Genesis of mineralization associated with Andean intrusions, northern Antarctic Peninsula region

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Portions of the 80–1 and 80–2 cruises of R/V *Hero* were reserved for investigations of metallic mineralization in the northern Antarctic Peninsula region. Efforts were concentrated on King George Island within the South Shetland Island group, to a lesser extent, on Livingston and Greenwich Islands in the South Shetlands, on Low Island, and in the vicinity of Palmer Station, southern Anvers Island (figure 1).

We spent 20 days (27 January to 15 February 1980) working on Keller and Barton Peninsulas, King George Island (figure 2). Our field studies included detailed structure and geologic mapping and collecting hand specimens and composite rock-chip samples for microscopic and geochemical study. The central axis of King George Island is formed by members of the Andean intrusive suite. Previous researchers (Hawkes 1961; Barton 1965) noted widespread alteration and mineralization of Upper Jurassic (?) basalts, andesites, and pyroclastic rocks around the Andean intrusions.

We chose Keller Peninsula for study because of reports (Barton 1965) of extensive quartz-pyrite metasomatism within Upper Jurassic volcanics of the peninsula. The volcanic units were mapped in detail and the microtectonic elements were measured wherever possible, in an attempt to determine the genesis of the hydrothermal alteration and the quartz-pyrite mineralization.

The alteration on Keller Peninsula is not as extensive as was thought previously. Mineralization is largely pyrite, is present as disseminations and as low-temperature veins, and is confined to a specific felsitic horizon within the volcanic sequence. Much of the iron staining evident on the peninsula is from surface oxidation of the pyrite.

The volcanic rocks apparently were folded into a broad syncline, the long axis of which coincides with the axis of the peninsula. At least one, and perhaps two, intrusions were found on the eastern side of the peninsula, and it is postulated (from microtectonic studies) that there may be two larger intrusions within the inlets flanking the peninsula. Two sets of faults and joints are present, oriented

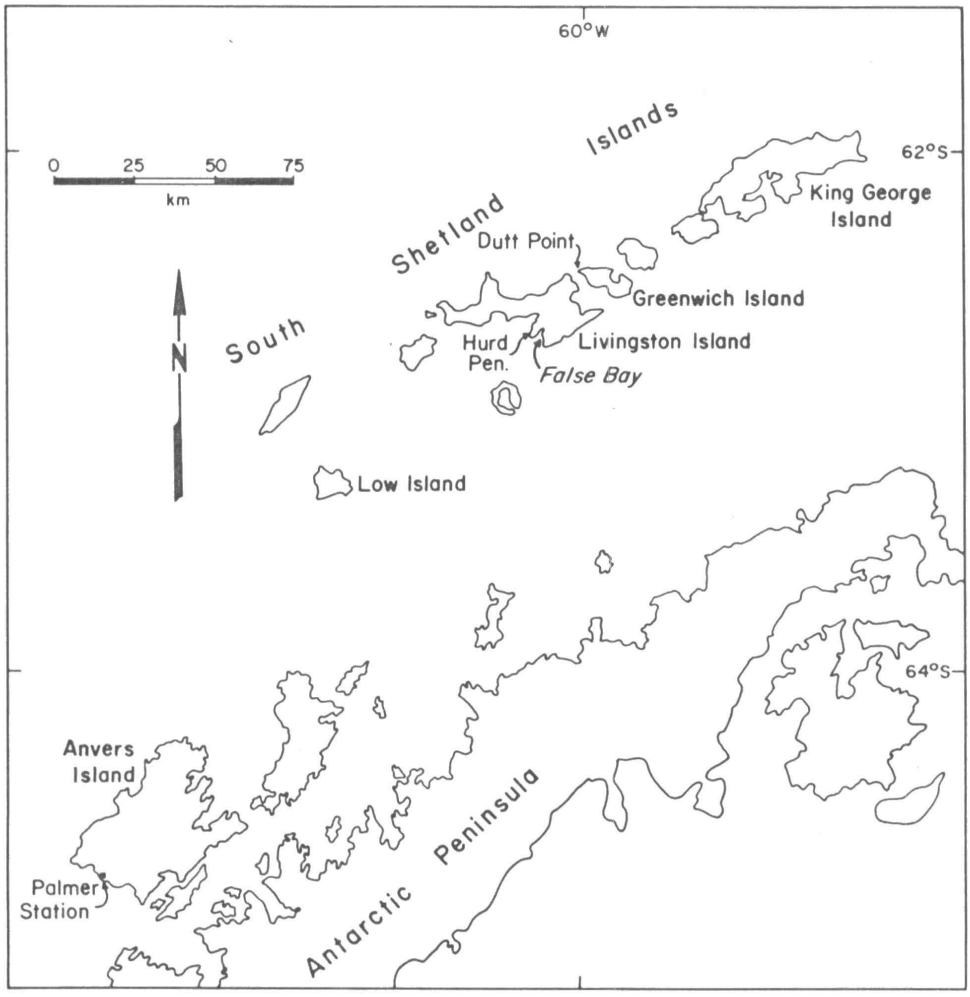

Figure 1. Location map of the South Shetland Islands, and Anvers Island, north Antarctic Peninsula.

