Heat Flow and Tectonics in the Western Ross Sea, Antarctica

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INTRODUCTION

The crustal thinning and subsidence of the Ross Embayment and the rapid Cenozoic uplift of the Transantarctic Mountains are strong evidence that the active tectonic regime in this part of Antarctica may be associated with regionally anomalous thermal conditions. Surface wave dispersion studies (Adams, 1972) and gravity modeling (Woollard, 1962; Smithson, 1972; Davey and Cooper, this volume) indicate 21–30 km thick crust in the Ross Embayment compared with average thicknesses of 40–45 km in East Antarctica and 30–40 km in West Antarctica. Gleadow and McKelvey (1980) and Gleadow (1983) infer uplift rates for the central Transantarctic Mountains from the relative elevation of basement outcrops and their ages, determined from fission track data on apatite in the basement rocks. They obtain uplift rates of 15 m/m.y. from the Late Cretaceous to the Tertiary during which the rate rapidly increased to 55 m/m.y. The existence of Cenozoic through Recent volcanism (Gonzales-Ferran, 1982) indicates the presence of at least localized thermal anomalies, though the rather linear trace from Weaver Volcano through Mt. Erebus, Mt. Melbourne, and the Balleny Islands (see Fig. 1) suggests that the volcanism may be an expression of a large-scale thermal feature. Measurements of the heat flow in the western Ross Sea may help to elucidate the tectonic regime of this transition between the East Antarctic craton and the structurally more complex West Antarctica.

Two days of the 1984 U.S. Geological Survey (USGS) cruise aboard the R/V S.P. Lee were devoted to collecting sediment samples and measuring heat flow. Owing to difficulties both in locating station sites with sufficiently thick, soft sediment cover and in holding station during adverse weather conditions, we obtained useful measurements at only two stations in the western Ross Sea (Fig. 1). Though the data are few and are characterized by some uncertainties, consistent data at each station indicate reliable results. When combined with previous results from onshore and in the central Ross Sea, these new measurements show that higher than average heat flow is found well away from recent volcanoes and may indicate the existence of a regional thermal anomaly.

DATA ACQUISITION

Several areas suitable for heat flow measurements were selected based on sedimentologic and hydrographic data (e.g., Anderson et al., 1984; Jacobs et al., 1974). Priorities were given to the following targets: Victoria Land basin; a profile traversing the linear, possibly continuous volcanic features that include Mt. Erebus, Mt. Melbourne, and the Balleny Islands;