Methods for the determination of Te isotope compositions of minerals in the system Au-Ag-Te by MC-ICP-MS

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The high precision of multicollector ICP-MS (MC-ICP-MS) analyses has led to the investigation of stable isotope variability of increasingly heavy elements (e.g., Cu, Se, Hg) found in ore-forming systems. Tellurium is commonly associated with Au and Ag in epithermal and orogenic ore systems. To date, there have been no high-precision studies of the natural variability of tellurium isotopes in ore-forming systems.

Using a micromill, a sufficient mass of telluride or native Te sample can be isolated and extracted from coexisting ore and gangue minerals from ~50 μm wide by ~50 μm deep drilled holes. Dissolution of those samples and subsequent ion exchange chromatography isolates Te from matrix metals, with a tellurium yield of ≥ 95%. The chromatography procedure causes no net fractionation of Te.

MC-ICP-MS analyses were completed using two techniques, both of which employ the doping of samples using Cd to correct for drift in instrumental mass bias. The first method was the introduction of 100 ppb Te bearing solutions (with 100 ppb Cd) using a desolvating nebulizer (DSN). The second method was direct introduction of 2 ppm solutions of Te (with 1 ppm Cd) into the MC-ICP-MS. The average precision using the DSN is ±0.17 ‰, whereas that for the wet method is ±0.08 ‰.

Natural, hypogene tellurides (n = 17) and native Te have shown an isotopic range of 303/125Te of ~1.9 ‰, demonstrating resolvable disparate isotope ratios between samples, including in samples from the same locality (i.e., Cripple Creek).

The understanding of isotope systematics for Te will lead to a better understanding of the geochemistry of Te, as well as its transport and deposition mechanisms. Systematic spatial variation of Te isotopes within an orebody may serve as an exploration vector for associated Au (as Au only has one stable isotope) and other precious metals.