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**Volcanology and lithogeochemistry of the  
Lundberg volcanogenic massive sulphide zone,  
Buchans, Newfoundland**

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The Buchans mining camp is characterized by a number of unusually high-grade low-tonnage volcanogenic massive sulphide (VMS) deposits hosted by a bimodal calc-alkaline continental arc sequence. The mining camp produced a total of 16.2 Mt of ore at an average grade of 14.5% zinc, 7.6% lead, 1.3% copper, 126 g/t Ag, and 1.37 g/t Au. Four volcanic units and one volcano-sedimentary unit have been identified including basalt, dacite, two different rhyolites (both geochemical and textural constraint) and a varying succession of sandstone, siltstone, and volcanogenic mass-flow breccias. These units can be correlated across the entire Lundberg zone and provide an excellent testable stratigraphy.

The stratigraphy of the Lundberg zone is characterized by lowermost massive basalt with local hyaloclastite and mafic tuff. Overlying the basalt is a volcano-sedimentary unit consisting of a rhyolite, dacite, siltstone, and basalt framework breccia with a pyritic sandstone matrix, plus rare sphalerite, galena, and pyrite xenocrysts (up to 1 cm long) and isolated massive sulphide clasts (up to 20 cm long). At the upper contact of the volcano-sedimentary unit lies a discontinuous barite horizon

that locally contains high metal grades (e.g., 4.52% combined Zn-Pb-Cu, 102.77 g/t Ag, and nearly 1 g/t Au over 3.92 m). Within the volcanogenic breccia unit lies a highly altered and locally sheared dacitic tuff with the same lithic fragment assemblage as the breccia that surrounds it. This volcano-sedimentary unit is structurally or stratigraphically overlain by a feldspar>>quartz-phyric, green to pale yellow or red, variably flow-banded, coherent rhyolite, and then by quartz>feldspar-phyric, pale beige to red or dark green rhyolite with large quartz phenocrysts, and is intruded by late diabase sills. The basalt is extensively altered and cut by stockwork chlorite-pyrite, polymetallic and chalcopyrite-rich veins which may form the stockwork to the overlying massive and transported sulphides. Some of the polymetallic veins contain extensive bladed calcite and quartz pseudomorphs, suggesting that local boiling occurred. Understanding of the detailed volcanic stratigraphy, lithogeochemistry and mineralization characteristics of the Lundberg zone provides a predictive stratigraphy that can be applied to focus exploration in this mining camp. On a broader scale, the presence of epithermal characteristics in the Buchans VMS camp provides clues to the origin of these very high-grade deposits.