

Isotope Geochemistry of Ankerite-Bearing Veins Associated with the Coeur d'Alene Mining District, Idaho

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Abstract

Ankerite-bearing veins are common and widespread throughout and adjacent to the Coeur d'Alene mining district. Oxygen isotope ratios for quartz from the calcite-dominant and ankerite-dominant veins overlap and range from 12 to 18 per mil, and average 16.2 and 15.5 per mil, respectively. Previous studies of quartz from the Ag-producing veins give average ratios of 14.5 to 14.7 per mil. Ankerite oxygen and carbon isotope ratios range from 11.0 to 15.8 per mil and from -11.8 to +0.1 per mil, respectively. All but one of the calcite oxygen and carbon ratios lie in the ranges 13.0 to 16.0 per mil and -6.9 to -2.8 per mil. Quartz-ankerite fractionations lie between 1.1 and 2.9 per mil, except for samples from four massive ankerite veins, suggesting equilibrium at moderate temperatures (perhaps 270° to 320°C). Quartz-calcite oxygen fractionations are scattered, as are the quartz-ankerite fractionations from the massive ankerite veins, and clearly represent disequilibrium. The high oxygen ratios suggest that the hydrothermal fluids were strongly buffered, prior to entering the veins, by isotope exchange with the sedimentary Belt Supergroup rocks that form the vein walls, and perhaps by deeper Archean rocks. The $^{40}\text{Ar}/^{39}\text{Ar}$ age of fluorophlogopite from a calcite-dominant vein is =1014 Ma while an ankerite-dominant vein yielded a minimum age of 963 Ma; the latter sample shows partial resetting at 100 to 120 Ma. These ages fall within the bimodal distribution of hydrothermal ages previously reported for the Coeur d'Alene district, one Proterozoic age near 1 Ga and a younger age in Late Cretaceous-early Tertiary time. Initial $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in the range 0.738 to 0.787 for several of the carbonate minerals require derivation from an old source. Local Belt wall rocks or deeper Archean schists and gneisses are likely possibilities.