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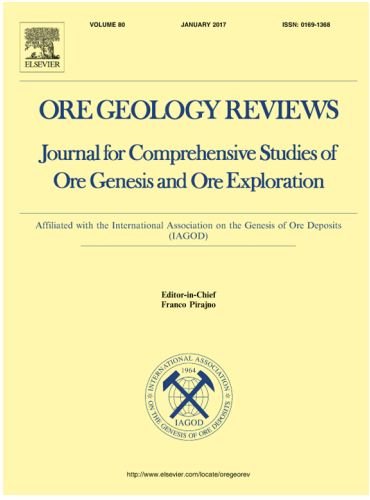

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The genesis of the Ali Ou Daoud Jurassic carbonate Zn-Pb Mississippi Valley-type deposit, Moroccan Central High Atlas: Constraints from bulk stable C-O-S, in situ radiogenic Pb isotopes, and fluid inclusion studies.

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Abstract

The proximity of the Ali Ou Daoud Zn-Pb ore deposit (AOD) to the Ikkou Ou Ali diapiric and magmatic paleohigh raises the question of the role of halokinesis and magmatism in the emplacement of the ore. The AOD ore deposit is hosted in hydrothermally dolomitized Bajocian carbonates. The mineralogical paragenetic sequence is simple and consists of dolomite-pyrite-galena-sphalerite-calcite. The mineralization is tectonically and unconformity controlled. Microthermometry of fluid inclusions in sphalerite indicates that ore precipitated from a NaCl-KCl-$CaCl_2$-$MgCl_2$ basin-derived hot (Th= 94 - 170°C) and saline (Salinity = 13.8 - 27.3 wt% NaCl eq.) mixed ore-forming fluid. Post-ore calcite also formed from a similar brine (Th = 176- 206 °C, Salinity =17.6 - 20.5 wt% NaCl eq.). The $\delta^{34}S$ values for sulfides range from 7.8 to 23.4‰ V-CDT with most values in the range of 16 to 23.4‰ V-CDT. Sulfur was mainly derived from the Triassic-Jurassic sulfates through thermochemical-sulfate reduction. The carbon-oxygen isotope values of calcite are overall similar to that of the barren Bajocian limestone and dolostone indicating that the calcite-forming fluid is in equilibrium with the carbonate host rock. Galena samples have a homogeneous Pb composition with $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ ratios ranging from 18.358 to 18.376, 15.636 to 15.663 and 38.486 to 38.606 respectively. This Pb isotopic composition points to the Paleozoic siliciclastic rocks as the main source of lead and presumably other metals with a possible contribution of Precambrian rocks. The long-distance fluid flow through a thick sequence of Paleozoic-Jurassic rocks ensured the homogeneity of Pb isotopes of the ore-forming fluids before they reached the loci of deposition. The emplacement of the ore occurred during Late Middle Jurassic-Early