Oxygen isotope constraint on radiometric disequilibrium in Cpx-garnetite from the Dabie terrane

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In order to understand how retrograde metamorphism affects mineral Sm-Nd and Rb-Sr chronometric systems in eclogite during exhumation, a clinopyroxene-garnetite from North Dabie in east-central China was investigated comprehensively. The sample was broken into two parts and different minerals (i.e. garnet, pyroxene, rutile) were seperated respectively. A detailed analysis was carried out for Sm-Nd, Rb-Sr and O isotopes as well as major and trace elements in mineral separates and whole-rock. In particular, pyroxene was separated as pure, altered and impure ones for the Sm-Nd, Rb-Sr and O isotope analyses. The results were used to figure out correlations in equilibrium or disequilibrium state of mineral fractions.

Major and trace element analyses show that the two parts of the Cpx-garnetite are almost homgeneous. For both two parts, assemblages of pure Cpx, Grt, and/or Rt with O isotopic equilibrium surviving amphibolite-facies retrograde metamorphism give consistently Sm-Nd isochron ages of 224±13 Ma, identical to known Triassic ages for UHP rocks in the Dabie terrane. However, the altered and impure pyroxenes with O isotope disequilibrium fall outside the isochron chords. In either case, the mineral Rb-Sr data do not constitute meaningful isochrons with Triassic ages.

If the observed relationships in the equilibrium or disequilibrium state among the Sm-Nd, Rb-Sr and O isotope systems of mineral fractions were dictated by diffusion mechanism, it can provide constraints on relative rates of isotope species in mafic minerals. In this regard, rates of Rb-Sr diffusion in the eclogite minerals are greater than those of O and Sm-Nd diffusion, and those of O diffusion are lower or close to those of Nd diffusion. As a result, Rb-Sr isotopic equilibrium was much easier disturbed than O and Sm-Nd systems in the Cpx-garnetite during the amphibolite-facies retrogression under dehydration conditions as suggested by petrologic studies. Apparently, the state of O isotope equilibrium between cogenetic minerals can provide a critical test for the validity of mineral Sm-Nd chronometer, but not for Rb-Sr chronometer under dehydration conditions.

In addition, the retrograde fluid has different sources from either exterior or interior in different domains. Thus their influence on different parts of the garnetite are different, which causes the altered and impure Cpx points locating under or above the isochron lines in Sm-Nd diagram.

Origin of PGE in fluorites from Maoniuping REE Deposit, Sichuan Province, China

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The PGE of fluorites are the first documented. Their PGE contents range from 4.96 to 23.26ppb. The ratios of Pd/Ir and Pd/Pt range from 0.9 to 3.9, 0.1 to 0.3, respectively. All samples show positive Pt^* (1.2 to 6.4) and Ru^* (1.1 to 3.7) anomalies.

The Maoniuping REE deposit, hosted in a carbonatite-syenite complex. Fluorite is main one of gangue minerals. Most of fluorites show 'zigzag type' PGE patterns, with enrichment in Ru, Pt and Pd relative to Ir and Rh. They differ from the flat, positive slope, and negative slope type rocks and minerals resulting from partial melting or crystal fractionation of the primitive mantle, but are similar to the carbonatites in the orefield (Xu et al., 2003a).

We found fluid-melt inclusions in the fluorites, with homogenization temperatures (Th) of between 494 and 502 centigrade, which shows the fluorites were magmatogene products. Xu et al. (2003b) suggest that the initial Sr isotope ratios (0.706031 to 0.706237) of fluorites of different colors are least radiogenic, by far, of any that have been documented from types of ore deposits, with the one exception of the Rodeo in Sierra Madre Occidental, Mexico. They have similar epsilon Nd (-4.3 to -3.7) and epsilon Sr (22.2 to 25.2) values to the Maoniuping carbonatites and syenites. These indicate that the fluorites came from the same sources, which are related to carbonatite and syenite magmas. However, the PGE of the syenites are lower than the limits of detection. The ore-forming fluids of the fluorites did not undergo evolutionary process of mantle. So, the PGE systematices of fluorites aren't determined by parting melting, crystal fractionation and mantle metasomatism, but inherit from carbonatites. Carbonatites enrich volatile and can differentiate F-rich fluids. Experiments have demonstrated the PGE may be transported as volatiles as fluoride and chloride (Fleet and Wu, 1993).

References

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