Alkalic basalts and ultramafic xenoliths on James Ross Island, Antarctic Peninsula

RANDALL A. KELLER

College of Oceanography
Oregon State University
Corvallis, Oregon 97331

JORGE A. STRELIN

Instituto Antartico Argentino
Cerrito 1248
1010 Buenos Aires, Argentina

The northern Antarctic Peninsula was the site of at least 200 million years of subduction of oceanic crust and related arc volcanism (Saunders, Tarney, and Weaver 1980), but recently (since approximately 7 million years ago) extension-related volcanism has taken over and is known at numerous locations on and around the peninsula (Smellie et al. 1988). Studies by ourselves (Fisk 1990; Keller and Fisk 1992; Keller et al. 1992) and others (Weaver et al. 1979; Smellie 1987; Hole 1988, 1990) of extension-related volcanism in this area suggest that significant chemical complexities of the earth's mantle are reflected in the recent volcanic products around the northern part of the peninsula. We are investigating the possibility that some of these mantle source variations can be related to the effects of the recently extinct subduction zone on the west coast of the Antarctic Peninsula. Extension-related lavas at a variety of distances (125-400 kilometers) from the South Shetland Trench provide an opportunity to study the spatial extent of subduction-contamination of the mantle beneath a relatively immobile lithospheric plate. The fieldwork component of this study included the sampling of the volcanic stratigraphy of James Ross Island undertaken by us during January and February 1992 at Massey Heights (figure 1), and the collection of ultramafic xenoliths near Ekelof Point (figure 1).

The sheer cliffs of Massey Heights (figure 2) offer excellent opportunities for observation and sampling of the volcanic stratigraphy of this area of the island. Most of the volcanic rocks on the island are mildly alkalic basalts and palagonite breccias between 7 and 1.5 million years old (Nelson 1966; Rex 1976; Smellie 1987; Smellie et al. 1988), but analyses of James Ross Island lavas by modern geochemical methods are extremely limited. One facet of our study will be the determination of the chemical compositions of the lavas we collected and comparison of them with other recent lavas of the Antarctic Peninsula to evaluate the range of chemical variation of the mantle.

We will obtain additional information on the nature of the mantle beneath James Ross Island in our study. Preliminary examination of the ultramafic xenoliths we collected from in and around a basalt dike near Ekelof Point (figure 1) suggests that they are predominantly spinel lherzolites (consisting of the minerals olivine, clinopryroxene, orthopyroxene, and spinel) with between 50 and 95 percent olivine. They therefore appear to be fertile fragments of the upper mantle rather than restites or cumulates.

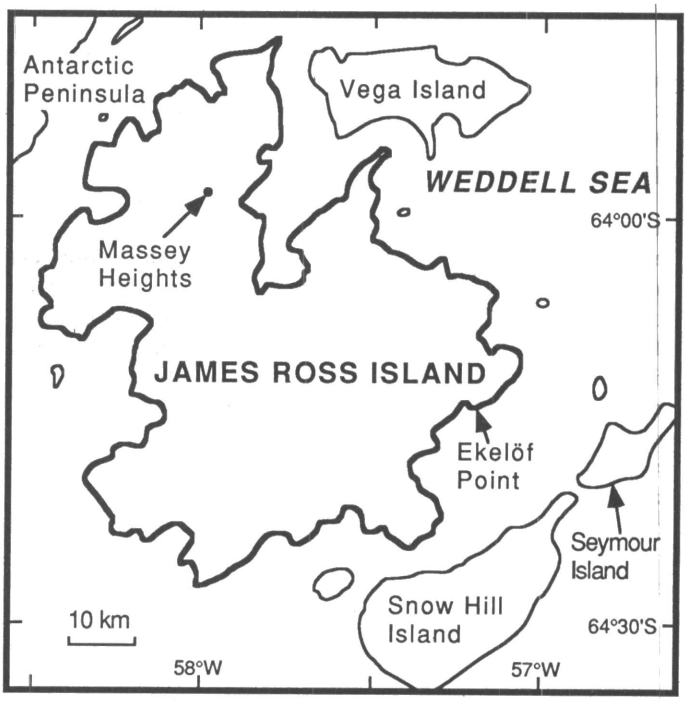

Figure 1. Map of James Ross Island area showing locations of Massey Heights and Ekelof Point, the two 1992 geological fieldwork sites discussed in text.

