APPENDIX VII

BLANCOVIN 1995

Chief Scientist: Maurice A. Tivey

Dates: 13th July - 30th July 1995

Location: Western Blanco Fracture Zone, Southern Juan de Fuca

Objective: To map the spatial variation of a magnetic anomaly polarity reversal boundary with depth in oceanic crust.

Results:

- 11 Dives traversing the Blanco scarp face
- 1 Dive lost to weather
- 2 Dives on ODP Hole 892 Oregon Margin (Keir Becker)
- Deepest dive 4337 m
- Average bottom time 4.3 hrs.
- Magnetic field data collected on all traverses
- Mesotech data on 10 dives
- 23 gravity stations
- 61 rock samples
- 12 oriented samples using geocompass
- 45 cored samples for paleomagnetic measurements
- 1000 lbs dredged rock samples from Parks Plateau
- 750 km sea surface magnetic field data using new WHOI system
- 2 deeptow magnetic tows
- 6 ABE launches and recovery

NSF Grant OCE-9400623

Title: Direct Measurement of a Polarity Boundary with Depth in Ocean Crust

P. I.: Maurice A. Tivey

Summary

The main goal of the research project referenced above is to determine the nature of a magnetic polarity reversal within the upper oceanic crust. It has been shown previously [Tivey, 1995] that measuring the magnetic field of a steep scarp face where oceanic crust is exposed can provide a high resolution picture of crustal magnetization and by inference crustal architecture. The first data collection phase of this project has been successfully completed. During July 1995, eleven ALVIN submersible dives (one dive was lost to weather) were carried out on the Blanco escarpment located at the western end of the Blanco fracture zone at the southern end of the Juan de Fuca Ridge in the northeast Pacific. The dives successfully measured magnetic field data on all dives and clearly defines the Jaramillo normal polarity anomaly as it intersects the steep scarp face. In addition to the magnetic field data, we also obtained

mesotech scanning sonar data, high quality 3-chip video observations of the scarp, 61 rock samples of which 12 were oriented for paleomagnetic reconstructions. 21 high quality on bottom gravity stations were also obtained. Rock samples were measured for paleomagnetic properties of susceptibility and natural remnant magnetization. In addition to the submersible program, we also collected 750 km of sea surface magnetometer data to better constrain the magnetic anomaly stripes as they intersect the scarp face. The night-time program also included 8 successful rock dredges over the surrounding region but mostly focused on the Parks Plateau which forms the southern boundary of the Blanco fracture zone in the study area. Four test dives of an small autonomous underwater vehicle being developed at Woods Hole, the Autonomous Benthic Explorer (ABE), were also completed in preparation for a later research cruise. Magnetic data were collected on one of these ABE dives.

- Second year

In the second year, processing- of the ALVIN data will be undertaken. These data include submersible magnetics, mesotech sonar data, and geological observations. Also, the deeptow magnetic profile obtained along the scarp top will be processed along with the sea surface magnetic data. The analysis of the ALVIN magnetic data will utilize the vertical magnetic approach developed in an earlier project [Tivey, 1995]. Other data collected during- the cruise will also be analyzed at no cost to this proposal. These data include oriented sample data and paleomagnetic data from rock samples and seafloor gravity stations. Once all the data has been processed, the submarine data will **be** integrated into an overall picture of crustal magnetization and architecture.

Tivey, M. A., A measurement of the vertical magnetic structure of ocean crust using near bottom sensors, *EOS Trans. AGU, 73,* 14, 90, 1992.

Tivey, M. A., The vertical magnetic structure of ocean crust determined from near-bottom magnetic field measurements, Jour. Geophys. Res., in revision, 1995

Tivey, M. A., C Fleutelot, S Hussenoeder, H P Johnson, R M Lawrence, D D Naidoo, D van Patten, C Waters and F B Wooding, BLANCOVIN: A Submersible Study of Oceanic Crust at a Magnetic Polarity Reversal Boundary, EOS Trans. AGU, Fall meeting, 1995.

Fleutelot, C., T Juteau, M A Tivey and BLANCOVIN Scientific Team, The Parks Plateau Unveiled EOS Trans. AGU, Fall meeting, 1995.

BLANCOVIN 1995

Cruise objectives

The main goal of the BLANCOVIN research cruise was to map the spatial variation of a magnetic anomaly polarity reversal boundary with depth where exposed in a cross-section of oceanic crust. The nature of the reversal boundary is of prime importance to the question of the source of the magnetic anomalies. While numerous models have been inferred and proposed for the configuration of the reversal boundary with depth, there have been no direct measurements of this feature. Just as magnetic anomalies can be used to define isochrons on the seafloor, likewise, the magnetic boundaries at depth can also define isochrons through the crust. These timelines provide important insight into the nature and timing of the crustal processes that both form and subsequently modify oceanic crust. The BLANCOVIN ALVIN dive program was designed to address these fundamental issues by directly measuring a magnetic reversal boundary with depth using new survey strategies and analysis techniques developed for magnetic data obtained on scarps. The vertical magnetic profiling technique [Tivey, 1992, 1993a] has been successfully tested using the French submersible NAUTILE in young, ca. 1.2 Ma old crust, exposed at the Blanco Scarp in the northeast Pacific Ocean. Results from this study show- that a large magnetic anomaly contrast (7000 nT) is found at the dike to extrusive lava contact and that the extrusive basalts contribute over 80% of the source of the magnetic anomaly signal measured at the sea surface. The NAUTILE survey was located in a region of constant reversed polarity crust (Matuyama epoch), providing the basic framework for the variation of magnetization with crustal depth. This dive program seeks to survey the crust adjacent to the NAUTILE] survey site, where the normal polarity Jaramillo magnetic anomaly clearly intersects the Blanco Scarp. The survey strategy will be to progressively increase the level of resolution of the crustal magnetic signal by starting with a close fine spacing sea surface magnetic survey, followed by a near-bottom survey of the seafloor using a deeptow magnetometer, and culminating in magnetic traverses by the ALVIN submersible on the scarp face. These surveys are designed to carry out a kind of .1 magnetic tomography" of the crust. The main magnetic objectives of this cruise are to address the following points:

- directly determine the nature of the reversal boundary with depth in the upper oceanic crust.
- determine the source of sea surface magnetic anomalies by defining the upper contributions, but also in doing so, putting constraints on the contribution from the lower crust.
- directly relate the measured magnetic structure of the crust to the overlying magnetic anomalies measured near the sea floor and at the sea surface.
- define the distribution and timing of the crustal processes responsible for emplacement, accretion, tectonic disruption, and alteration of oceanic crust. These observations can then be related to the observations at the current axis of spreading.

This appendix contains 5 figures. Copies of these figures can be obtained from the UNOLS Office.