

Hydrogen, Oxygen, and Carbon isotope studies on the Xiaotongguanshan Skarn Cu deposit, Anhui, China

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The Xiaotongguanshan copper deposit, located in the Tongling area, Anhui province, is a skarn deposit. Its host rocks are limestone of upper Carboniferous Chuanshan Formation and dolomite of middle Carboniferous Huanglong Formation, intruded by the Tongguanshan quartz monzodiorite dated about 137 Ma with Rb-Sr isochrone method. Hydrogen, oxygen and carbon isotope compositions of mineral and inclusion fluids were determined on a set of samples collected from both skarns and ores. Some inclusions can be drawn as follows.

1) The $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values both decrease systematically from limestone ($\delta^{13}\text{C}=3.3\text{‰}$, $\delta^{18}\text{O}=23.0\text{‰}$) to marble ($\delta^{13}\text{C}=0.1\text{‰}$, $\delta^{18}\text{O}=22.1\text{‰}$) and calcite in skarn ($\delta^{13}\text{C}=-1.3\text{‰}$, $\delta^{18}\text{O}=12.3\text{‰}$). These trends are similar to those observed by previous workers (Taylor and O'Neil, 1977; Nabelek, 1991). The decrease of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values in marble relative to limestone is ascribed to decarbonation during contact metamorphism.

2) The oxygen and hydrogen isotopic compositions of ore-forming fluids for different mineralizing stages can be summarized as follows: a) $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ of 10.3–14.5‰ (avg. 11.8) and $\delta\text{D}_{\text{H}_2\text{O}}$ of -50--108‰ for skarn stage; b) $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ of 13.5–15.9‰ for magnetite stage (avg. 14.7); c) $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ of 2.0–4.8‰ (avg. 3.7) and $\delta\text{D}_{\text{H}_2\text{O}}$ of -54--63 ‰ for quartz-sulfide stage; d) $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ of 0.8–0.9‰ (avg. 0.8) and $\delta\text{D}_{\text{H}_2\text{O}}$ of -77‰ for carbonate stage. From the early mineralizing stages to later ones, the $\delta^{18}\text{O}_{\text{H}_2\text{O}}$ of the ore-forming fluids decreased. It implies that the ore-forming solution in the initial stage was dominated by magmatic water, but the meteoric water gradually entered the mineralizing system and played an important role in ore formation of late stages.

Acknowledgements

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References

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Contrasting trace element signatures in subduction-related mafic cumulates from the Adamello Batholith (Central Alps, Italy)

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The Adamello batholith is the major tertiary calc-alkaline intrusion of the Italian Alps. It mostly consists of tonalites to granodiorites and locally contains bodies of amphibole-rich mafic cumulates (hornblendites to amphibole gabbros). In the amphibole gabbros, two different parageneses can be distinguished. The first consists of euhedral brown amphibole (up to 50 vol%) with olivine, spinel and clinopyroxene inclusions. The second paragenesis is constituted by poikilitic plagioclase (An = 31-42 mol%) containing fine-grained euhedral clinopyroxene and accessory green amphibole, titanite, calcite and quartz. Both mineral assemblages have been analysed for trace elements by laser ablation ICP-MS and ion microprobe.

The liquids in equilibrium with the early assemblage show a marked enrichment of light, large ion lithophile elements (LILE), U and Th over high field strength elements (HFSE) and rare earth elements (REE). This signature is in agreement with an origin by partial melting of a subcontinental mantle triggered by Alpine slab derived fluids (Tiepolo et al., 2002). The liquids in equilibrium with amphibole and clinopyroxene from the second paragenesis are abruptly enriched in LREE over HREE ($\text{La}_\text{N}/\text{Yb}_\text{N}$ up to 70; $\text{Yb}_\text{N} < 1$ time N-MORB), in U and Th (up to 300 times N-MORB) and show negative Nb and Ta anomalies. The marked LREE enrichment over HREE and the high U and Th contents of secondary liquid are also indicated by titanite, plagioclase and calcite compositions.

The trace element variability between the two parageneses cannot be related to fractional crystallisation and an exotic component must be invoked. On the basis of stable isotope mineral compositions (δO^{18} and δC^{13}), a major role of shallow level crustal contamination can be excluded. We suggest that the Adamello mafic cumulates record the injection of slab derived acid melts into an amphibole-rich crystal mush.

Reference

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