Overview of the Regional Geological Setting of the Stirling VMS Deposit, SE Cape Breton: A Shear-Zone Hosted Massive Sulphide Deposit with Associated Quartz-Carbonate-Talc Alteration[1]

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The Stirling massive sulphide deposit was discovered in 1895. Mine development in the 1930s and 1950s produced 1.06 Mt of 6.3% Zn, 1.5% Pb, 0.8% Cu, 74 g/t Ag, 1.1 g/t Au. The deposit is hosted by a mixed package of metavolcanic and metasedimentary rocks that are part of the Late Hadrynian Stirling Group of ca. 680 Ma (U/Pb Zr). The Stirling Group consists of mixed mafic and felsic volcanic rocks of flow and pyroclastic origin with thick sequences of intercalated sedimentary rocks indicating a submarine origin for the package. These rocks are intruded by the 620 Ma (U/Pb Zr) Chisholm Brook granitoid suite, which consists of biotite-hornblende monzosyenites and granodiorites that have textures indicating magma mixing with the more mafic dioritic member. The Stirling Group is in structural contact (Mira-L'Archeveque Fault Zone) with mixed mafic to felsic volcanic rocks of the 570 Ma (U/Pb Zr) Fourchu Group. In contrast to rocks of the Stirling Group, only minor amounts of sedimentary rocks are present in the Fourchu Group; most of the sequence is interpreted to have been deposited subaerially. The Fourchu Group is intruded by similar age monzogranites of the Capelin Cove granitoid suite, which locally features abundant mafic enclaves. All rock types are cut by mafic dyke swarms, probably of several ages. Previous workers have interpreted the aforementioned volcanic and plutonic rocks to have formed in volcanic arc and within-plate environments based on their geochemical signatures. Structurally, the rocks have been affected by at least two periods of coaxial deformation (NW-SE compression), and the strain is heterogeneously distributed such that relatively undeformed rocks are juxtaposed against mylonitized equivalents. Where exposure permits, refolded F_1 structures are observed and overprinting of earlier structures by kink zones occurs. Alteration, mainly within the volcanic rocks, is variably developed and includes epidote, chert, carbonate and sericite; in some cases mafic rocks are completely metasomatized to, for example, epidosite and chert. Metamorphic grade is low and has been estimated at ca. 300°C and 2 kbars.

The Stirling deposit is located within a mixed volcanic-sedimentary unit of the Stirling Group which is cut (intruded ?) by quartz-feldspar porphyry. Distal to the deposit the sedimentary sequence thickens, thus suggesting a basinal setting on the flank of a rhyolite dome. At the deposit, the ore is hosted by intensely deformed rocks and the scarcity of surface exposure limits geological interpretation; thus, underground plans and drill core logging become essential to the interpretation. Based on surface mapping, the ore zone, as exposed in the Glory Hole area, strikes northeast and dips steeply (ca. 70-80°SE), is in structural contact (shear zone) with green intermediate tuff in the structural footwall, and is bounded by grey-green sericitic schist (felsic tuff, flow ?) in the structural hanging wall. The sulphide ore zone (ca. 1 km strike length) consists of both well-laminated massive sulphide (sph, py, gal, py) and sulphide-rich carbonate rock. Selected samples of sulphide-rich ore assayed to 280 ppm Ag and 1.5 ppm Au. Alteration types include carbonate, silica, sericite and chlorite, but their spatial distribution and relation to ore zones is not constrained. Based on underground maps: (1) multiple ore lenses occur dispersed as subparallel ore zones, (2) the massive sulphide ore is entrained within a quartz-carbonate (dolomite-magnesite)-talc (QCT) unit, (3) the QCT unit is bounded by sericite schist (rhyolite tuff), and (4) the ore zones owe their structural complexity to the intense deformation that affected the area. At depth the QCT rock was ca. 70-80% talc and it truncated the ore zone. The QCT horizon has previously been interpreted as being of submarine exhalative origin; however, an epigenetic origin is offered and a genetic association with the sulphide ore, rather than spatial, is questioned. Although the Stirling deposit is a volcanogenic massive sulphide, there remain problems concerning the nature of its regional setting and the nature and origin of the abundant quartz-carbonate-talc rock. These problems will be the focus of further investigation.

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