

# Source of ore-forming materials in the Longtougou gold deposit, South Qinling Orogen, China: Constraints from trace element and S–Pb–H–O isotopes

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Orogenic gold deposits are a significant source of gold production, although the geological processes and sources of metallogenic material remain somewhat controversial. The Longtougou deposit is located in the South Qinling Orogen, China, and is a newly discovered moderate tonnage gold deposit. In this paper, trace element, and S–Pb–H–O isotopes analysis were performed on the samples of different stages to trace the source of ore-forming materials. The deposit can be split into four stages of mineralization and contains three types of pyrite. Pre-ore stage pyrite ( $\delta^{34}\text{S} = -15.1\text{‰}$  to  $-14.5\text{‰}$ ) derived from bacterial sulfate reduction. Early-ore stage samples yield  $\delta^{18}\text{O}_{\text{H}_2\text{O}}$  and  $\delta\text{D}_{\text{V-SMOW}}$  values from  $9.8\text{‰}$  to  $13.9\text{‰}$  and  $-75.4\text{‰}$  to  $-65.3\text{‰}$ , respectively, and the sulfides have restricted ranges of  $\delta^{34}\text{S}$  values ( $-5.7\text{‰}$  to  $5.6\text{‰}$ ) that are indicative of fluids may be derived from a mixing of magmatic and metamorphic fluids. Main-ore stage samples yield  $\delta^{18}\text{O}_{\text{H}_2\text{O}}$  and  $\delta\text{D}_{\text{V-SMOW}}$  values of  $5.4\text{‰}$  and  $-70.6\text{‰}$ , respectively. The pyrite yields lower positive  $\delta^{34}\text{S}$  values ( $2.4\text{‰}$  to  $5.3\text{‰}$ ) and coexisting barite has higher positive  $\delta^{34}\text{S}$  values ( $15.3\text{‰}$  to  $17.5\text{‰}$ ), and the  $\delta^{34}\text{S}_{\text{A-B}} - \delta^{34}\text{S}_{\text{B}}$  diagram yields a  $\delta^{34}\text{S}_{\text{ore-fluid}}$  value of  $8.2\text{‰}$ , indicate that the sulfur derived from a mix of sedimentary and magmatic sources. The late-ore stage samples yield  $\delta^{18}\text{O}_{\text{H}_2\text{O}}$  values from  $-9.02\text{‰}$  to  $3.30\text{‰}$  and  $\delta\text{D}_{\text{V-SMOW}}$  values from  $-74.5\text{‰}$  to  $-56.7\text{‰}$ , suggested the fluid was dominated by meteoric water. All of the sulfides have Pb isotopic ratios that plot within the field of underlying Paleozoic strata and are close to the Indosinian and Yanshanian granites, suggesting that the metals were derived from a combination of underlying Paleozoic sedimentary and granitic sources. In addition, hydrothermal pyrites have trace-element variations that differ from Py0, suggesting that the gold was not derived from the local host rocks. An underlying Paleozoic sedimentary sequence enriched Au that underwent greenschist facies metamorphism may be another source of the gold.

In conclusion, we proposed that the ore-forming materials of the Longtougou gold deposit were derived from the magma and underlying Paleozoic sedimentary rocks.

Foundation: National Natural Science Foundation of China (Grant Nos. 42173066 and 42273066)