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Eclogite-type rutile mineralization in North Jiangsu, China and its geochemistry and genesis

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Total more than 2,000 eclogite bodies with different sizes have been discovered in the UHP metamorphic zone 140 km long and 90 km wide in North Jiangsu, China. About 90% of the eclogite bodies are rutile-bearing and the 50% contains rutile up to pay grade, including three large tonnage deposits. The rutile resources in this zone has reached several tens millions of ton. Three kinds of eclogite in North Jiangsu could be recognized according to their occurrences and rock association. Most of eclogite as interlensing associated with thin layers of amphibolite occurs in the Neoproterozoic granitic gneiss. Comparing with others, this kind of eclogite is characterized by richer in rutile, smaller shape variation and larger scale with tens to thousands meters long, several to hundreds meters wide and more than 3,000 m deep extension, and is rich in TiO₂, Fe_T, P₂O₅, K₂O and Na₂O and poor in SiO₂, Al₂O₃ and MgO. Other two kinds of eclogite bodies are respectively in the Paleoproterozoic metasedimentary rocks (marble + quartzite) and ultramafic-mafic intrusive rocks with serpentization, and rich in SiO₂, Al₂O₃, MgO and poor in TiO₂, Fe_T, P₂O₅, K₂O and Na₂O relatively. Of them, the rutile mineralization of eclogite in granitic gneiss is the most important in economy.

Chondrite-normalized REE diagrams of the eclogites in granitic gneiss show three kinds of patterns respectively similar to gabbro, island arc tholeiite and distinctly HREE-enriched garnet-type. Meanwhile, positive Eu anomaly is overprinted on the all REE patterns. In MORB-normalized spider diagram, all the eclogite samples from granitic gneiss are obviously depleted in Nb, Ta, Zr, Hf and some time K, and enriched in Ba, P and Ti. This pattern should be quite similar to that of island arc basalts except high Ti anomaly. Electron microprobe analyses of minerals in eclogites reveal that Na content of omphacite with rutile inclusions is two times higher than the rutile-free. In genesis, therefore, geochemical research show that the eclogite bodies in granitic gneiss would represent a lower crust composition overcompensated by the distinctly larger negative Eu-anomaly in the upper crust, and suffer multi-episodic mantle metasomatism, intracrustal partial melting, and subduction or overthrusting through the Proterozoic mafic rocks together with surrounding biotite- and hornblende-bearing sedimentary rocks and their metamorphic equivalents to a refractory residue of partial melting at high pressures.

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Mantle-derived components in Maoniuping REE deposit, Sichuan, China

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The Maoniuping REE deposit, located about 22 km to the southwest of the Mianning County, Sichuan Province, is the second largest LREE deposit in China, subsequent to the Bayan Obo Fe-Nb-REE deposit. The Maoniuping deposit is a carbonatite vein-type deposit hosted in alkalic complex rocks.

The deposit was formed in the period of 40.3 ~ 12.2 Ma according to the K-Ar and U-Pb data (Yuan et al., 1995). Systematic mineralogical, chemical and isotopic studies have been carried out on the inclusions of fluorite, calcite, quartz and bastnaesite.

Four types of inclusions have been identified: i.e. fluid-melt inclusion, aqueous inclusion, CO₂-H₂O inclusion and poly-phase inclusion containing daughter minerals. Raman spectrum study shows that the compositions of fluid-melt inclusions are barite (in crystallized phase), H₂O (in liquid phase) and CO₂ (in vapor phase). The ⁴He content, Re/Ra ratios are (13.95 ~ 119.58)×10⁶cm³STP/g and 0.02 ~ 0.11, respectively. And ⁴⁰Ar/³⁶Ar is 313±1 ~ 437±2. Considering the ⁴He increase caused by high contents of radioactive elements, the Mantle-derived fluid probably exists in the inclusions in the fluorite, calcite and bastnaesite samples. REE of fluid from quartz exhibits distribution pattern of flat curve with negligible Eu and Ce anomalies, showing its deep source origin. In addition, the REE distribution patterns of fluorite, calcite and bastnaesite are similar to those of nordmarkite, implying the deposit is closely related to magma of nordmarkite. All these data suggest that large quantities of mantle fluids were involved in the metallogenetic process of the Maoniuping REE deposit.