

# Superimposition of Quartz-carbonate-talc Sinter Deposits with Massive Sulphide Mineralization in a 680 Ma Hydrothermal Sea Floor Setting at Stirling, Southeast Cape Breton Island, Nova Scotia<sup>1</sup>

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The Stirling volcanogenic massive sulphide (VMS) deposit (historical production 1.2 Mt of 6.4% Zn, 1.5% Pb, 0.74% Cu, 2.2 oz./t Ag, 0.03 oz./t Au) is hosted by intermediate pyroclastics and finely laminated volcanoclastics of the Late Hadrynian (680 Ma) Stirling Group, SE Cape Breton Island. The volcanic strata are intruded by a quartz-feldspar porphyry (Stirling rhyolite) of elongate shape, which is subparallel to and underlies the ore zone along its 1500 m of strike length. Logging of drill core, surface mapping and a review of previous work indicate: (1) The footwall (FW) and hanging wall (HW) rocks consist of graded (cm to 3-4 m scale) volcanoclastics of intermediate composition; sedimentary features indicate tops are NW. (2) The Stirling rhyolite is a high-level, polyphase intrusion with variable crystal (quartz, feldspar) content (<3% to 25%), well-preserved spherulitic textures and Na-metasomatism. Eruptive equivalents may occur in the highest part of the stratigraphy. (3) Massive sulphides, consisting of finely laminated (tectonic ?) Zn-Fe-Cu-Pb sulphides dominated by Fe-poor sphalerite and pyrite, occur along a single horizon within a shear zone (Mine Shear). (4) Polyphase deformation has overturned the strata (dips 70-80° SE) and dismembered the sulphide mineralization. (5) The immediate HW and FW strata, now carbonate-talc schist, represent altered intermediate volcanoclastics and not felsic volcanic rocks, as previously considered by some workers. (6) Extensive zones (to 10s of m) of fine- to coarse-grained quartz-talc-carbonate (QTC) rock replace sections of both intermediate volcanoclastics and rhyolite porphyry throughout the FW. These zones formed from alteration processes and are not of exhalative origin. Minor disseminated calcite occurs as alteration in HW rocks. (7) The QTC is generally barren, but rare zones of disseminated to massive pyrite (±sphalerite, galena) occur. Textural observations suggest the QTC post-dates the sulphide rock. (8) In one locality a quartz-carbonate mound (palaeosinter deposit) underlies a 2 m thick massive sulphide zone. The above observations are interpreted to indicate that VMS mineralization and QTC zones formed from fluid focusing of heated sea water, but under different thermal and chemical conditions such that two distinct hydrothermal systems formed, one high temperature (ca. 250-300°C) and analogous to modern black smokers and the second a lower temperature (ca. 80-100°C) system akin to hot springs depositing travertine at Yellowstone Park, U.S.A. The porphyry unit is considered the source of thermal energy to initiate and drive the hydrothermal cells.

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