

## Age and Origin of Base and Precious Metal Veins of the Coeur D'Alene Mining District, Idaho

ROBERT J. FLECK,<sup>†</sup>

*U.S. Geological Survey, Mail Stop 937, 345 Middlefield Road, Menlo Park, California 94025*

ROBERT E. CRISS,

*Department of Earth and Planetary Sciences, Washington University, St. Louis, Missouri 63130*

GAIL F. EATON,

*Lawrence Livermore National Laboratory, Livermore, California 94550*

RODNEY W. CLELAND, CRAIG S. WAVRA,\* AND WILLIAM D. BOND

*Sunshine Precious Metals Company, P.O. Box 1080, Kellogg, Idaho 83837*

### Abstract

Ore-bearing quartz-carbonate veins of the Coeur d'Alene mining district yield  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios of 0.74 to  $>1.60$  for low Rb/Sr, carbonate gangue minerals, similar to current ranges measured in Middle Proterozoic, high Rb/Sr rocks of the Belt Supergroup. Stable isotope and fluid inclusion studies establish a genetic relationship between vein formation and metamorphic-hydrothermal systems of the region. These extraordinary  $^{87}\text{Sr}/^{86}\text{Sr}$  ratios require accumulation of radiogenic  $^{87}\text{Sr}$  in a high Rb/Sr system over an extended period prior to incorporation of Sr into the hydrothermal veins. Evaluation of the age and composition of potential sources of highly radiogenic Sr indicates that the ore-bearing veins of the Coeur d'Alene district formed during the Cretaceous from components scavenged from rocks of the Belt Supergroup, the primary host rocks of the district. Proterozoic Pb isotope ratios observed in galena from many Coeur d'Alene veins were established when Pb separated from uranium during deposition or diagenesis of the Belt Supergroup at 1400 to 1500 Ma, possibly as disseminated syngenetic deposits.

K-Ar and Rb-Sr apparent ages and  $\delta^{18}\text{O}$  values of Belt Supergroup rocks decrease from the Coeur d'Alene district toward the Idaho and Kaniksu batholiths, approximately normal to the trends of metamorphic isograds, fold axes, foliation, and the major reverse faults of the district. Isoclinal folding, thrust faulting, high-temperature metamorphism, granitic plutonism, and regional-scale metamorphic-hydrothermal activity is documented in the region between 140 and 45 Ma, representing the only such combination of events in the Coeur d'Alene region subsequent to about 1300 Ma. The Sr and oxygen results and geologic evidence favor formation of the ore-bearing carbonate veins by fluids related to a complex metamorphic-hydrothermal system during the Cretaceous. Pb with Proterozoic isotopic compositions was probably mobilized and incorporated like other metals into the hydrothermal veins during this event. The ore-bearing veins were sheared and displaced during early Tertiary northwest-trending dextral strike-slip faulting along the Osburn fault and related structures of the Lewis and Clark line.