The 404th Geodynamics Seminar

Melting experiments on the MgO-$MgSiO_3$ system under the lower mantle condition

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Abstract

Seismological studies suggest the presence of ultralow-velocity zones (ULVZ) near the core mantle boundary (CMB). Partial melting of the lower mantle materials has been proposed to explain these zones, but experimental validation under high temperature and pressure conditions remain challenging. Investigation of melting behavior under high *P-T* conditions is a key to constrain the composition of melt at the base of the mantle. Major components of the lower mantle are $MgSiO_3$-perovskite (Mg-Pv) and periclase (Pc) making up about 90%. These materials behave as a eutectic system with the end members MgO and $MgSiO_3$. A laser heated diamond anvil cell (LHDAC) provides an enabling tool for determination of melting behavior of materials under high *P-T* conditions. Although YAG, YLF lasers (the wavelengths are about 1 μm) have been generally used for LHDAC experiments, the use of metal absorber is required to heat silicate materials. However, the thermal absorber may cause a chemical reaction and a temperature gradient in the sample. The chemical reaction and the temperature gradient make it difficult to accurately determine temperature. In contrast, the CO_2 laser with the wavelength of about 10 μm can directly heat silicate materials. For the minimization of temperature gradients, double-sided heating system for LHDAC was suggested by Shen *et al*. (1996). This technique using the YAG laser has been widely used to study the behavior of materials under high *P-T* conditions. However, the double CO_2 laser heating system has not been used due to the wavelength of this laser is different from that of visible light.

The requirements for the pressure medium in laser heating experiments are low thermal conductivity and chemical inertness. Ar, which is a noble gas, is one of the suitable pressure mediums. However, loading Ar into the DAC is difficult under room temperature and ambient pressure. Therefore, a simplified method to load Ar into the DAC is required. I have established new experimental technique using LHDAC for the minimization of temperature gradients and chemical reactions. In this study, I performed melting experiments on the MgO-$MgSiO_3$ system using the double CO_2 lasers heated diamond anvil cell and Ar as the pressure medium.

I used forsterite (Mg_2SiO_4) and glasses of the MgO-$MgSiO_3$ system as the starting material. After the complete pressure release, the sample was polished and examined by a focused ion beam (FIB) and an FE-SEM, respectively. From the cross section texture of recovered samples, I discussed melting behavior of the lower mantle materials under high *P-T* conditions.

The double CO_2 laser heating and loading Ar methods developed in this study could powerful tool for determination melting behavior of the lower mantle materials.

詳細は当センターホームページ：http://www.ehime-u.ac.jp/~grc/をご覧ください
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