SEG 2017 Conference

Geology, geochronology, and geochemistry of the Tianjingshan lode gold deposit, China: Implications for Middle Triassic gold mineralization in southern Anhui Province

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Tianjingshan is the only lode gold deposit that is being mined in the southern part of Anhui Province. It is located at the southeastern margin of Yangtze Platform and the northern segment of the Anhui-Zhejiang-Jiangxi fault zone. Gold mineralization mainly developed in the contact zone between Proterozoic greenschist facies metamorphic rocks and the Jinningian granite. The mineralization types include auriferous quartz veins and a few disseminated/altered rock type orebodies. Hydrothermal mineralization can be divided into four stages: (1) quartz stage: quartz and a small amount of coarse-grained pyrite; (2) quartz-pyrite stage: quartz, pyrite, arsenopyrite, sericite, and a small amount of native gold; (3) quartz-polymetallic sulfides stage: quartz, polymetallic sulfides, sericite, and a small amount of native gold; (4) quartz-calcite-fluorite stage: quartz, calcite, fluorite, and pyrite. The alteration related to mineralization includes silicification, sericitization, pyritization, and chloritization. The sulfides in the deposit are dominated by pyrite, with subordinate chalcopyrite, sphalerite, galena, and tetrahedrite. Quartz and pyrite are the main gold-bearing minerals. The native gold is either discrete grains hosted in quartz, pyrite, and polymetallic sulfides, or fills microcracks in pyrite and quartz.

Hydrothermal sericite from the two mineralization stages yielded $^{40}Ar/^{39}Ar$ ages of 243.5 Ma (MSWD=0.15) and 239.4 Ma (MSWD=0.08), which both provide the ages of the gold ore formation. Zircon U-Pb ages of the Hanjia and Mi'ao granites, located in the Tianjingshan ore field, are ca. 789.5±7.0 Ma and 147.8±1.5 Ma, respectively, which are significantly different from the mineralization ages. It suggests that the gold mineralization in the Tianjingshan gold deposit was not related to these intrusions. Combining this information with the geological characteristics of the deposit and the formation time of the regional shear zone (331.5±3.2 Ma), it can be suggested that the regional gold mineralization was also not related to the ductile shearing. The $\delta^{34}S$ values of pyrite are between 0.7% to 9.2%, indicating that sulfur probably was sourced from a magma. Quartz from stage I yielded $\delta^{18}O$ values of 1.1‰ to 1.5‰ and δD values of -76‰ to -69‰. Quartz from stage II showed $\delta^{18}O$ values of -8.2‰ to -7.8‰ and δD values of -76‰ to -69‰. The data show that the ore-forming fluid in the early stage was dominated by a magmatic hydrothermal fluid, however meteoric water was the main ore fluid in the late stage. In summary, the Tianjingshan lode gold deposit is of magmatic hydrothermal origin, and it thus may be related to the regional tectonic magmatic events in the Middle Triassic.

The gold deposits (spots) in the southern Anhui and in the Yinshan ore field in northeastern Jiangxi share nearly the same ore-forming ages and similar geological characters, and are all constrained in the Anhui-Zhejiang-Jiangxi fault zone. We propose that the gold deposits in both locations are comparable and that southern Anhui Province is very prospective for discovery of new gold resources.