

Volcanogenic sulphide metallogeny of the Iapetus Ocean in the Canadian Appalachians: complexities in time, space and tectonic setting

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Remnants of the Cambro-Silurian Iapetus Ocean in the Canadian Appalachians record a long-lived multistage history of volcanism and related volcanogenic mineralization. Geological and geochemical (whole rock, mafic volcanic) data suggest that volcanogenic sulphide deposits were formed in at least five distinct plate tectonic environments: (1) ensimatic primitive island arcs—Mafic volcanics are dominantly arc tholeiites. The environment is variously represented by suprasubduction-zone ophiolites or by thick volcanic-epiclastic sequences. Massive sulphides (e.g., Duck Pond, Tilt Cove, Rambler, Newfoundland.; Huntington, Eustis, Quebec) are locally associated with refractory mafic volcanics and, particularly in non-ophiolitic sequences, with high-silica rhyolites; (2) ensimatic mature island arcs—Mafic volcanics are calc-alkalic basalt and andesite. Massive sulphides (e.g., Buchans, Newfoundland) are typically associated with dacite-rhyolite domes, and locally may have formed in submarine collapse calderas; (3) ensimatic mature back-arc basins—Mafic volcanics are typically high-TiO₂ tholeiite or alkalic basalt. Massive sulphides (e.g., Great

Burnt Lake, Newfoundland.; Annidale, New Brunswick) are cupriferous, broadly Besshi-type deposits; (4) continental-margin (ensialic back arc) rifts—Volcanics are dominantly rhyolite, underlain by mafic arc tholeiites and overlain by continental tholeiites and alkalic basalt. Massive sulphides (e.g., Bathurst, New Brunswick) are broadly associated with rhyolites, but commonly are sediment-hosted; (5) syntectonic transtensional basins—Mafic volcanics are typically high-TiO₂ tholeiite and alkali basalt. Massive sulphides (e.g., Memphremagog, Clinton River, Quebec) range from volcanic-hosted to broadly Besshi-type deposits.

Geochronological, geological and radiogenic isotopic data indicate that environments 1 to 3 recurred several times at two or more Cambrian to Middle Ordovician subduction complexes in different parts of Iapetus. Environment 4 occurred at a Middle Ordovician continental margin outboard of Laurentia, and environment 5 formed in re-entrants in the Laurentian margin, synchronous with Taconian collision of oceanic terranes on the adjacent promontories.