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Regional Acoustic Imagery and Detailed Geophysical Studies of Northern Juan de Fuca Ridge

Acoustic image and high-resolution swath mapping studies have been conducted over the northern Juan de Fuca Ridge system from the central Juan de Fuca Ridge at lat. 46°N to the triple junction of the ridge with the Queen Charlotte Islands continental margin at lat. 52°N. Results of the surveys have been published as 1:250,000 compilations and 1:50,000 detailed sheets of acoustic image mosaics and 10-m contour bathymetric maps. Of particular interest is the information that influences processes of hydrothermal mineralization. In general, little direct information is present in the imagery; only the exact location and nature of the currently active rift axis are seen. However, this information is important, since the along-strike variations in crestal morphology, the recency and level of volcanic activity, and the degree of post-volcanic extension must be known in order to understand any hydrothermal system observed along the axis.

An exceptional case has been studied in detail at the northern Juan de Fuca Ridge, lat. 49°30' N, where Pleistocene turbidite sediments bury the axial valley, and structures suspected to be of hydrothermal origin were observed in the acoustic imagery over faults that bound the valley. Subsequent higher resolution acoustic imagery, seismic reflection profiling, and heat-flow studies indicated that the features were of hydrothermal origin. A 2.5-m piston core sample of massive sulfides from one of the structures confirmed this speculation. The setting in which these relatively large (500-m diameter, 60-m surficial relief, 350-m relief above basement) structures occur is remarkably similar to that where large sediment-hosted sulfide deposits are found on land, although we do not know what the bulk composition of the structures is, and thus whether the analogy is complete.