The Brunswick No. 6 Cu Zone: petrology, geochemical composition, and petrogenesis

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Located along the eastern margin of the Bathurst Mining Camp, the Brunswick No. 6 deposit is approximately 27 km southwest of Bathurst, New Brunswick. In 1907, the deposit was intersected during an investigation of the iron formation that was similar to the Austin Brook Fe deposit located 900 m south. In 1952, the deposit was rediscovered after drilling vertical loop electromagnetic anomalies, which led to the subsequent staking rush that identified most of the known deposits in the Camp. Production at Brunswick No. 6 began in 1966 from an open pit producing 12,125,000 tonnes of ore grading 5.43% Zn, 2.16% Pb, 0.39% Cu, and 66.5 g/t Ag before production ended in 1983. The massive sulphides can be divided into three zones: (1) massive pyrite zone(s) containing minor to significant amounts of chalcopyrite, magnetite, and pyrite with minor sphalerite and galena; (2) a massive to banded, pyrite-sphalerite-galena zone with minor chalcopyrite and pyrrhotite; and (3) massive pyrite with minor sphalerite, galena, and chalcopyrite. (Is the Cu zone another part of these zones or another zone?) The massive sulphides and associated exhalative iron formation (Brunswick Horizon) are hosted at the top of an altered felsic sedimentary-volcanoclastic sequence (Nepisiguit Falls Formation) and beneath rhyolitic flows and related fragmental rocks (Flat Landing Brook Formation) within the Lower Ordovician Tetagouche Group. The main deposit occurs in an asymmetrical F_2 fold with a variable plunge (F_1) with a north-south axial plane dipping approximately 50°W.

The highest Cu concentrations are associated with: (1) the uppermost part of the pyrite-pyrrhotite-rich stockwork and remobilized veins hosted in the intensively chloritized, felsic volcaniclastic sequence that forms the stratigraphic footwall to the deposit; and (2) the potentially economic, basal massive-sulphide body located beneath a relatively barren, pyritic zone near the base of the deposit. Relative to the main orebody, the Cu-rich zone under consideration is located near surface at the north end of the deposit, although Cu-rich massive sulphides are known to envelop the north end and base of the Pb-Zn massive-sulphide lens. Preliminary, ore reserve calculations indicate a tonnage of 1.7 Mt grading 0.9% Cu (William Luff, personal communication). Mineralogically, the principle minerals are pyrite, pyrrhotite, chalcopyrite, and trace sphalerite, galena, and arsenopyrite. Generally, chalcopyrite and pyrite are fine grained, although cataclastically deformed pyrite porphyroblasts (porphyroclasts) and clasts are hosted in a recrystallized pyrrhotite-rich matrix. The weighted average composition of the Cu Zone using all the analyses (n = 344) from 24 drill holes into the resource are: 0.60% Cu, 1.10% Zn, 0.51% Pb, and 48.3 g/t Ag, which is similar to the original resource calculations. In this study, 12 sample intervals, 5 feet long, from 10 drill holes were re-assayed yielding an average of 0.90% Cu, 1.28% Zn, 0.42% Pb, 28.6 g/t Ag, 0.046% Bi, and 0.225 g/t Au, as well as 0.131% As, 0.030% Sb and Sn values below the detection limit of 0.005%.

Overall, the Cu-rich basal sulphide zone at Brunswick No. 6 is very similar to the Cu-rich basal massive-sulphide zone at the Brunswick No. 12 deposit, which is estimated to contain 25 Mt grading 1.1% Cu. The high Cu and low base-metals within the basal massive-sulphide zone compared to the Zn-Pb-Ag exhalative massive sulphides in both deposits is common in proximal VMS deposits. It is usually interpreted as a hydrothermal zone-refining feature, which is consistent with (1) the relatively high pyrrhotite to pyrite abundance and higher abundance of chalcopyrite, arsenopyrite, bismuthunite, and cassiterite, which have higher temperature sensitive solubilities; (2) lower sphalerite, galena, tetrahedrite/tennantite, and argentite, which have lower temperature dependant solubilities; and (3) occurrence above the stockwork feeder zone that formed the deposit.