Geological setting of the Smith Option: an ophiolite-hosted Cu(-Zn) massive sulphide system, Bathurst Mining Camp, northeastern New Brunswick

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In an area of complex tectono-stratigraphy with numerous volcanic massive sulphide deposits at different stratigraphic positions such as the Bathurst Mining Camp (BMC), determining a deposit's local to regional geologic setting is fundamental to understanding its origin, and to formulating an appropriate exploration model. The Smith Option Cu-rich massive sulphide occurrence is unique in the Bathurst Mining Camp, because it is associated with a deformed ophiolitic mafic to ultramafic volcanic package (Sormany Formation) of the Middle Ordovician Fournier Group. It lies on the eastern limb of the Tetagouche Antiform, just east of the D1 thrust separating the California Lake Group from the Fournier Group. Following its discovery in 1968, geological, geochemical, magnetic, and electromagnetic surveys were conducted along with trenching, which revealed notable Cu grades, including a 0.6 m zone of 0.58% Cu. Further trenching was conducted in 1973 exposing chalcopyrite, bornite, malachite, and pyrite mineralization with assays up to 7.2% Cu over 0.3 m. The massive sulphides are predominantly hosted in chloritic schist and silicified basalts that are enclosed within locally magnetic mafic flows. Sixteen holes were drilled in the area, seven of which encountered considerable Cu, including 1.39% Cu over 2.7 m in a magnetite- and sphalerite-bearing sulphide exhalite (Fe-formation). However, an analysis of one of the schistose magnetite-pyritic sulphide zones in outcrop (23 cm chip sample) yielded 0.38 wt% Cu with 550 ppm Co and 990 ppb Hg, but only 200 ppm Zn, 20 ppm Pb, 5 ppm Ag, and 150 ppb Au.

Whole-rock geochemical analyses (n=27) from outcrop and selected drill holes indicate a zoning of the host volcanic sequence. The stratigraphically lowest rocks are ocean floor ultramafic basalts (picrite) with MgO up to 32.0 wt%, very low alkalis, and Cr up to 2100 ppm, whereas the stratigraphically highest rocks are within-plate tholeiitic basalts. N-MORB to EMORB compositions occur within the central part of the sequence with the overall FeOtotal/MgO ranging from 0.5 to 3.0, and TiO_2 contents of between 0.7 and 3.5 wt%. The immediate footwall and hanging wall volcanic rocks and host chloritic schists have NMORB characteristics, with low Cr (~ 100 ppm), Nb (~ 3 ppm), Ta (~ 0.13 ppm), Th (0.16 ppm), and La (3.2 to 5.2 ppm), with higher Yb (~ 2.0 to 3.1 ppm), and flat chondrite-normalized rare-earth-element patterns. This host rock chemistry is consistent with the Smith option being, an ophiolite-related, Cyprus-type VMS Cu deposit, unique to the BMC.