

Fluorine Concentrations of Ore Fluids in the Illinois-Kentucky District: Evidence from SEM-EDS Analysis of Fluid Inclusion Decrepitates

Stuart Kenderes

Dr. Martin Appold, Thesis Supervisor

Abstract

The midcontinent of the United States hosts many world-class MVT districts, most of which are dominated by metal-sulfide mineralization, such as the lead rich Southeast Missouri, and zinc rich Tri-State districts. The Illinois-Kentucky district is anomalous in that it is a fluorite deposit. The research questions that guided this study are, one why is the Illinois-Kentucky district dominated by fluorite rather than metal-sulfides, and two what was the composition of the ore fluids responsible for the mineralization. Our hypothesis is the fluids that precipitated the minerals in Illinois-Kentucky were anomalously rich in fluorine.

Fluid inclusions hosted within sphalerite were decrepitated generating discrete solute mounds that can then be analyzed using a scanning electron microscope equipped with an energy dispersive spectroscopy detector. The composition of the solute mounds can then be used as a proxy for ore fluid concentrations. Results show fluid equivalent fluorine concentrations on the order of 100's to 1000's of ppm.

Ore fluid fluorine concentrations of this magnitude would correspond to an ore fluid pH of 0.0 to 0.8. In the presence of calcium, this ore fluid composition would have promoted the precipitation of fluorite, while simultaneously suppressed the precipitation of metal-sulfides such as galena and sphalerite. Ore fluids rich in fluorine would have also required a source anomalously rich in fluorine, such as HF rich gases exsolved during the cooling of ultramafic igneous rocks underlying the district, or dissolution of a sedimentary phosphorite deposit.