

R/V *Hero* cruise 79-4: Geology and setting of the Sarmiento Complex ophiolite, southern Chile

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The objective of cruise 4 of the R/V *Hero*, during May and June of 1979, was to study the stratigraphy and setting of the Sarmiento Complex in southern Chile (see figure). In addition to this reconnaissance study, Hernan Vergara (of the Instituto de Investigaciones Geológicas in Santiago, Chile) sampled stream sediments for geochemical study to assess the economic potential of the area. As senior scientist, I was accompanied during portions of the cruise by Don Elthon, Richard Hansen, Ian Dalziel, and Ian Ridley of Lamont-Doherty Geological Observatory and Columbia University, and Linda Raedeke of the Department of Geological Sciences of the University of Washington.

The Sarmiento Complex is one of the largest and northernmost major exposures of the mafic floor of the Rocas Verdes marginal basin. During the latest Jurassic to Early Cretaceous ages the formation of this marginal basin separated an active volcanic arc, founded on the continental crust, from the western margin of South America (Dalziel, de Wit, and Palmer 1974; Katz 1972; Suárez and Pettigrew 1976). The marginal basin formed in continental crust composed of two units: a polyphase deformed metamorphic basement locally named the Staines Complex by Forsythe and Allen (in press), unconformably overlain by silicic volcanics and volcanoclastic rocks of the Tobifera Formation (Bruhn, Stern, and De Wit 1978; Cortés and Dalziel 1970). The Staines Complex, because of its structure, rock types, and pre-Tobifera age, may represent part of a fore-arc assemblage of possible late Paleozoic to early Mesozoic age (Dalziel, de Wit, and Ridley 1975; de Wit 1977; Forsythe 1978; Forsythe and Allen in press). The Tobifera Formation on the other hand may be at least largely derived from anatexis of the South American crust across a wide volcano-tectonic rift zone in the Middle to Late Jurassic age (Bruhn et al. 1978). Significantly, observations of complex stratigraphic interrelationships between the Tobifera Formation and both intrusive and extrusive mafic rocks of the Sarmiento Complex confirm previous suggestions of the essentially autochthonous nature of the marginal basin (Dalziel et al. 1974; de Wit 1977; Suárez and Pettigrew 1976). These interrelationships include both inclusions of the Tobifera Formation within the intrusive part of the Sarmiento Complex, as well as intercalation of mafic pillows in the Tobifera.

The Sarmiento Complex itself, with exposures of isotropic gabbro and plagiogranite, sheeted dikes, mafic intrusives, and a sedimentary cover, represents only a partial ophiolite, though geochemical work suggests that the remainder of a normal ophiolite sequence may lie below present sea level (Saunders, Tarney, Stern, and Dalziel 1979). Within and to the west of the Sarmiento Complex, plutons of the Patagonian Batholith, dated as of at least Late Jurassic to Eocene age in this area by Halpern (1973), are thought to represent the roots of an active volcanic arc on the Pacific margin of South America (Dalziel et al. 1974; Suárez and Pettigrew 1976).

