Public Abstract
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Title:Gold in the Northern Yellowknife Greenstone Belt, Canada and Pb-Zn-Cu in the MVT Deposits of S.E. Missouri: Geochemical Studies and Numerical Models

Numerical and geochemical studies were performed in this thesis to investigate the formation of ores in (1) the gold-bearing northern Yellowknife Greenstone Belt (YGB), Canada and (2) the southeastern Missouri Mississippi Valley-type (MVT) Pb-Zn-Cu district.

Metavolcanic rocks of the Discovery-Ormsby and Clan Lake areas are sites of active gold exploration in the north end of the YGB. In order to investigate the spatial relationship between hydrothermal alteration and gold deposition in these areas, this study produced 3-D models of the intensity of potassic alteration by reconstructing the chemistries of altered metavolcanic rocks according to mineral phases associated commonly with potassic alteration.

A lack of spatial correlations between potassic alteration and gold enrichment in the Ormsby area is potentially a consequence of limited lithogeochemical data, but may suggest that gold distribution was dominantly influenced by physical properties of host rocks, such as enhanced porosity and permeability. The spatial distribution of potassic alteration and gold enrichment at Clan Lake, however, suggest that fault systems may have influenced hydrothermal fluid flow in the area, and that hydrothermal fluids may have overprinted preexisting alteration patterns and remobilized gold subsequent to the main gold mineralizing event at Clan Lake.

Lead-dominant MVT deposits of the Viburnum Trend occur mainly in the reef-grainstone facies of the upper Bonneterre Dolomite (Cambrian). Unusually Cu-(Ni-Co)-Zn-rich ores have recently been discovered within the lower Bonneterre Dolomite and underlying Lamotte Sandstone of the Brushy Creek mine, more than 30 m below the main ore-bearing horizon of the Viburnum Trend.

Epigenetic dolomite cement associated with the atypical lower section ores in the Viburnum Trend exhibit cathodoluminescent (CL) patterns that are distinct from the pervasive CL cement stratigraphy observed in the upper Bonneterre Dolomite throughout southern Missouri and northern Arkansas, indicating the presence of multiple, chemically distinct fluids. Pronounced vertical zoning of Ni-Co-, Cu-, Zn-, and Pb-rich mineralization with increasing distance above the Lamotte Sandstone and sporadic variation in sulfur isotope compositions of sulfides have been interpreted to indicate that metal-specific mineralizing fluids utilized multiple sulfide sources and entered the system along multiple, fault-related flow paths (Cavender et al., 2016; Shelton et al., 2016).

Reaction path models constructed in the present study suggest that multiple pulses of metal-specific fluids utilizing multiple sources of sulfide through time is the most suitable depositional mechanism for the variable sulfur isotope compositions and multiple, alternating generations of ore sulfides in the lower ore zone of the Viburnum Trend. CL and stable isotope studies of dolomite cements from ore subdistricts elsewhere in southeast Missouri were also performed in this study, and indicate that both CL and stable isotope compositions (carbon and oxygen) vary spatially and stratigraphically, which suggests the presence of multiple, chemically distinct fluids whose CL patterns and isotopic composition was influenced by stratigraphic position.

Geochemical studies and reaction path calculations suggest that ores hosted in the lower Bonneterre Dolomite in southeast Missouri likely resulted from multiple, distinct fluids whose CL and isotopic signatures were influenced along stratigraphically and fault-controlled flow paths. Ore systems in the lower Bonneterre Dolomite likely breached higher stratigraphic levels via faults and fractures, and may have interacted with an overlying, regionally extensive, Pb-Zn ore system associated with mineralization in the upper Bonneterre Dolomite in the Viburnum Trend.