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Phase transitions in pyrolite mantle and subducted basalt at the bottom of the lower mantle

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Phase relations of peridotite and basalt at high pressures and high temperatures have attracted attention in the geophysical community because these compositions are generally accepted to be an important to understand the dynamics and chemical evolution of the Earth's mantle. Many multi-anvil studies have reported reliable phase relations of peridotite and basalt at pressures corresponding to the uppermost part of the lower mantle [e.g., 1-4]. However, it is difficult to investigate the phase relations using the multi-anvil technique under the entire lower mantle conditions. Therefore, the laser-heated diamond anvil cell was used under pressures of 25-140 GPa and temperatures of 300-3000 K in this study. The synchrotron X-ray was also used for in situ observations of phase transitions at high pressures and high temperatures [5]. In the peridotite composition, the phase transition of Fe- and Al-bearing Mg-perovskite to $CaIrO_3$-type structure was observed at 125 GPa corresponding to the top of the D" layer. The transition pressure in the peridotite was in good agreement with the calculated transition pressure in pure $MgSiO_3$ [6,7]. In the basalt composition, the phase transition of Fe- and Al-bearing Mg-perovskite to $CaIrO_3$-type structure was also confirmed. In addition to Mg-perovskite, the phase transitions of silica and aluminous phase were observed. Stishovite transformed to $CaCl_2$-type structure at 70 GPa, and finally to α-PbO_2-type structure at 100 GPa. The calcium-ferrite type aluminous phase transformed to $CaTi_2O_4$-type structure at 120-130 GPa. In contrast, Ca-perovskite was stable up to 140 GPa in both peridotite and basalt compositions. According to these experimental results, the adiabatic temperature gradient in the lower mantle could be calculated using the observed depths of seismic discontinuities. The calculated average gradient is about 0.31 K/km. The density of the subducted basalt was also cal-

culated using in situ observations of each mineral volume in the basalt composition. The estimated density of the subducted basalt was lager than that of the surrounded mantle. This indicates that the subducted oceanic crust is possible to decent into the base of the lower mantle.

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