetisation was particularly ineffective in many intervals owing to thermal alteration that was common above 500°C and was evident in some samples even at low temperatures. Above Lithostratigraphic Unit (LSU) 8 (436.18 mbsf), where lithologies are generally more coarse grained than lower in the section, resolving a ChRM is difficult and recent overprints or a drilling overprint are a concern. Within LSU 8 and below, most samples have a ChRM that can be resolved. The ChRM is most likely an original depositional magnetisation throughout most of this lower section, although orthogonal demagnetisation diagrams contain evidence that normal polarity overprinting affects some intervals. Based on $^{40}Ar/^{39}Ar$ dates and diatom datums, the magnetozones identified from the base of the hole up to ~266mbsf are consistent with spanning from either Chron C6n (18.748-19.772 Ma) or C6An.1n (20.040-20.213 Ma) up through Chron C5Br (15.160-15.974 Ma). Above this, intervals of constant polarity are isolated within longer stratigraphic intervals of uncertain polarity, making their correlation with the geomagnetic polarity timescale (GPTS) speculative and highly dependent on ages obtained from other dating methods. One exception is a reversed-to-normal polarity transition that occurs at ~31 mbsf and is interpreted to most likely be the Brunhes/Matuyama boundary. The spacing of polarity reversals below 266 mbsf and their correlation with the GPTS indicates that this part of the stratigraphic section was deposited between 15 to 20 Ma at a mean sedimentation rate of about 18 centimetres (cm)/ thousand year (k.y.).

INTRODUCTION

The Southern McMurdo Sound (SMS) Project of the ANDRILL Programme cored site AND-2A (77°45.488'S, 165°16.605'E, ~383.57 m water depth) to a total depth of 1138.54 mbsf (Fig. 1). The thick sequence of rocks recovered contains a geologic history of the region, including records of climate change, tectonics, and much more.

In this study, we examine the palaeomagnetic record of the core with a primary focus on determining a preliminary magnetostratigraphy, which can be used to assist in dating the stratigraphic section. We follow a sampling and measurement strategy similar to that applied in the palaeomagnetic study of cores from Site AND-1B from the McMurdo Ice Shelf (MIS) Project of ANDRILL (Wilson et al., 2007), with a goal of building a long continuous palaeomagnetic record that spans from the early Miocene to present. To accomplish this, we collected oriented mini-core samples (~2.3-cm long and 2.5-cm diameter) roughly every one to two metres downcore, for a total of 813 samples. The samples were shipped to palaeomagnetism laboratories at the University of California, Davis (UCD), at the Istituto Nazionale di Geofisica e Vulcanologia, Rome (INGV), and at Otago University (OU), Dunedin, New Zealand, for analysis.

The laboratory analyses consisted of measuring the natural remanent magnetisation (NRM) prior to and following progressive alternating field (AF) or thermal demagnetisation. Demagnetisation is used to remove secondary overprints, with the goal of resolving a characteristic remanent magnetisation (ChRM) direction. Ideally, this ChRM is a primary component acquired during deposition or very shortly thereafter, such that it gives the ancient direction of the ambient magnetic field at or near the time of deposition, from which the magnetic polarity is obtained. Ages are determined by mapping the