He, Ar, S, and Pb Isotopic Constraints on the Origin of the Shuanghe Gold Deposit, China

FengChun Li, Qingdong Zeng, Shuai Gao, RiXiang Zhu, Shaoxiong Chu
Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

The Shuanghe gold deposit lies on the southern margin of North China Craton. Based on vein crosscutting relationships, mineral assemblages, and alteration characteristics, the formation of the deposit can be divided into four stages: 1) the barren quartz ± pyrite stage; 2) the quartz ± pyrite stage; 3) the quartz-polymetallic sulfides-ankerite stage; and 4) the quartz-carbonate stage. The abundant gold being mainly hosted at the stage 2−3. Pyrite-hosted fluid inclusions yield $^{3}He/^{4}He$ ratios of 0.05–0.25 Ra (most are greater than 0.14Ra; Ra = 1.4×10^{-6}) and $^{40}Ar/^{36}Ar$ ratios of 758.4–3560.1(average = 2024.7), which indicate the ore-forming fluids were predominantly crust-derived with minor mantle-derived components. The $\delta^{34}S$ values of pyrite range from – 4.2‰ to 2.1‰, show a relatively narrow range and consist with deep seated magma source. Lead isotope analyses indicate that the sulfides have $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ ratios from 18.226 to 20.016, from 15.597 to 15.880, and from38.475 to 39.396, respectively, indicating a mixed Pb sources with obvious proportions of mantle. Combined with previous data, we suggest that the ore-forming fluids and metals of the Shuanghe gold deposit stemmed directly from the regional mantle-derived magmatic hydrothermal system. The gold mineralization may genetically associate with the Early Cretaceous magmatism in an extensional tectonic setting, which is coupled with the large-scale lithospheric extension and thinning on the southern margin of the North China Craton.