

In-situ sulfur isotope analysis of the sedimentary and magmatic rock hosted gold deposits from the north and south gold belt of the South Qinling orogen : Implication for the source of sulfur and their difference

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Gold is believed to be transported as bisulfide complexes in acidic hydrothermal fluids and coprecipitates with pyrite or arsenopyrite in most deposits. Therefore, understanding of the sulfur isotopic composition of pyrite is a key to better understanding the source of sulfur, furthermore, the source of Au and the source of the hydrothermal fluids.

Gold deposit genesis in the Qinling orogen is highly debated. The sedimentary and magmatic rock hosted Pangjiahe gold deposit is located in the north belt of the South Qinling orogen (NB), with a proven reserve of 38 t Au at an average grade of 6.3g/t. Five stages of pyrite have been recognized according to our studies. The diagenetic P-Py1 consists of euhedral granular or elongate grains in the core of zoned pyrite in phyllite, with a mean As content of 0.18wt% and a wide range of $\delta^{34}\text{S}$ from -1.5‰ to +9.4‰. Magmatic G-Py1 is comprised of euhedral fine grains in the core of zoned pyrite in granite, with a mean As content of 0.15wt% and a narrow range of $\delta^{34}\text{S}$ mostly from 2‰ to 5‰. The main ore stage Py2 is the most common sulfide in the field, with a mean As content of 4.14wt% (in phyllite) and 3.31wt% (in granite). It always occurs as an oscillatory zoned replacing or overgrown on P-Py1 and G-Py1 or as individual fine grains close to Py2. Arsenopyrite is always associated with Py2. The later ore stage Qz-Py usually exists in microfractures that cut the phyllite and granite rocks or in unrooted quartz veins that fill the gap between ore phyllite and granite. Qz-Py also displays slightly oscillatory zoning textures, with a mean As content of 1.21wt%, and native gold is commonly observed in this stage or spatially related to the quartz veins. Py3, also belonging to the later ore stage, can be distinguished by native gold inclusions in them, all occurring as the outer rim overgrown on or replacing Py2, with a mean As content of 0.75wt% (in phyllite) and 0.45wt% (in granite). The ore stage sulfides have the same and narrow range of sulfur isotopic composition mostly from 8‰ to 10‰. That is slightly lower than the age equivalent and spatially related SEDEX Pb-Zn deposit from the graben basins, but totally different from the diagenetic P-Py1 and magmatic G-Py1. Therefore, we believe that the prograde metamorphism of the underlying Devonian sedimentary sequences during seafloor exhalation may have produced H₂S forming the auriferous sulfides by reduction of sulfate to sulfide by thermochemical or inorganic reactions.

Gold mineralization in the south belt of the South Qinling orogen, represented by the Yangshan gold deposit, shows the same mineralization style as within the NB, including the host rocks and the abundant pyrite structures. However, the $\delta^{34}\text{S}$ values of the ore stage hydrothermal sulfides are similar to those for magmatic sulfur, which coupled with the massive magmatic activities behind the South Qinling orogen caused by delamination, are a distinct difference from the NB.