ST.151

The Genesis of the Telluride-Rich Epithermal Gold Deposits: A Perspective of Thermodynamic Modeling

Degao Zhai[1], Anthony Williams-Jones[2], Jiajun Liu[1]
1. China University of Geosciences Beijing, Beijing, China, 2. McGill University, Montreal, QC, Canada

Telluride minerals are regularly minor in most epithermal gold deposits, and only relatively few ore deposits are dominated by telluride minerals, for example Emperor, Cripple Creek, and Golden Sunlight. Those telluride-rich deposits, however, commonly are characterized by very high-grade ores in which both gold and tellurium are economic metals, and especially tellurium has been selected as one of the critical metals that are important for our modern technologies. However, how Te was incorporated into the epithermal system and the critical factors dominating both Au and Te precipitation from the epithermal environment are still unclear. In this contribution, we select the Sandaowanzi Au-Ag-Te deposit in NE China to address those issues.

The Sandaowanzi gold deposit has a total reserve of ≥28 tonnes Au and an average grade of 15 g/t. The deposit has attracted broad attention for two reasons: (1) it is the first example of a gold deposit in NE China, in which >95% of the gold is present as coarse-grained tellurides; and (2) it contains bonanza Au- and Ag-telluride ores, with grades of Au, Ag, and Te up to 35,000, 25,000 and 30,000 g/t, respectively. Gold-bearing veins are hosted in 20 NW-trending, syntaxial, layered quartz veins and tension gashes within almost coeval trachyandesites and andesitic breccias. Alteration halos are developed around the quartz veins and tension gashes, which consist of an inner silicic-pyritic zone, two intermediate zones containing quartz-illite-sericite and quartz-adularia, and an outer zone containing a quartz-calcite-kaolinite-chlorite assemblage.

Fluid inclusion microthermometric data show that the gold-silver telluride ores deposited from an epithermal system emplaced at a depth of <1 km that boiled intensely and cooled from a temperature in excess of 300°C to a temperature less than 200°C at a pressure that approached hydrostatic. Although fluid boiling is commonly invoked to explain the genesis of adularia-sericite (low-sulfidation) epithermal deposits, this mechanism cannot explain the genesis of the Sandaowanzi Au-Ag-Te deposit. Instead, based on physicochemical modeling results, we show convincingly that the deposit owes its origin to an H_2Te vapor, which was derived from the coeval alkaline magma and condensed in the dominantly meteoric ore fluid, and sulfidation of the host rocks contributed to the deposition by destabilizing the gold and silver bisulfide species.

This study emphasizes the importance of fluid-rock interaction (sulfidation) and the mixing of low-density H_2Te-bearing magmatic fluids with meteoric waters in producing large Au- and Ag-telluride deposits.