

SCIENTIFIC COMMUNICATIONS

CARBONATE-HOSTED ZINC-LEAD DEPOSITS IN THE LOWER CAMBRIAN OF HUNAN, SOUTH CHINA: A RADIOGENIC (Pb, Sr) ISOTOPE STUDY

JENS SCHNEIDER,[†]

*Institut für Geowissenschaften und Lithosphärenforschung, Justus-Liebig-Universität Giessen, Senckenbergstrasse 3,
D-35390 Giessen, Germany*

MARIA BONI, FABIO LAPPONI,

Dipartimento di Geofisica e Vulcanologia, Università Federico II, Via Mezzocannone 8, I-80134 Napoli, Italy

AND THILO BECHSTÄDT

Geologisches Institut der Universität Heidelberg, Im Neuenheimer Feld 234, D-69120 Heidelberg, Germany

Abstract

Zinc-lead deposits hosted by Lower Cambrian carbonate rocks near Huayuan in the Hunan-Guizhou orogenic belt, southern China, have been studied by means of Pb and Sr isotopes. The deposits are characterized by two mineralization stages: (1) a main economic stage comprising cockade-style sphalerite, galena, pyrite-marcasite, fluorite, barite, and calcite, and (2) a subsequent noneconomic stage with nodular (rosette) sphalerite, saddle dolomite, and bitumen. Both ore stages are postdated by a generation of late calcite.

Main-stage sulfides ($^{206}\text{Pb}/^{204}\text{Pb} = 18.162\text{--}18.225$) display a steep linear trend on conventional Pb-Pb diagrams which indicates binary mixing of lead components bearing the imprint of ancient, ^{207}Pb -dominated crustal rocks and reservoirs with elevated Th/U ratios, possibly located in the lower crust. Nodular rosette sphalerites fall outside this line but reflect a second mixing trend between mineralizing fluids characterized by $^{206}\text{Pb}/^{204}\text{Pb} > 18.3$ and lead isotopically similar to specific main-stage cockade sphalerites, suggesting either remobilization of Pb from main-stage ores or contemporaneous mixing of three distinct lead components in the course of an evolving hydrothermal event.

The $^{87}\text{Sr}/^{86}\text{Sr}$ ratios of diagenetic and hydrothermal carbonate cements and barites range from 0.70905 to 0.71006 and increase systematically with the paragenetic sequence, indicating progressive mixing of marine Sr derived from the Lower Cambrian carbonate host rocks with radiogenic Sr supplied by external mineralizing fluids.

In order to identify possible local metal sources, U-Pb and Rb-Sr analyses were performed on six whole-rock samples from the Lower Cambrian sequence and their time-integrated Pb and Sr isotope evolution was compared to the isotopic signature of the mineralization. Whereas shales and black shales of the Cambrian Balang and Niutitang Formations underlying the ore-bearing Qingxudong carbonate unit appear to be possible external sources for the radiogenic Sr found in hydrothermal carbonates, the U-Pb data do not permit these shales to be considered as primary source rocks for the ore lead.

Both the Pb and the Sr isotopes indicate mineralizing fluids that had interacted with various external metal sources, some of them most probably being located in sedimentary or crystalline basement rocks. This refutes prevailing genetic models favoring the hydrocarbon- and metal-rich Lower Cambrian Niutitang black shales as the most likely source reservoir for the Zn and Pb in the deposits of the Huayuan district. The Pb and Sr isotope mixing trends observed for the ore and gangue precipitates reflect small-scale heterogeneous fluid systems that were not capable of producing large deposits. This may indicate that the Huayuan district is not a favorable target for future exploration of economic ore deposits. It also limits the prospects of successful radiometric dating of the mineralization, since conventional geochronologic models require initial isotopic homogeneity.

[†]Corresponding author; email, Jens.C.Schneider@geolo.uni-giessen.de