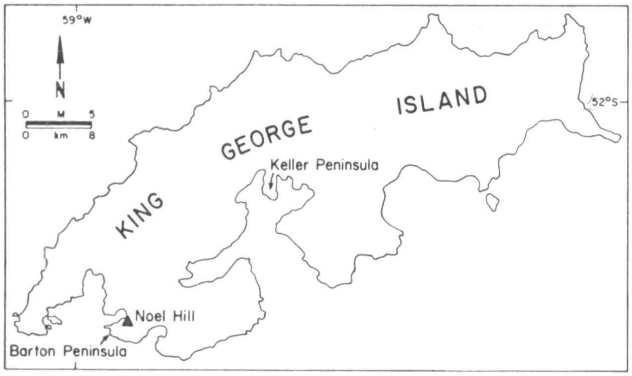

Figure 2. Location map, Keller and Barton Peninsulas, King George Island. (Adapted from Barton 1965).

NE-SW and NW-SE respectively; they and the Andean intrusions appear to be related genetically. It is suggested that the NE-SW set of joints and faults may be related to major strike-slip plate movement within the northern region of the peninsula. The NW-SE set of fractures is tensional and may be related to opening of the Bransfield Strait.

We chose Barton Peninsula for study because of the presence of large quartz-pyrite replacement bodies (Barton 1965), plus the presence of an Andean intrusion cropping out east of Noel Hill (figure 2). Field studies have identified four, and perhaps five, different intrusions on the peninsula. The general trend, as far as presently can be determined, is from basic (diorite) to acidic (granodiorite). One body of altered pyritized breccia (tectonic?) also was found. Much of the pyrite on Barton Peninsula is peripheral to late granodiorite intrusions. Mineralization in the peninsula includes pyrite, magnetite, chalcopyrite, and molybdenite. Hydrothermal alteration is not as widespread as previously described, although it is greater than on Keller Peninsula. Products of alteration include epidote, chlorite, calcite, quartz, sericite, and clays.

Emplacement of the Andean intrusions and the hydrothermal alteration-mineralization apparently were controlled by regional NE-SW and NW-SE structures. The structural elements on Barton Peninsula are similar in type and general attitudes to those noted on Keller Peninsula.

The remainder of the field season was spent in reconnaissance studies of (1) Greenwich Island (Duff Point)—25 and 26 February; (2) Livingston Island (Hurd Peninsula and area east of False Bay)—21 February; (3) Low Island (Cape Wallace, 63°13′S 62°15′W)—22 February; and (4) southern Anvers Island (vicinity of Palmer Station and Arthur Harbor, 64°46′S 64°04′W)—18 and 19 February. The work included reconnaissance mapping and collection of samples for laboratory study.

We defined two areas of considerable interest during the reconnaissance studies. These are (1) Hurd Peninsula, on Livingston Island; and (2) the vicinity of Palmer Station, on southern Anvers Island.

Veins bearing sphalerite, plus subordinate galena, pyrite, chalcopyrite, and quartz were found near Johnsons Dock (62°40′S 60°22′W), on Hurd Peninsula, Livingston Island. One sphalerite vein measured 50 centimeters in thickness. The veins apparently are associated with a small body of tonalite, presumably an apophysis of a larger intrusion nearby.

Mineralization in the vicinity of Palmer Station is present as (1) disseminated pyrite, chalcopyrite, and molybdenite (plus secondary copper carbonates), within tonalite; and (2) quartz-pyrite veins, bearing chalcopyrite and molybdenite, within the same rock.

We would like to thank Captain Lenie and the crew of R/V *Hero* for their excellent support throughout the course of the field studies. This work was supported by National Science Foundation grant DPP 78-21103.

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Geologic studies in the South Shetland Islands and at Hope Bay, Antarctic Peninsula: R/V *Hero* cruises 80-1 and 80-2

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During cruises 80-1 and 80-2 (January-February 1980) R/V *Hero* supported geological studies in the South Shetland Islands and at Hope Bay. Parties were ashore for periods between 4 and 12 days at Hope Bay, Point Thomas, Byers Peninsula, and President Head. Close support was provided for landings at a number of other localities through the South Shetlands (figure 1).

The field program conducted during this time is part of a continuing study of the northern Antarctic peninsula area and South Scotia Ridge (57°00′S 27°00′W) (Dalziel, Elliot, Thomson, Thomson, Wells, and Zinsmeister 1977; Elliot, Watts, Alley, and Gracanin 1978). The overall objective of the project is to elucidate the late Mesozoic-early Cenozoic tectonic evolution of the Antarctic Peninsula and includes igneous and sedimentary petrology investigations, radiometric and paleontological dating of rocks, and paleomagnetic studies.

