Terra Antartica
2008-2009, **15**(1), 49-56

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

G.B. Dunbar[1*], C. Atkins[2], D. Magens[3], F. Niessen[3]
& the ANDRILL-SMS Science Team[4]

[1]Antarctic Research Centre, Victoria University of Wellington, P.O. Box 600, Wellington - New Zealand
[2]School of Geography, Environment and Earth Sciences, Victoria University of Wellington, P.O. Box 600, Wellington - New Zealand
[3]Alfred Wegener Institute for Polar and Marine Research, P.O. Box 120161, 27515 Bremerhaven - Germany
[4] http://andrill.org/projects/sms/team.html

**Corresponding author* (gavin.dunbar@vuw.ac.nz)

Abstract - Whole-core measurements of Wet Bulk Density (WBD), compressional (P)-wave velocity (Vp), and Magnetic Susceptibility were measured at a sampling interval of 1 or 2 centimetres (cm) throughout the AND-2A drill core for initial core characterisation and on-site correlation with seismic modeling to predict target-reflector depth. Measurements were made using a GEOTEK (Multi-Sensor-Core-Logger MSCL). Density and velocity standards were measured together with core runs of 3-6 metres (m) (and occasionally up to 18 m) throughout the entire depth range to monitor data quality. Drift of the magnetic susceptibility sensor was also monitored and corrected where necessary. These physical properties show a large range of values, reflecting the different nature of the various lithologies including extremely high velocity and density values in individual clasts, and the effects of cementation on porosity. A downcore increase in WBD and Vp occurs in the upper 200 m, however, no systematic trend exists at greater depths although large fluctuations on a m-decimetre- (dm) scale occur. Magnetic susceptibility is generally low ($<100 \times 10^{-5}$ SI), however, four intervals of high ($>600 \times 10^{-5}$ SI) susceptibility occur at 560, 800, 980 and 1 080 mbsf, indicating a relatively greater contribution of volcanic-derived material to the core site in the lower half of the AND-2A core.

INTRODUCTION

Whole-core physical properties provide a means of rapidly and non-destructively characterising geological core at cm-scale resolution (*e.g.* Mayer, 1991; Weaver & Schultheiss, 1990; Weber et al., 1997). During the drilling of AND-2A, on-site core measurements were carried out in a similar manner to those described for the Cape Roberts Project (CRP) (Cape Roberts Science Team, 1998; 1999; 2000) and the McMurdo Ice Shelf (MIS) (Niessen et al., 2007).

Wet Bulk Density (WBD), P-wave velocity (Vp) and Magnetic Susceptibility (MS) can be used to characterise gross lithology, including the effects of diagenesis (*e.g.* Jarrard et al., 2000; Niessen et al., 2000). Importantly, whole core physical logs can be used to correlate between drill sites where downhole logs are absent or incomplete (Henrys et al., 2000).

Furthermore, P-wave data can be processed on-site to yield 'real-time' vertical profiles of cumulative P-wave travel time that allows the stratigraphic depth of target seismic reflectors to be recalculated from the initial geophysical survey interval velocities (*e.g.* Henrys et al., 2000; 2001).

This paper presents (i) data acquisition, calibration and processing of physical properties during the drilling phase on-ice, (ii) analysis of physical-property standards and suggestions for enhancing the data through off-ice processing, and (iii) a preliminary overview of stratigraphic patterns in the physical-property data in the AND-2A core.

METHODS AND MATERIALS

A GEOTEK Multi-Sensor-Core-Logger (MSCL) was used at the drill site to measure core temperature, core diameter, P-wave travel time, gamma-ray attenuation and MS data (Fig. 1; details of the instrument and measurement process can be found at www.geotek.co.uk). In addition to the standard MSCL measurements, as part of the P-wave travel time acquisition process, full waveform transmission seismograms were digitized using the approach of Breitzke et al. (1996). The technical specifications and setup of the MSCL system as used during AND-2 drilling are summarized in table 1.

Each 1 m-long whole-core section was logged by placing it on a plastic carrier (a "split"). This was used to maintain the integrity of fractured or friable sections of core as they passed through the sensor array. The methodology is described in detail in the CRP-2 Initial Report (Cape Roberts Science Team, 1999). Individual 1m-long core sections were butted together to create continuous logging runs between 3 and 18 m (usually 6 m) in length. At the beginning and end of each run, standards made of aluminum, water and PolyOxyMethylene (POM) were logged to calibrate and/or monitor data quality for core diameter,