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# $CO_2$-rich fluid inclusions in gold-rich ores from the Dongtongyu-Wenyu gold deposits, Xiaoqinling Mountains, China

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The Xiaoqinling Mountains area, extending from eastern Shaaxi to western Henan Province, is one of the most productive gold provinces in China. The Dongtongyu and Wenyu gold deposits are two of several large deposits in this area. The gold-bearing quartz veins are controlled by a series of east-west shear zones within the Archean Taihua Group that are composed of amphibolite, plagioclase gneiss, and migmatites. Principal alteration surrounding shear zones includes sericitization, silicification, pyritization, and carbonization. Four paragenetic stages of mineralization can be distinguished: I) pyrite-quartz, II) quartz-pyrite, III) polymetallic sulfide, and IV) quartz-calcite. Stages II and III are the main gold mineralization stages. Gold-rich ores are generally located where the stage III assemblage is well developed.

Fluid inclusions are abundant in various stages of vein quartz. Three types of primary fluid inclusions can be observed under room temperatures: $CO_2$-$H_2O$, $H_2O$-free carbonic, and aqueous. $CO_2$-$H_2O$ inclusions are commonly seen in stages I, II, and III.

Gold-rich ores were selected for fluid inclusion microthermometry in this study. The $CO_2$-$H_2O$ inclusions in quartz from gold-rich ores have melting temperatures of solid $CO_2$ from -60.8℃ to -57.3 ℃, homogenization temperatures of $CO_2$ phases from +8.7℃ to +25.9℃, and melting temperatures of clathrate from +2.7~+8.9 ℃. The final homogenization temperatures of $CO_2$-$H_2O$ inclusions are from 202℃ to 348℃ for stage III gold-rich ores. The salinities of $CO_2$-$H_2O$ inclusions are from 2.2 to 12.3 wt% NaCl equiv. according to melting temperatures of clathrate. The minimum ore-forming pressures of the gold-rich stage are estimated to be 95-145 MPa, according to V-X relations in the $CO_2$-$H_2O$ system and pressure estimation relationships.

The $d^{18}O$ of quartz measurements are from 10.9 to 14.3 ‰ for stage I, and from 7.9 to 9.7 ‰ for stage II. The calculated $d^{18}O(H_2O)$ of associated fluids varies from 7.2 to 10.2‰ for stage I, and from 4.1‰ to 5.9‰ for stages II and III. The dD of fluid inclusions ranges from –78.1 to -29.5‰ for stage I, and from -50.8 to -43.8‰ for stages II and III. It is concluded that the water in the hydrothermal fluids precipitating orebodies could have been mainly of magmatic and/or metamorphic nature.

The $d^{34}S$ values for pyrite of the ores range from 2.5 to 8.2‰ for stage I, and from 3.7 to 7.1‰ for stage II. Those of other sulfides in stage III (chalcopyrite, galena, and sphalerite) range from -3.7 to +3.4‰. These data are identical with those from other gold deposits from the Xiaoqinling district. The ranges of $d^{34}S(H_2S)$ in the fluids could be from 1.5 to 7.2‰, 2.5 to 8.9‰, and -1.4 to +3.0‰, respectively for stages I, II, and III. They show that the sulfur in the ore-forming fluids may be from magma or from Precambrian rocks in the lower crust.