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Preliminary study on copper isotopes of the Zijinshan ore field, Fujian Province, SE China

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Zijinshan Cu-Au polymetallic ore field is located in Southeast China, tectonically belonging to the Interior Cathaysia Block. It is a complete porphyry-epithermal mineralization system, including Luoboling porphyry Cu–Mo deposit, Zijinshan high sulfidation Cu-Au deposit, Yueyang low sulfidation Ag–Au deposit, Wuziqilong and Longjiangting transitional style Cu deposits, etc. Main ore minerals from Zijinshan and Wuziqilong deposits are covellite and digenite. Copper isotopic compositions of these two minerals were analyzed. Copper isotope ratios are reported in the standard delta notation: δ^{65} Cu‰[(^{65}Cu/^{63}Cu)$_{Sample}$/(^{65}Cu/^{63}Cu) $_{ERM-AE633}$-1] $\times$1000. The overall δ^{65}Cu values for the analysed samples vary from -2.76 to 1.33‰The Zijinshan Cu-Au deposit show large Cu isotopic variability (-2.76 to 1.33‰), among which covellite samples range from -2.76‰ to 0.38‰ with -0.79‰ in average and digenite samples range from -1.8‰ to 1.33‰ with -0.11‰ in average. During the leaching process of hypogene sulphides, ^{65}Cu was leached more easily and then trapped in the supergene enrichment zone. Therefore, enrichment minerals should be enriched in ^{65}Cu and the leached cap enriched in ^{63}Cu. Thus the relationship of δ^{65}Cu values for different Cu reservoirs should be leached cap minerals $<$ hypogene sulphides $<$ enrichment minerals. Nonexistence of enriched δ^{65}Cu values indicate that the major copper minerals (mainly covellite and digenite) in the Zijinshan Cu-Au deposit and Wuziqilong Cu deposit are of hypogene origin rather than secondary origin. At the Wuziqilong Cu deposit, Cu isotopes has narrow range from 0.16‰ to 0.43‰ with 0.31‰ in average, which is typically of hypogene origin. Two coexisting covellite –digenite fractionations (δ^{65}Cu =δ^{65}Cu$_{covellite}$ $-$ δ^{65}Cu$_{digenite}$) are 0.27‰ and 0.18‰ relatively. For minerals of the Cu-S system, from chalcocite (Cu$_2$S) to covellite (CuS), proportions of Cu(II) become higher and higher. The classical definition of the crystallographic structure of covellite indicated that one third of the Cu is Cu(II) and digenite (Cu$_{1.8}$S) has one ninth of Cu(II). Therefore, covellite is more oxidized species and has higher δ^{65}Cu compared with coexisting digenite.