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Noble gas isotopes of the Xuejiping porphyry Cu deposit, western Yunnan, China

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The Xuejiping porphyry deposit is an important copper polymetallic deposit in Yidun Island arc, located in Zhongdian area, northwest Yunnan. Its formation is closely related to the tectonic evolution of the Tethys Ocean, and mineralization is closely related to magmatic activity. Tectonically, it is located in the east margin of the Zhongza block and within the Yidun Island arc on the west side of the Ganzi-Litang suture. The Yidun Island arc is the product of the westward subduction and orogeny of the oceanic crust of the Ganzi-Litang Ocean Basin in the southwest Sanjiang Paleo-Tethys. It has experienced multiple tectonic stages, including subduction of oceanic crust and orogenic processes in the Late Triassic (237–206 Ma), intracontinental collisional orogeny in the Jurassic (206–138 Ma), orogeny, crustal thickening and intraplate extension in the Cretaceous (138–75 Ma), and intracontinental convergence and strike-slip extension in the Cenozoic (65–15 Ma). Zircon U-Pb and molybdenite Re-Os dating indicate that the mineralization age of the Xuejiping deposit is the late Indosinian period, which is consistent with the subduction of the Ganzi-Litang oceanic crust in the region, indicating that the formation of the deposit is closely related to magmatic activity caused by plate tectonic activities. Here we report He and Ar isotope determinations from ore fluids from the Xuejiping deposit to decipher the contribution of mantle.

The hydrothermal fluids in sulfides have $^{3}He/^{4}He$ ratios from 0.37 to 1.15 Ra (Ra: the $^{3}He/^{4}He$ ratio of air, $1Ra = 1.39\times10^{-6}$), and $^{40}Ar/^{36}Ar$ ratio vary from 369 to 517, indicating the involvement of mantle-derived noble gases in the ore-forming fluids. $\delta^{34}S$ range from -1.75‰ to +0.18‰, with an average of -0.67‰, indicating the magmatic origin of the ore-forming fluid. Combined with other isotopes, it suggests that the ore-forming materials may come from the mixture of crust and mantle. This study helps to enrich and improve the theory of the relationship between plate tectonic evolution and mineralization in the Tethys metallogenic belt, and provides a typical example for the study of the relationship between magmatic activity, fluid interaction and mineralization during the Indosinian period within the Tethys metallogenic belt.