Age and sources of the Qingchengzi Pb-Zn deposit in the northeastern China: Evidence from Rb-Sr, Sm-Nd and Fe isotopes

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The Qingchengzi deposit is one of the famous Pb-Zn-Ag deposits in the northeastern China. However, the mineralization age is still debated, hindering our understanding of its metallogenesis and geodynamics. Step leaching Rb-Sr isotopic dating of pyrites that crystallized coeval with galena and sphalerite from five sampels yield isochron ages of 143 ± 12 Ma to 159 ± 11 Ma with a weighted mean age of 151.9 ± 4.2 Ma, similar to the crystallization age of Late Jurassic granites in the orefield, which can be interpreted to be the mineralization age. The pyrites have negative ε_{Nd}(152Ma) values of -17.6 to -22.0, among the Archean to Paleoproterozoic meta-sedimetary rocks (i.e., wallrocks), mafic dikes and Late Jurassic granites. However, the initial $^{87}Sr/^{86}Sr$ ratio of 0.71878 ± 0.00035 is similar to those of Late Jurassic granites and Paleoproterozoic rocks (0.71158-0.73040), distinct from those of mafic dikes (0.70871-0.70886), indicating the Pb and Zn are mainly derived from wallrocks and Late Jurassic granites. While the mineralizaing fluids may be mainly derived from dehydration of granitic magmas, interacted with meteoric water that extracted Pb and Zn from the wallrocks. $\delta^{56}Fe$ values of pyrites in the Pb-Zn ores and Paleoproterozoic metamorphic rocks range from 0.13‰ to 1.09‰ and -0.49‰ to 0.17‰, respectively, distinct from those of granites (0.03‰ to 0.28‰). Importantly, the positive correlation between $\varepsilon_{Nd}(t)$ and $\delta^{56}Fe$ values for pyrites suggests a fast precipitation process of pyrites from the ore-forming fluids, which is evidenced by the occurrence of fine-grained pyrites. This process would increase the $\delta^{56}Fe$ values in the residual fluids. In summary, our new Sr-Nd-Fe isotopes of pyrites constrain the mineralization age of Qingchengzi Pb-Zn deposit, and suggest that the ore-forming fluids were mainly derived from Late Jurassic granites and the Pb-Zn mineralization was the result of interaction between ore-forming fluids and wall rocks.