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Research Advances

Fluid Inclusion and Stable Isotope Geochemistry of the Shangxu Gold Deposit, Northern Tibet

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Objective

The Shangxu gold deposit is located in the south of the middle Bangong-Nujiang suture zone in northern Tibet. The origin of this deposit as an orogenic gold deposit is debatable. The study of the Shangxu deposit has a profound implication on gold exploration in the Bangong-Nujiang metallogenic belt and can also improve our understanding of gold mineralization in northern Tibet.

Methods

Microthermometry analysis was conducted with a Linkam THSMG-600 heating and freezing stage at Chinese Academy of Geological Sciences (CAGS), Beijing. Laser Raman component analysis was performed using Renishaw System-2000 in the Laser Raman Laboratory of the Institute of Mineral Resources, CAGS, Beijing. The C-H-O isotope analyses were conducted with a MAT-253EM mass spectrometer at the Analytical Laboratory of Beijing Research Institute of Uranium Geology.

Results

(1) Mineralization stages

The orebodies in the Shangxu gold deposit are hosted in the Middle-Lower Jurassic metamorphic flysh Mugagangri group, and are mainly controlled by NWW-trending faults. The gold mineralization is closely related to quartz veins. Auriferous quartz veins contain a large amount of sulfides, such as pyrite, chalcopyrite, galena and sphalerite. Native gold is dominantly distributed in the cracks of quartz (Fig. 1a), with minor in the cracks of pyrite. Four stages of mineralization were identified, including quartz stage (S1), quartz-pyrite stage (S2), quartz-polysulfide stage (S3) and carbonate stage (S4). The precipitation of gold mainly occurs in S2 and S3.

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(2) Fluid inclusions

The Shangxu gold deposit contains two types of fluid inclusions: NaCl-H_2O inclusions (type L) and CO_2 inclusions (type C), including two-phase and three-phase inclusions, respectively (Fig. 1b). Homogenization temperatures of S2 fluids are in the range of 142.0–397.0°C, with peak values at 180.0 –190.0°C, whereas S3 fluids yield homogenization temperatures of 141.0–409.8° C, with peak values at 160–170° C and 280–290° C. In addition, peak values of salinities (4.0wt%–4.5wt%) are consistent in S2 and S3. CO_2 is the only vapor phase identified in S2 and S3 fluid inclusions.

(3) H-O isotopes

Twenty-one quartz samples were conducted with H and O isotopic analyses. Their $\delta^{18}O_{V\text{-}SMOW}$ and $\delta D_{V\text{-}SMOW}$ values vary from 9.3‰ to 18.2‰ and from −123‰ to −89‰, respectively. The estimated fluid $\delta^{18}O_{fluid}$ values are between −0.8‰ and 8.5‰. The H-O isotopic compositions fall in the area among metamorphic fluid, formation water and meteoric water in a $\delta D_{V\text{-}SMOW}$–$\delta^{18}O_{fluid}$ diagram (Fig. 1c). The $\delta D_{V\text{-}SMOW}$ values are as low as −123‰, suggesting an influx of either exchanged meteoric water and/or organically derived hydrogen.

(4) C-O isotopes

Two calcite samples from S4 have $\delta^{13}C_{V\text{-}PDB}$ values of −0.9‰ and 0.3‰, and $\delta^{18}O_{V\text{-}SMOW}$ values of 16.5‰ and 17.9‰, respectively. The C-O isotopic compositions of calcites indicate a close relationship of the ore-forming fluids with regional carbonate rocks in a $\delta^{13}C_{V\text{-}PDB}$–$\delta^{18}O_{V\text{-}SMOW}$ diagram (Fig. 1d). The calcite $\delta^{13}C_{V\text{-}PDB}$ values are higher than igneous rocks and magmatic systems (−3‰ to −30‰), atmospheric CO_2 (−7‰ to −11‰), the continental crust (−7‰) and the mantle (−5‰). Therefore, these high $\delta^{13}C_{V\text{-}PDB}$ values are likely indicative of a marine carbonate sedimentary origin. In addition, the negative relationship between calcite $\delta^{13}C_{V\text{-}PDB}$ and $\delta^{18}O_{V\text{-}SMOW}$ values suggests that the carbon was produced by metamorphic

