Mantle contributions in the formation of Mesozoic Sn-W-Mo-Cu-Pb-Zn deposits in South China: take Shizhuyuan orefield as example

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South China is one of the most important polymetallic metallogenic provinces in the world. Of particular importance are world class deposits of felsic intrusion-related Sn-W-Mo-Cu-Fe-Pb-Zn, which are spatially, temporally and genetically associated with Jurassic granitoids, which are believed to be produced by crustal anataxis, without a mantle contribution. Recently, a growing number of studies show that mantle components were involved in the genesis of some deposits. However, it has been poorly constrained in what form mantle participates in the mineralization, volatile, heat or material? Here we report He and Ar isotope determinations from ore fluids from the Shizhuyuan orefield to decipher the contribution of mantle.

Hydrothermal fluids in sulfides have $^{3}He/^{4}He$ ratios from 0.06 to 1.66 Ra (Ra, the atmospheric $^{3}He/^{4}He$ ratio of 1.4×10^{-6}), from 0.16 to 1.02 Ra and from 0.06 to 1.37 Ra for W-Sn-Bi-Mo, Sn-Cu and Pb-Zn deposits respectively, indicating the presence of mantle-derived noble gasses in the fluids. The ^{3}He concentrations are a little higher in W-Sn-Bi-Mo deposit than in Sn-Cu and Pb-Zn deposits. The ^{3}He/heat ratios of ore-forming fluids are similar to that of mid-oceanic ridge hydrothermal fluids. The fault systems in the orefield provide the channel for mantle volatile and heat from the deep magma chamber. The heat not only initiated the melting of crustal rocks but also provided heat for magmatic differentiation and deep circulation of atmospheric water, which not only bring the maximum concentration of mineralization material in the rock mess but also extracted a large amount of radiogenic ^{4}He as well as ore-forming material (eg. W, Sn, Mo, Bi, Be, Zn, Ag) from ancient crustal rocks. It appears that mantle-derived heat and volatiles have made a major contribution to the mineralization of W-Sn-Bi-Mo, Sn-Cu and Pb-Zn in the orefield.