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

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Abstract

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.

The Archean metavolcanic-volcaniclastic complex in the Clan Lake area is a site of active gold exploration in the northern end of the YGB. To investigate the spatial relationship between wall-rock alteration and gold deposition in the area, this study produced 3-D models of potassic alteration intensity by reconstructing the chemistry of altered metavolcanic rocks according to mineral phases associated commonly with potassic alteration. The spatial distribution of potassic alteration and gold enrichment at Clan Lake suggests that regional- and local-scale fault systems may have influenced ore fluid flow in the area, and that later, fault-associated fluids may have overprinted preexisting alteration patterns and remobilized gold subsequent to the main gold mineralizing event at Clan Lake.

Typical MVT ore deposits in the Viburnum Trend are Pb-dominant and occur mainly in the upper third of the Bonneterre Dolomite. Recently, unusually Cu-(Ni-Co)-Zn-rich ores have been discovered within the lower Bonneterre Dolomite and underlying Lamotte Sandstone in the Brushy Creek mine of the Viburnum Trend. Reaction path modeling shows that the atypical, lower ore zone deposits formed by multiple pulses of metal-dominant fluids mixing with sulfide-bearing fluids from multiple sources, which was likely facilitated by fault-related flow paths. Spatial variations in the cathodoluminescence (CL) and stable isotope signatures of gangue dolomite cements among the Viburnum Trend and several other subdistricts in southeast Missouri suggest that multiple, distinct fluids contributed to ore formation in the southeast Missouri MVT Pb-Zn-Cu district. The chemical and isotopic signatures of these fluids were likely influenced along stratigraphically and fault-controlled pathways that varied both temporally and spatially.