High-pressure phase transitions in MgAl2O4

Akito Enomoto[1]; Hiroshi Kojitani[1]; Masaki Akaogi[1]

[1] Dept. of Chem., Gakushuin Univ.

It is widely accepted that mid-oceanic ridge basalt(MORB) which covers the upper part of oceanic plates is subducted into the deep mantle. Experimental studies on MORB at high pressures and high temperatures have been extensively carried out. The results indicate that Mg-perovskite, Ca-perovskite, Stishovite and Al-rich phase with a calcium ferrite structure are stable at depth of about 800 km. In these phases, stability field and physical properties of the calcium ferrite phase have not yet been studies in detail. Although phase relations of calcium ferrite phase are complicated, major endmembers of the phase are $NaAlSiO_4$, $MgAl_2O_4$, Mg_2SiO_4, etc. In this study, we have intended to examine high pressure phase relations in $MgAl_2O_4$ at relatively high temperature.

The high pressure phase relations in $MgAl_2O_4$ were examined at 21-27GPa and 1400-2500C using a Kawai-type multianvil apparatus by quenching method. Starting material was $MgAl_2O_4$ spinel. Phase identifications were performed using a microfocus X-ray diffractiometer, a powder X-ray diffractiometer, and a scanning electron microscope with energy-dispersive spectrometer. Below 2000C, the calcium ferrite-type $MgAl_2O_4$ is stable above about 26GPa, and below the pressure a mixture of MgO periclase and Al_2O_3 corundum is stable. Above 2100C, a new phase of $MgAl_2O_4$ becomes stable above 26GPa, while a mixture of another new phase of $Mg_2Al_2O_5$ and Al_2O_3 corundum is stable at 21-26GPa.

The new phase of $Mg_2Al_2O_5$ synthesized at high pressure and high temperature from a mixture pf 2MgO + Al_2O_3 was examined by powder X-ray diffraction, and the Miller indices of the diffraction peaks were determined. The $Mg_2Al_2O_5$ phase belongs to orthorhombic symmetry, and the lattice parameters are a = 12.194(2)A, b = 9.369(2)A and c = 2.792(1)A. We found no reports on synthesis of high-pressure phase of $Mg_2Al_2O_5$.

The new $MgAl_2O_4$ phase is stable above 26GPa. Using the powder X-ray diffraction pattern consisting of several sharp peaks with relatively weak broad ones, determination of the cell is in progress.