A SEA FLOOR MAGNETOMETER 
FOR THE CONTINENTAL SHELF

ANTONY WHITE
School of Earth Sciences, The Flinders University of South Australia, Bedford Park, South Australia 5042

(Accepted 20 October, 1978)

Abstract. Measurement of temporal magnetic variations on the sea floor is desirable in order to extend the technique of geomagnetic depth sounding into the oceans. This paper describes a recording three-component sea floor magnetometer and its use in continental shelf depths. The orientation and tilt of the instrument on the sea floor are recorded using gelatine solutions to 'freeze' a compass card and a ball-bearing, respectively. A backing-off procedure initially nulls the magnetic field components along each of the three mutually orthogonal fluxgate sensors. Magnetic variations along each sensor axis are then recorded within a range of ±300 nT of these nulled positions. The resolution is ±1 nT, and with a power drain of 800 mW the magnetometer can record continuously for 30 days. The instrument capsule is moored to surface buoys for recovery in continental shelf applications. The buoys may have marker flags, radar reflectors or radio beacons attached to them to aid in relocation.

Introduction

In the last two decades the measurement of geomagnetic variations (with periods ranging from a minute to several days) has become popular in connection with a technique known as geomagnetic depth sounding. In this technique, profiles or arrays of recording magnetic variometers are left in position for periods of from one to several months, during which time they record geomagnetic variations such as storms, bays, pulsations and the normal daily variation. The variations contain both external and internal parts, the latter being due to concentrations of induced electric current flowing in the more conductive regions of the crust and upper mantle. By mapping the patterns of induced currents and using suitable analysis of the magnetic variations, theoretical models of the subterranean electric conductivity structure may be inferred.

Land-based magnetometers have recorded many 'anomalous' geomagnetic variations associated with conductive bodies or regions, which include such areas as inland seas and lakes, large sedimentary basins and the ocean waters. These near-surface conductors can make it difficult to detect and interpret the effects of deep conductivity structure and impose a potentially severe limitation on land-based surveys directed towards a straightforward conductivity depth-sounding experiment. Although the need to extend the technique to include sea floor observations has long been recognised, relatively few attempts have been made. Studies of the ocean–continent structure along the California coastline (Filloux, 1967; Cox, Filloux and Larsen, 1970; Greenhouse, 1972) included

Copyright © 1979 by D. Reidel Publishing Company.
observations both on the continental shelf and on the deep ocean floor, while Poehls and Von Herzen (1976) chose to avoid structural and tectonic complications by making observations on abyssal plains in the North Atlantic. This paper describes a sea floor magnetometer developed initially for use on the continental shelf and which has been used in a study of the coast effect in geomagnetic variations in South Australia (White and Polatajko, 1978). In design it is similar to the Cambridge University sea floor magnetometer (Owen and Sik, 1972; Sik, 1973), with which, unfortunately, no sea floor observations of any significance were ever made.

The Instrument Capsule

The design of a sea floor magnetometer falls naturally into two parts; the design of the magnetometer and the design of the instrument capsule which houses it on the sea floor. Although some design details will be given here as necessary, fully detailed descriptions and specifications on all aspects of the sea floor magnetometer are available in an unpublished report (White, 1977).

The physical layout of the instrument capsule may be seen in Figure 1 which shows the magnetometer being readied for launching by hand from a small