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Mineralogical Sequestration of Tellurium at the Perseverance Volcanogenic Massive Sulfide Deposit, Quebec, Canada

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Tellurium is a rare element that is essential for the production of photovoltaic cells. At present, most Te is produced as a by-product of anode slimes from electrorefining of copper ores. Volcanogenic massive sulfide (VMS) deposits represent one of the few primary sources of Te. Kankberg in the Paleoproterozoic Skellefte district in Sweden and the Silurian to Devonian VMS deposits of the Urals in Russia collectively account for ~17% of the global Te production of ~450 tonnes Te. While deposits of this type are significant producers of Te, there is a knowledge gap pertaining to the origin and enrichment processes of Te in VMS deposits and the mineralogical sequestration of this element in massive sulfide ores. To close this knowledge gap, this study focuses on the ore mineralogy of the Perseverance VMS deposit in Quebec, Canada, which was known for its elevated Te content. The deposit was mined between 2008 and 2013 with pre-mining resources of 5.1 million tonnes of ore grading at 15.8% Zn, 1.24% Cu, 29.4 g/t Ag, and 0.4 g/t Au.

Polished thin sections of samples collected from different ore zones were investigated by quantitative scanning electron microscopy to locate Te-bearing minerals and to determine their relative abundances. Minerals identified include altaite, hessite, montbrayite, frohbergite, and melonite. The microtextural characteristics of these phases were subsequently studied by scanning electron microscopy and reflected light microscopy. Many of these phases are located along the grain boundaries of the main ore minerals or form small inclusions within them. The textual evidence suggests that the Te-bearing phases formed primarily during metamorphic recrystallization and remobilization as impurities originally contained in the major ore minerals were expelled from the crystal structure during recrystallization to form new accessory minerals. These changes in mineralogical sequestration have important implications to mineral processing.