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Pyrite stability and chalcophile element mobility in a hot Eocene forearc of the Pacific Rim Terrane, Vancouver Island, Canada

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Abstract

The conditions of pyrite (Py) stability inform the extent of S mobility during prograde metamorphism, the formation of orogenic Au deposits, and the S cycle in subduction zones. The variables that affect Py stability and chalcophile element mobility are investigated in the Pacific Rim Terrane of Vancouver Island, Canada, where sulfide-bearing carbonaceous sediments have been metamorphosed from 230 to 600 °C and 4 kbar by mid-ocean ridge subduction in a hot fore arc setting during the Eocene. The petrographic evidence in the rocks shows Py can coexist with pyrrhotite (Po) over a wide temperature window to >550 °C as preserved in porphyroblasts of andalusite, staurolite, and garnet. Conversely, equilibrium phase diagrams constructed for the rock compositions conflict with observations and suggest the breakdown of primary Py occurs over a narrow temperature range below 400 °C. The phase diagrams are consistent with the coexistence of Py and Po up to lower amphibolite facies only if S locally comprises a much greater proportion involved in a reaction than that of the overall bulk-rock composition used in the calculations. While the chemistry of the bulk rocks and Po included in porphyroblasts show mobilization of H_2O and S with increasing metamorphic grade of the forearc, this process appears unrelated to the distribution of chalcophile elements or Au deposits found in the Pacific Rim Terrane.

Keywords: Sulfide, chalcophile, metamorphism, forearc, phase equilibria, gold