

Experimental study of Fe-Mg exchange reaction between sapphirine and spinel in the high-Mg granulite system

Kei Sato[1]; Tomoharu Miyamoto[2]; Toshisuke Kawasaki[1]

[1] Earth Sci., Ehime Univ.; [2] Earth and Planetary Sci., Kyushu Univ.

Sapphirine and spinel often coexist within ultrahigh-temperature (UHT) metamorphic rocks (e.g. Harley, 1998). Owen and Greenough (1991) provided an empirical Fe-Mg exchange thermometer derived from literature data of sapphirine and spinel. However, used data for estimation of correlation between distribution coefficient (Kd) and estimated temperature for coexisting sapphirine and spinel in various occurrences deviated from regressed thermometer remarkably. In our study, the Fe-Mg exchange reaction between sapphirine and spinel was experimentally investigated for the high-Mg granulite system ($X_{Mg} = 0.81$) containing sapphirine and spinel ($X_{Mg} = 0.84$ and 0.59 , respectively). This granulite was suffered by UHT metamorphism at the Napier Complex, East Antarctica.

We used a mixture of 90 wt% glass and 10 wt% seed mineral aggregation prepared by pulverizing of the granulite as a starting material. The glassed sample was obtained from fusion of the pulverized granulite at 10 kbar and 1670C for 2 minutes in a graphite capsule. High-pressure and high-temperature experiments have been carried out at pressures 9-13 kbar and temperatures 950-1150C using a piston-cylinder apparatus at Ehime University. The Mo-Pt double capsule (inner: Mo-foil, outer: Pt tube) was used as a sample container. Chemical compositions of sapphirine and spinel in run products were analyzed by EPMA.

The Fe-Mg Kd between sapphirine and spinel increased with decreasing temperature: 2.38 at 1150C; 2.18-2.68 at 1100C; 2.44-2.73 at 1050C; 2.52-2.83 at 1000C; 2.73-3.36 at 950C. These results indicate that the Kd is temperature-dependent. It is probable that our experimental data is available to apply to a geothermometer for high-Mg granulites.

References: Harley, S.L. (1998), In Treloar, P.J. and O'Brien, P.J. eds., What drives metamorphism and metamorphic reactions?, Geol. Soc. London Spec. Publ., 138, 81-107.; Owen, J.V. and Greenough, J.D. (1991), Lithos, 26, 317-332.