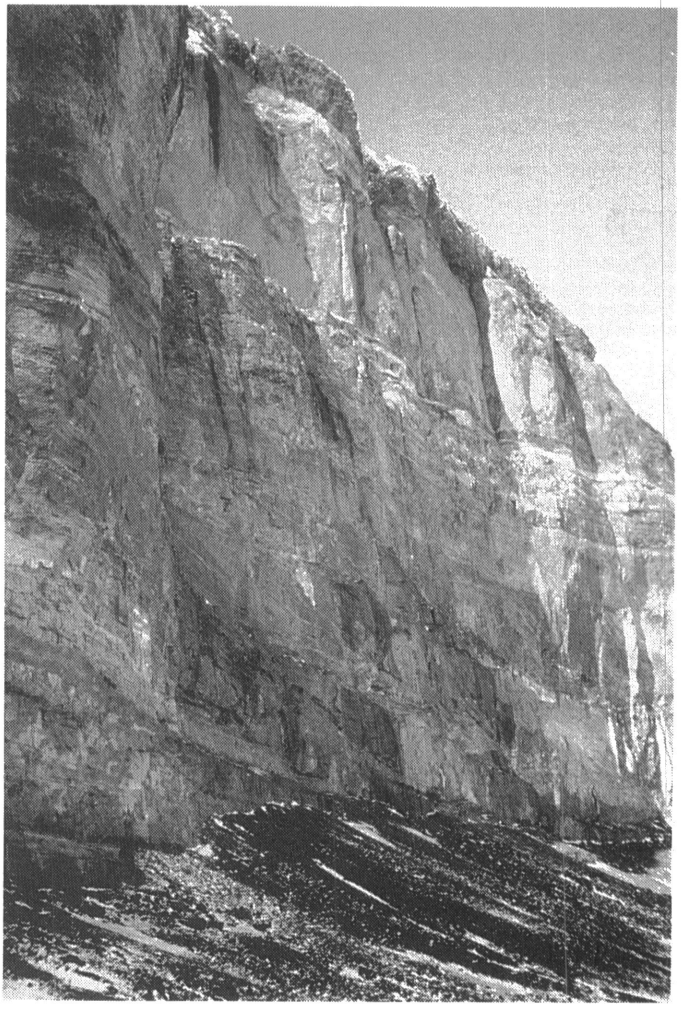

Figure 2. Photograph of cliffs of Massey Heights, showing palagonite breccias and basalt flows. Cliff is approximately 150 meters tall at this location.

Lherzolithic xenoliths are generally believed to represent fragments of the upper mantle brought to the surface by their host volcanic rocks (for example, Francis 1987). Studies of these xenoliths are the primary sources of our present knowledge of the upper mantle in many regions (Menzies 1983; Xue et al. 1990).

Detailed geochemical analyses of mantle xenoliths can decode not only present mantle conditions in an area but also, through radiogenic isotype systematics, the history of chemical inputs and outputs for a region of the mantle (Xue et al. 1990). Similarly, we will conduct an integrated mineral phase and radiogenic isotope study of the spinel lherzolite xenoliths from James Ross Island. The virtual lack of Tertiary motion of the Antarctic Plate (LeMasurier and Rex 1989) suggests the mantle is relatively stable there, but the nature of the antarctic mantle is exceptionally poorly known; we expect this study to make a significant contribution to our knowledge of the sources and processes extant beneath the Antarctic Plate in the region of the Antarctic Peninsula.

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