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Helium and Argon Isotope Systematics of Orogenic Gold, Antimony Deposits in the Himalayan Orogen, Southern Tibet

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1 Regional Geological Setting and Geology of the Ore Deposits

Orogenic gold deposits formed in accretionary or collisional orogens have common geological and geochemical features (Groves et al, 1998; Goldfarb et al., 2005), but there is debatable as to the source of ore-forming fluids, e.g., metamorphic, magmatic, mantle, and meteoric water origin or mixing of two end-members. The Himalayan orogenic system was created by the collision of India with Asia and the orogenesis is still ongoing. This makes the orogeny one of the outstanding natural laboratory for studying continental collisions and related metallogenesis. Mineral deposits formed in this orogeny are thus relatively young and have undergone limited overprinting of metallogenesis, making it an ideal site of studying metallogenesis and the accompanying process of mountain building.

The southern Tibet Au-Sb metallogenic belt, in the Himalayan orogeny to the south of the Indus-Tsangpo suture, contains more than fifty gold-and/or stibnite-bearing vein deposits or occurrences (Nie et al., 2009). Most deposits are hosted in Mesozoic strata, which compose mainly post-rift passive margin turbidites and underwent low-grade metamorphism during the Himalayan orogeny. The typical gold deposits include Mayoumu (Duo et al., 2009) and Bangbu (Sun et al., 2010), gold-antimony and antimony include Mazhala and Shalagang, these gold-and/or antimony deposits belong to typical epizonal orogenic mineral systems (Zhai et al., 2014). From deep to shallow, gold, gold-antimony and antimony deposits compose a mineralization comtinuum.

2 He-Ar Isotopes and Conclusions

Helium and argon isotope analyses indicate, at Bangbu and Mayoumu gold deposits, $^{3}He/^{4}He$ and $^{40}Ar/^{36}Ar$ rations for fluid inclusions in sulfides are 0.174 to 1.010 Ra (Ra is atmospheric $^{3}He/^{4}He$, 1.399´10^{-6}) and 311.9 to 1724.9, 0.0755 to 1.69 Ra and 298.9 to 2850.8, respectively (Duo et al., 2009, Wei et al., 2010); at Mazhala gold-antimony and Shalagang antimony deposits, $^{3}He/^{4}He$ and $^{40}Ar/^{36}Ar$ rations for fluid inclusions in stibnite are 0.01382 to 0.05642 Ra and 283.7 to 4770, 0.02385 to 0.11488 Ra and 300.6 to 537.5, respectively. As these deposits formed during Cenozoic, samples for He-Ar isotope analysis were mined in adits, and sulfides are reliably trap helium, the post-entrapment modification to He-Ar isotope ration can thus be ignored (Kendrick and Burnard, 2010). Using the crust and mantle two end-member formula (Ballentine et al., 2002), the proporations of mantle He in the ore-forming fluid can be calculated from 0 to 14.8% (average of 7.2%) and 0.8 to 23.9% (average of 6.1) for Bangbu and Mayoumu Au deposits, and 0 to 0.5% and 0 to 1.4% for Mazhala Au-Sb and Shalagang Sb deposits respectively, the $^{*40}Ar/^{4}He$ rations are 0.02 to 0.40 and 0.04 to 2.72 for Bangbu and Mayoumu, 0.005 to 0.22 and 0.001 to 0.23, respectively. These results combining with stable isotope data (Zhai et al., 2014) indicate that the ore-forming fluid for Bangbu and Mayoumu Au deposits consisted of predominantly crustal metamorphic fluid with minor involvement of modified air-saturated water and mantle component, the ore-forming fluid for Mazhala Au-Sb and Shalagang Sb deposits consisted of a mixture of crustal metamorphic fluid and modified air-saturated water almost without involvement of mantle component.

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