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Tellurium: Geometallurgy of a Critical Element at the Perseverance VMS Deposit, Quebec, Canada

Filip Kasprowicz¹, Katharina Pfaff¹, Thomas Monecke¹, David Diekrup², Samuel Pierre⁴, Mark Hannington³
1. Center to Advance the Science of Exploration to Reclamation in Mining, Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO, USA, 2. Geological Survey, Department of Industry, Energy, Technology, Government of Newfoundland and Labrador, St. John's, NL, Canada, 3. Department of Earth and Environmental Sciences, University of Ottawa, Ottawa, ON, Canada, 4. Samuel Pierre Geoservices, Bern, Switzerland

Tellurium is a metalloid needed in numerous high-tech applications, most notably in cost-effective Cd-Te photovoltaic panels. The role of Te in green technologies and limited domestic sources led to Te being listed on the 2022 USGS critical mineral list. Tellurium is recovered as a by-product from anode slimes generated from processing porphyry copper and volcanogenic massive sulfide (VMS) ores. Tellurium can occur as traces in sulfides and sulfosalts, as native Te, or as discrete tellurate and telluride minerals.

VMS deposits can host significant Te and currently produce ~17% of global tellurium. However, there is a knowledge gap regarding the occurrence and mineralogical sequestration of tellurium in VMS deposits. To narrow the gap, samples from the Perseverance VMS deposit, located in the Matagami district of the Abitibi greenstone belt, Quebec, Canada, were analyzed to better understand the occurrence and sequestration of Te. Perseverance was mined between 2008 and 2013, with pre-mining reserves of 5.1 Mt of ore grading at 15.8% Zn, 1.24% Cu, 29.4 g/t Ag, and 0.4 g/t Au. Deposits of the Matagami district are notable for elevated Te concentrations; however, there is no systematic description of the occurrence and distribution of Te. Tellurides were identified and analyzed using field-emission scanning electron microscopy, scanning electron microscope-based automated mineralogy, and electron probe microanalysis.

In total, 17 discrete telluride minerals were identified. Spatial relationships studied using reflected light microscopy and electron microscopy methods show that tellurium-bearing phases form multi-mineral grains of up to four distinct phases, inclusions in highly recrystallized major ore minerals, and along grain boundaries. Microtextural evidence suggests telluride sequestration may be a direct result of regional greenschist facies metamorphism and post-depositional structural modification of the deposit. This research provides new insights that may impact ore processing methods and improve our understanding of tellurium sequestration in the VMS environment.