New techniques in sediment core analysis: an introduction

R. GUY ROTHWELL[1] & FRANK R. RACK[2]

[1]*National Oceanography Centre, Empress Dock, Southampton SO14 3ZH, UK (e-mail: rgr@noc.soton.ac.uk)*

[2]*Joint Oceanographic Institutions, 1201 New York Avenue, NW, Suite 400, Washington, DC 20005, USA*

Abstract: Marine sediment cores are the fundamental data source for information on seabed character, depositional history and environmental change. They provide raw data for a wide range of research including studies of global climate change, palaeoceanography, slope stability, oil exploration, pollution assessment and control, and sea-floor surveys for laying cables, pipelines and siting of sea-floor structures. During the last three decades, a varied suite of new technologies have been developed to analyse cores, often non-destructively, to produce high-quality, closely spaced, co-located downcore measurements, characterizing sediment physical properties, geochemistry and composition in unprecedented detail. Distributions of a variety of palaeoenvironmentally significant proxies can now be logged at decadal and, in some cases, even annual or subannual scales, allowing detailed insights into the history of climate and associated environmental change. These advances have had a profound effect on many aspects of the Earth Sciences, particularly palaeoceanography. In this paper, we review recent advances in analytical and logging technology, and their application to the analysis of sediment cores. Developments in providing access to core data and associated datasets, and data-mining technology, in order to integrate and interpret new and legacy datasets within the wider context of sea-floor studies, are also discussed. Despite the great advances in this field, however, challenges remain, particularly in the development of standard measurement and calibration methodologies and in the development of data analysis methods. New data visualization tools and techniques need to be developed to optimize the interpretation process and maximize scientific value. Amplified collaboration environments and tools are needed in order to capitalize on our analysis and interpretation capability of large, multi-parameter datasets. Sophisticated, yet simple to use, searchable Internet databases, with universal access and secure long-term funding, and data products resulting in user-defined data-mining query and display, so far pioneered in the USA and Australia, provide robust models for efficient and effective core data stewardship.

Sea-floor sediment cores are the fundamental data source for information on seabed character, depositional history and environmental change. Research into global climate change, slope stability, oil exploration, pollution assessment and control, surveying for laying telecommunications cables and offshore pipelines all rely on data obtained from marine sediment cores and samples (Table 1). Important oceanographic and earth science disciplines such as palaeoceanography rely on core material to determine past climate changes and changes in ocean circulation. Models of past climate changes can only be validated by examining the past record preserved in marine sediment and ice cores, and such records allow us to understand the past and predict the future world.

References to marine sediments occur in Ancient Greek and Roman texts, but it was not until 1773 that the first recorded sediment was recovered from the deep sea. In that year 'fine soft blue clay' was sampled with the first recorded deep-sea sounding made by Captain John Phipps on HMS *Racehorse* in 1250 m water depth on the southern margin of the Vøring Plateau north of Norway. Forty-five years later in 1818, Sir John Ross recovered 2.7 kg (6 lbs) of greenish mud from the floor of Baffin Bay, offshore Canada, using a deep-sea grab. This recovery from 1920 m water depth represents one of the first recorded successful substantial deep-sea sediment recoveries. In 1851 the first functioning submarine telegraph cable was laid across the Straits of Dover and the advent of submarine cable laying as a new means of intercontinental communication led to a rapid growth in the collection of deep-sea soundings and samples. However, it was not until the *Challenger* expedition of 1872–1876 that enough deep-sea samples were recovered to produce the first global sea-floor sediment map. Victorian intellectual curiosity led Sir Charles Wyville Thomson, Professor of Natural History at Edinburgh University, and his Canadian-born

From: ROTHWELL, R.G. 2006. *New Techniques in Sediment Core Analysis*. Geological Society, London, Special Publications, **267**, 1–29. 0305-8719/06/$15.00