THE INTERACTION BETWEEN PRIMARY BASEMENT STRUCTURE AND SECONDARY CRUSTAL EXTRUSION ALONG THE HAWAIIAN RIDGE

A DISSERTATION SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

IN OCEANOGRAPHY

AUGUST 1978

By

Jerome A. Foreman

Dissertation Committee:

James E. Andrews, Chairman
Richard N. Hey
Loren W. Kroenke
Stanley V. Margolis
Edward D. Stroup

ABSTRACT

Recently acquired marine magnetic data collected during detailed geophysical investigations along the Hawaiian Ridge are presented. These data verify the proposed extension of Mesozoic magnetic lineation sequences eastward through the Hawaiian Ridge and Emperor Seamount Chain. In addition, the position of several small fracture zones extending from anomaly M9-M10 eastward toward the Hawaiian Ridge are located. These small fracture zones appear to have formed in conjunction with a reorientation in seafloor spreading around anomaly M10 time (122 my.BP.).

New and previously published data obtained by seismic reflection profiling confirm the position of these small fracture zones as well as the major parallel fracture zones which offset the entire Hawaiian Lineation sequence west of the Hawaiian Ridge. This major fracture zone is traced in profile eastward through the Hawaiian Ridge to 177°W to the previously identified western limit of the Cenozoic Mendocino Fracture Zone, thereby establishing the continuity of this Pacific-Farallon great fault system with the Late Mesozoic seafloor spreading sequence west of the Hawaiian Ridge. Reflection profiles and magnetic data also reveal the presence of two other possible fracture zones west of Laysan Island which may mark a bifurcated westward extension of the Cenozoic Murray great fault system.

The junction of the Hawaiian Ridge with these major fracture zones, as well as one of the minor offsets, is shown to coincide with discontinuities in the topographic expression of the Ridge. This observation

suggests that these fracture zones may have acted in a regulatory capacity to constrain the extrusive upwellings associated with Hawaiian Ridge-Emperor Seamount Chain growth.

The continuity of magnetic and structural trends through the Hawaiian-Emperor trend suggests these volcanic chains do not mark the location of a Pacific-Farallon plate margin nor any sort of translational boundary. Furthermore, the proposed existence of fracture zone control of ridge propagation implies the Hawaiian Ridge and the Emperor Seamount Chain are not the volcanic traces of a propagating fracture. The conclusions drawn from the current study favor a model for Hawaiian-Emperor growth which maintains the structural integrity of the seafloor through which volcanism propagates. This condition is best described by hypotheses which utilize hot spots or thermal plumes as volcanic sources.