The effect of CO2 on alpha-beta-gamma phase transformation of olivine

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The 410- and 520-km seismic discontinuities are generally considered to be caused by the phase transformations of olivine, alpha-beta-gamma. CO2 is an important volatile material in the Earth's interior, and it may affect the phase transformation of olivine. In this study, we investigate the effect of CO2 on alpha-beta-gamma phase transformation of olivine in the system Mg2SiO4-Fe2SiO4. In (Mg0.9Fe0.1)2SiO4-CO2 1wt% system, the coexisting region of alpha and beta became wider than that for CO2-free system. Moreover, the coexisting region of beta and gamma shifted to high pressure side comparing with that for CO2-free system. These results imply that the effect of CO2 component became important factor in considering the structure and the dynamics of the Earth's interior.

The 410- and 520-km seismic discontinuities are generally considered to be caused by the phase transformations of olivine, alpha to beta and beta to gamma, respectively. CO2 is an important volatile material in the Earth's interior, and it may affect the phase transformation of olivine. In this study, we investigate the effect of CO2 on alpha-beta-gamma phase transformation of olivine in the system Mg2SiO4-Fe2SiO4. The experiments were conducted at pressures of 11.8~18.4 GPa and a temperature of 1473K using multi-anvil high pressure apparatus in Ehime University.

In (Mg0.9Fe0.1)2SiO4-CO2 1wt% system, the coexisting region of alpha and beta equivalent of the 410-km seismic discontinuity became wider than that for CO2-free system, and its width of pressure was about 0.9 GPa. Moreover, the coexisting region of beta and gamma equivalent of the 520-km seismic discontinuity shifted to high pressure side comparing with that for CO2-free system, and its shift was about 1 GPa.

The partition coefficient of Mg and Fe between alpha and beta phases (KD=(Fe/Mg)beta/(Fe/Mg)alpha) in CO2-bearing system was larger than that in CO2-free system, and the coefficient between beta and gamma phases (KD=(Fe/Mg)gamma/(Fe/Mg)beta) in CO2-bearing system decreased with increasing pressure in spite of the unity in CO2-free system.

These results imply that the effect of CO2 component became important factor in considering the structure and the dynamics of the Earth's interior.