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Cl-rich amphibole in the Shenglikou peridotite, N.Qaidam Mountain and its comparison with Cl-amphiboles in oceanic rocks

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The saline-rich fluid (brine) activity are considered as important components in the lower crust and upper mantle due to the following reasons:

(1)dehydration reaction in the slab released brine at sub-arc depth.

(2)brine can contain and transport abundant trace-elements.

(3)saline-rich fluid can be detectable by geophysical method (magnetotelluric).

The distribution of the intraplate earthquake suggests that hydrous minerals are formed in the subducting plate to the depth up to 100 km. However it has not been reconciled how to transport water to the depth of 50-100 km in the subducting plate. As a rare example of mantle rocks hydrated by seawater derived fluid in the mantle depth, we would like to introduce an occurrence of Cl-rich hydrous minerals in the Shenglikou peridotite, N.Qaidam mountains.

The Shenglikou peridotite predominantly consists of garnet lherzolite with minor layers of dunite and garnet-pyroxenite. In all the lithotypes, Cl-enriched hydrous minerals are observed as inclusions in high-pressure minerals.In garnet, two kinds of inclusions with different sizes have been identified, (i)a coarse-grained inclusion mainly consists of Cl-enrich ed Ti-pargasite, orthopyroxene, spinel and sodium gedrite, and (ii)a fine-grained one consists of Cl-rich Ti-poor hornblende, apatite, anthophyllite, talc, graphite and rare scapolite (maliarite). The coarse and fine-grained inclusions were formed under spinel-lherzolite facies and chlorite peridotite condition respectively, prior to the high-pressure metamorphism. The clinopyroxene also includes Cl-rich hornblende-tremolite, lizardite, +-chlorite+-brucite+-Ca-garnets(uvarovite,andladite)+-brucite which were formed by a low-T (<400 C) serpentinization. Subsequently, the Shenglikou peridotite experienced ultrahigh-pressure metamorphism that transformed Cl-enriched hydrous minerals into the high-P garnet peridotite assemblage consisting of garnet+clinopyroxene+orthopyroxene+-olivine+-chromite.The application of garnet-orthopyroxene geobarometer and two pyroxene thermometer of Taylor (1998) yields at 790 C/4.1 GPa (+-80/0.3).This garnet-bearing assemblage is affected by retrogression, which transformed garnet to Cl-poor Ti-pargasite (Cl<0.1 wt.%)+-spinel and clinopyroxene to Cl-poor tremolite. Above result indicates that the Shenglikou garnet peridotite was infiltrated by a saline-rich fluid prior to the Paleozoic UHP metamorphism, which is interpreted as follows in the context of regional geological history.

The northern Qaidam terrane was originally formed at the margin of Rodinia supercontinent, and the oceanic basin was formed as a result of continental breakup of the Rodinia at 800 Ma. Emplacement of the subcontinental peridotites onto the ocean floor, and the alteration by saline-rich fluid activity should have occurred during the rifting episode. Subsequently, ocean basin closed and continental collision occurred at early Paleozoic (460Ma), which brought the northern Qaidam rocks to >100 km depth during the UHP metamorphism. The Shenglikou rocks were transformed to garnet peridotite at this episode.

To constrain the origin of Cl-rich amphibole in the Shenglikou rocks, we compare it with amphibole data reported from oceanic gabbro/peridotite in the mid-ocean ridge/rift. It is possible to estimate the salinity by use of Cl contents in amphibole. It is shown that Cl contents in the Shenglikou Cl-rich pargasite and hornblende included in garnet are similar to those in pargasite from gabbros in the fast spreading ridges. It is well known that the high saline fluid activity (40 NaCl mol.%) occurred in the lower crust of fast spreading ridge, and the similar saline-rich fluid should have occurred in the mantle depth in the Shenglikou rocks.

These result suggests that the seawater derived brine could have penetrated into the mantle in some rift system, which offer a possible mechanism to transport water and to form hydrous minerals in the interior of the lithosphere.

Keywords: orogenic peridotite, Rodinia super continent, Qaidam craton, oceanic peridotite, hydrothermal alteration, brine