

Metamorphic Recrystallization of Telluride Minerals at the Perseverance Volcanogenic Massive Sulfide Deposit, Matagami Camp, Quebec

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Tellurium is a metalloid element with applications in advanced manufacturing, machining, and high-efficiency solar panels, resulting in its continued status as a US critical mineral. Crustal abundance of tellurium averages 3 ppb, but it is commonly enriched 1,000x to 10,000x in volcanogenic massive sulfide deposits, with enriched VMS containing 20 ppm to 150 ppm Te and locally as high as 400 ppm Te. Despite the potential of VMS as Te producers, a significant knowledge gap remains in understanding the enrichment mechanisms and mineralogical deportment of Te in VMS deposits. The Te-rich Perseverance VMS in the Matagami camp of the northern Abitibi greenstone belt, Quebec, Canada, is a past producer that yielded 5.1 Mt of ore grading at 15.8% Zn, 1.24% Cu, 29.4 g/t Ag, and 0.4 g/t Au. Regional deformation and metamorphism to greenschist facies caused widespread grain coarsening, recrystallization, and deformation textures to develop. Previous research has established a link between metamorphic recrystallization of the massive sulfides and the formation of trace Te-bearing phases. This study advances the existing research on Perseverance by incorporating new samples from the Perseverance Main orebody in addition to new analytical data to further unravel the role of metamorphism in telluride mineral formation. Te-bearing phases were identified and found to occur in fractures, associated with annealing textures, in triple junctions, and filling pressure shadows. Additionally, this study presents new bulk-rock geochemical data and high-resolution field emission scanning electron microscopy data which has identified distinct regions within coarse pyrite crystals (50 μm to 500 μm) of subgrain (1 μm to 5 μm) development. Pyrite subgrains were found to be encased by rims of submicron Te phases. These findings further suggest a spatial and temporal relationship between discrete Te phase formation and metamorphic recrystallization processes.