One objective of the project was to establish the relationship between the sedimentary and volcanic sequences of Late Jurassic to Early Cretaceous (Mesozoic) age and the

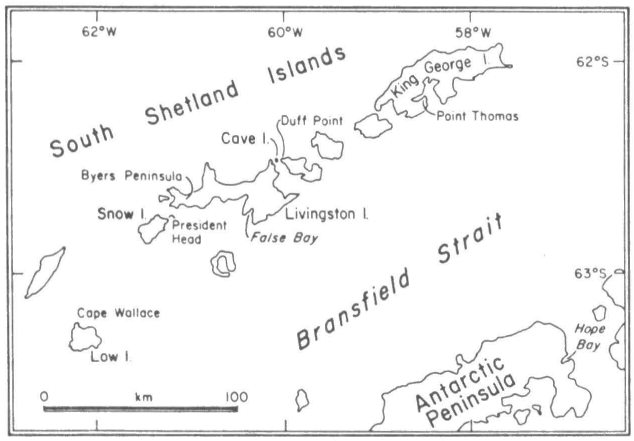

Figure 1. Location map for the South Shetland Islands and the northern Antarctic Peninsula.

evolution of the antarctic cordillera. We continued the work begun at Hope Bay in 1978 (Elliot et al. 1978). Particular attention was paid to volcanic rocks consisting of airfall and ashflow tuffs and including finely laminated waterlain beds showing a variety of depositional features. Further detail was added on environments of the sedimentary sequence, particularly the plant-bearing beds. The sedimentary rocks on Byers Peninsula were examined briefly and sedimentology of the marine rocks suggests turbidite deposition.

We believe the geology of Byers Peninsula can be interpreted somewhat differently from that outlined by Smellie, Davies, and Thomson (in press). Relationships between the sedimentary and volcanic sequences, other than on Start Point, are difficult to establish because of poor exposure; detailed mapping may clarify this problem. President Head, Snow Island, was mapped and the stratified rocks, which are largely volcanogenic, examined in detail. A thin sequence of clastic sedimentary rocks with sparse intercalated limestone was found near the edge of the ice cap. Relations to the volcanogenic sequence are not clear. The remnants of a turbidite sequence crops out on the east coast of Cape Wallace and, like the other Mesozoic sequences, was sampled for petrologic study. As noted by Thomson (in press), the sequences in the South Shetlands are probably fore-arc assemblages.

The dating of paleobotanical Mesozoic sequences is poor except for that on Byers Peninsula where ammonites have been found. Thus, a concerted effort was made to obtain material that might contain fossil palynomorphs; laboratory studies are in progress. Plant megafossils were collected at Hope Bay, Byers Peninsula, and at President Head. Preservation is better at the latter locality (figure 2); the entire nature of the fronds, compared with the generally fragmentary Hope Bay and Byers Peninsula material, indicates a near source and lower energy environment.

Mesozoic intrusive rocks and Cenozoic intrusive and volcanic rocks were collected from King George Island, Byers Peninsula, and False Bay on Livingston Island, President Head, Cape Wallace, Cave Island, and Duff Point. These rocks will be dated by radiometric methods and analyzed for major and trace elements to investigate time-dependent changes in the evolution of magmatism in the South Shetland Islands.

We collected nearly 400 oriented cores and hand samples in the South Shetlands for paleomagnetic study. It is anticipated that the data from these rocks, together with that already obtained from the 1978 field collection (Alley and Watts 1978), will provide information on the movement of the Antarctic Peninsula relative to East Antarctica, as well as contribute to the establishment of a polar wander path for the Antarctic Peninsula.

Raised beaches and marine platforms in the South Shetlands (Araya and Herve 1966; Everett 1971; John and Sugden 1971) are well known. In addition to localities noted in their studies, evidence for former sea level was observed at Cape Wallace where there is a particularly striking marine platform.

Members of the field party were Rosemary A. Askin, Dallas D. Dupre IV, David H. Elliot, Tom M. Gracanin, Kim S. Stemen, and Gary C. Watts. We wish to acknowledge the excellent support of Captain Lenie and the crew of R/V *Hero*.

This research was supported by National Science Foundation grants DPP 77-23427 and DPP 78-21102.

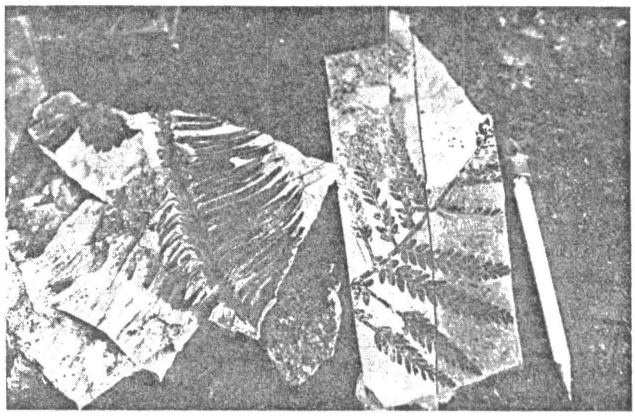

Figure 2. Plant fossils from President Head, Snow Island. *Ptilophyllum* sp. (left) and *Scleropteris* (?) sp. (right).

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