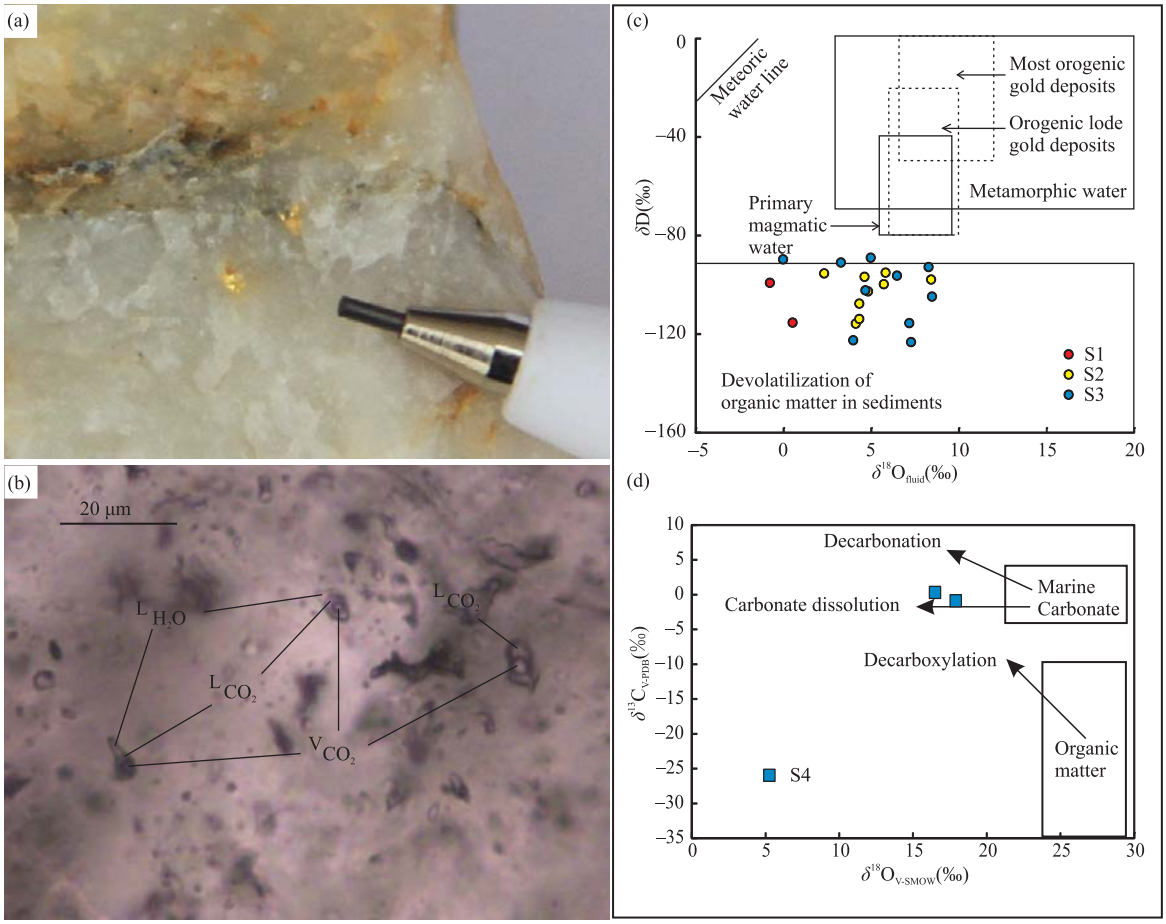

Fig. 1. Typical features of the Shangxu gold deposit in northern Tibet.
(a), Native gold in quartz; (b), CO_2 inclusions; (c), Plot of $\delta D_{V\text{-}SMOW}$ vs. $\delta^{18}O_{fluid}$; (d), Plot of $\delta C_{V\text{-}PDB}$ vs. $\delta^{18}O_{V\text{-}SMOW}$.

decarbonation of regional carbonate sediments.

Conclusions

Similar to typical orogenic gold deposits, the ore-forming fluids of the Shangxu gold deposit are CO_2-rich, and have low to moderate homogenization temperature, low salinity and low density. The C-H-O isotopic data suggest that the ore-forming fluids are mainly derived from the mixing of metamorphic fluid, formation water and meteoric water. Fluid inclusions and stable isotope geochemistry indicate that the Shangxu gold deposit is probably an orogenic gold deposit in northern Tibet.

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