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Age and Metal Source Constraints for Gold Deposits in Southeast Guizhou Province, China, from Re-Os and He-Ar Isotopes in Arsenopyrites

WANG Jiasheng[1], FAN Bo[2] and ZHU Yan[1]

1 Kunming University of Science and Technology, Southwest Institute of Geological Survey, Kunming 650093, China
2 Kunming Engineering & Research Institute of Non-ferrous Metallurgy Co., Ltd., Kunming, 650051, China

1 Geology

The Jiangnan Old Land in China refers to the Neoproterozoic epimetamorphic sedimentary strata and a series of magmatic rocks shown as zonal distribution between Yangtze and Cathaysia blocks. It can be divided into four gold districts as: the Northeastern Jiangxi district, the Eastern Hunan-Western Jiangxi district, the Western Hunan district and the Southeastern Guizhou-Northern Guangxi district, with the latter two districts representing the main part of the Xuefeng gold metallogenetic belt. The gold deposits in the Tianzhu–Jinping area, Southeast Guizhou, belong to the Southwest section of this belt. The stratigraphy of the area includes the Presinian Xiajiang Group (the equivalent of the Banxi Group in Hunan province), and Sinian, Carboniferous, Permian, Jurassic, Cretaceous and Quaternary. There is an angular unconformity between the Xiajiang Group and the other strata and there are parallel unconformities between the Carboniferous and Permian, and also between the Permian and Jurassic (Lu et al., 2005). The Xiajiang Group which has a total thickness up to 7000 m has been subdivided into the following (list in ascending order): the Fanzhao, Qingshuijiang, Pinglue, and Longli formations. Gold-bearing quartz veins are found in all formations except the Pinglue Formation (Lu et al., 2005).

The Southeast Guizhou area has experienced multistage tectonic events since Proterozoic. The NE-trending tectonic framework was first established by the Xuefeng movement (1000 to 800 Ma). After that, several EW-trending shear zones were developed in the Caledonian movement (513 to 386 Ma), including the Gaoniang shear zone situated in the north and the Qimeng shear zone in the south of the study area. These two EW-trending shear zones have controlled the graben-type structure and local subsidence in the Hercynian-Indonesian movements (386 to 205 Ma). During the Yanshanian movements (180 to 65 Ma), NNE-trending structures were overlapped and overprinted the EW- and NE-trending tectonics, experienced sinistral transpressional shear due to the oblique subduction of Pacific Plate under Asian continental plates. No igneous rocks have been found in the region, although some ring structures have been interpreted to be related to concealed intrusions (Lu et al., 2005; Zhao et al., 2006).

2 Results and Discussion

Three sets of arsenopyrites $^{187}Re/^{188}Os$-$^{187}Os/^{188}Os$ isochron ages were calculated using Isoplot V. 3.23 (Ludwig, 2005). An age of 400 ± 24 Ma, MSWD = 0.96, initial $^{187}Os/^{188}Os$ (Os_i) = 1.24 ± 0.57 is obtained for the altered slate-type (AST) arsenopyrite from Pingqiu; 400 ± 11Ma, MSWD = 0.34, Os_i = 1.55 ± 0.14 is obtained for the AST arsenopyrite from Jinjing; and 174 ± 15 Ma, MSWD = 1.07, Os_i = 8.04 ± 0.45 is obtained for the large quartz vein-type (LQVT) arsenopyrite from Jinjing. The former two ages for the AST arsenopyrite from different ore deposits are in complete accord, both belonging to Caledonian and therein Os_i ratios are basically consistent. On the other hand, the formation time of the LQVT arsenopyrite belongs to Yanshanian. All of the Os_i isotopic characteristics suggest that the ore-metals of the gold deposits in this region mainly come from the gold-bearing Proterozoic strata.

The results of He and Ar isotope analyses of arsenopyrite fluid inclusions show $^3He/^4He$ ratio range from 5.3×10^{-4} to 2.5×10^{-2} Ra (Ra represents the $^3He/^4He$ ratio of air, 1.4×10^{-6}), $^{40}Ar^*/^4He$ ratios $(0.64–15.39) \times 10^{-2}$, $^{40}Ar/^{36}Ar$ ratios are 633.2 to 6582.0, $^3He/^{36}Ar$ ratios are 0.5 to 54.5×10^{-4}. These noble gas isotopic characteristics suggest that the ore-forming fluids were mainly derived from the crust. Comparatively, Pingqiu AST arsenopyrites have higher ^4He, ^{40}Ar, Th and U concentrations. It is

* Corresponding author. E-mail: jiashengwang@126.com

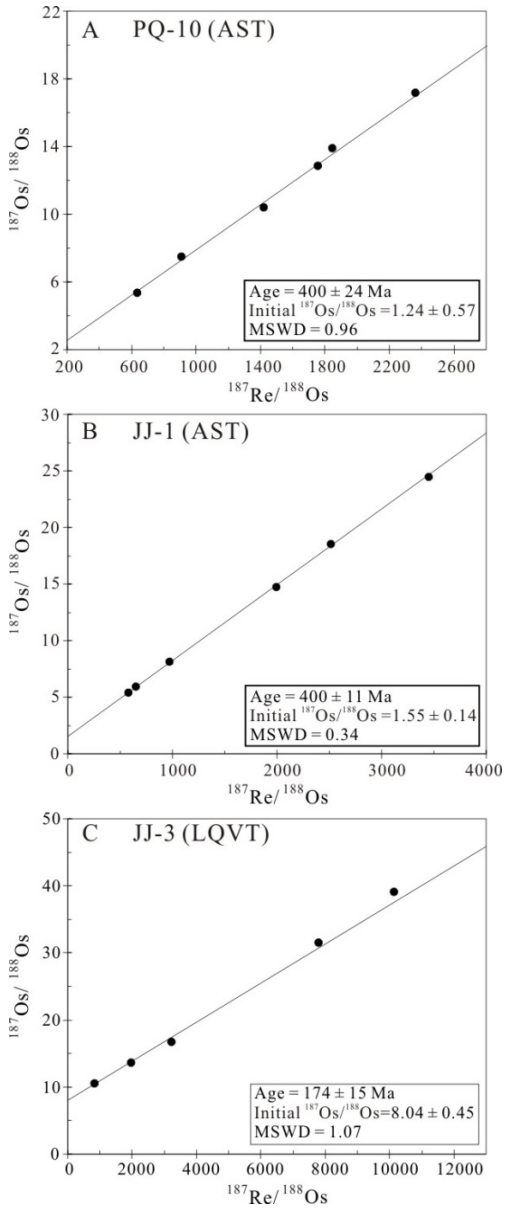

Fig. 1. Re-Os isochrone diagrams of AST arsenopyrite from Pingqiu (A, PQ-10) and Jinjing (B, JJ-1) gold deposits, and LQVT arsenopyrite from Jinjing gold deposit (C, JJ-3), SE Guizhou.

indicated that the amount of in situ generated radiogenic ^{4}He should not be ignored in the noble gas studies, even if there is only a few ppm of Th and U in host minerals.

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