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Petrography and Ore Microscopy of the Homelode Structural Trend, Black Hills, South Dakota, USA; Understanding Trace Element Zonation Patterns on a District Scale

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The Homelode Trend is a newly discovered, ~6-km-long belt of vein-hosted gold-silver mineralization in the north-central portion of the Black Hills, South Dakota. This study incorporates petrographic analysis and trace element geochemistry across the district and aims to describe district-scale mineralogic and geochemical zonation of mineralization across the district. Mineralization is hosted in multistage quartz-carbonate-sulfide veins within sheared and folded phyllites, schists, and siliceous metagraywackes. Gold-silver mineralization is associated with variable amounts of pyrite, arsenopyrite, boulangerite, sphalerite, chalcopyrite, and other arsenic, antimony, and bismuth sulfides and sulfosalts. Hydrothermal alteration within the district is dominated by sericite dominated “bleached” zones, coarse muscovite in vein selvages, and tourmaline-graphite-rich zones. Many of the veined zones exhibit brecciated fragments of wall rock and pockets of euhedral quartz terminations, indicative of open space filling and a higher-level emplacement within the crust compared to other occurrences and deposits throughout Black Hills. Based on mineralogic, geochemical, and deformational features, the Homelode Trend has been classified as an epizonal orogenic gold deposit. In plan view, the district exhibits an elliptical zoning pattern within trace element geochemical data sets with an arsenic-zinc-copper-rich core transitioning to a lead-antimony-arsenic-silver-rich periphery. Petrographic analysis consistently describes a paragenesis of an arsenic-rich mineralization event followed by base metal- and/or antimony-rich mineralization event. Gold and silver mineralization, occurring as electrum and various silver-bearing sulfides, has been documented within both mineralization styles. The district-scale zonation may be attributed to evolving fluid chemistry from a higher-temperature arsenic-zinc-copper-rich mineralizing center, transitioning to a more distal, lower-temperature lead-antimony-silver signature. Alternatively, this zonation may be attributed to multiple pulses of distinct mineralizing fluids overprinting preexisting mineralization.