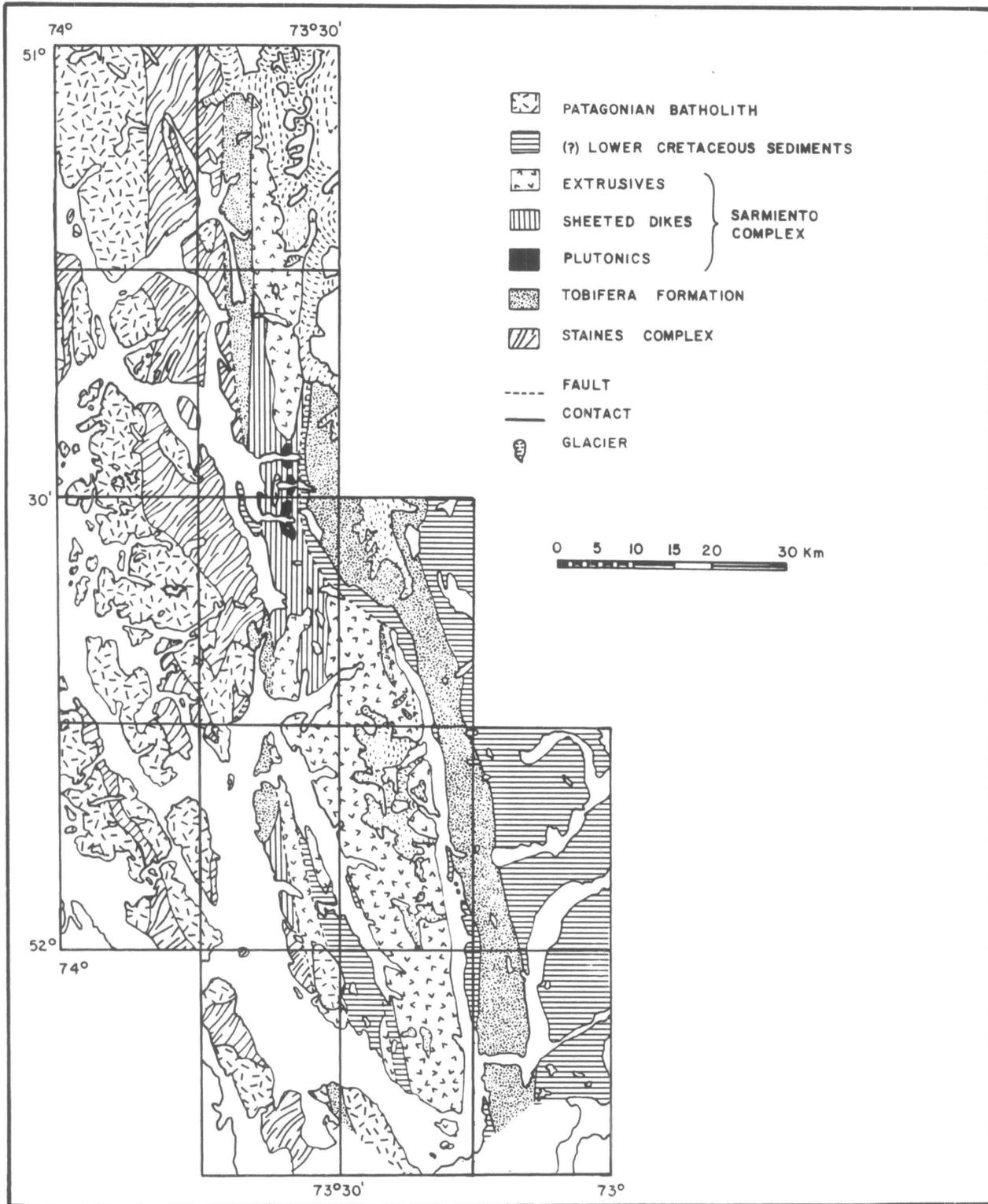
The rocks in the area of the Sarmiento Complex have been deformed, to a greater extent than previously thought, by a number of high-angle, approximately north-south striking faults and associated zones of strong penetrative cleavage development. In addition, folds at various scales, with approximately north-south striking and steeply dipping axial planes and variably plunging axes, are found locally. Stratigraphic and structural relationships in the study area suggest that this deformation is related to closure and uplift of the marginal basin in approximately the mid-Cretaceous age (Bruhn and Dalziel 1977; Dalziel et al. 1974; Forsythe and Allen in press), resulting from a change from relative extension to compression across the marginal basin. This change is observed in the Sarmiento Complex area; the majority of the faults, where determinable, show relative offsets of a high-angle reverse sense, with relative offsets of possibly 2 or 3 kilometers or more.

In conclusion, cruise 79-4 of the R/V *Hero* will aid greatly in interpreting the history and setting of an essentially autochthonous marginal basin, including both its development and later destruction.

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Simplified geologic map of the Sarmiento Complex area, southern Chile.

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