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下部マントル上部までにおける沈み込んだ大陸地殻の高圧相転移と密度
High-pressure transitions and the density of subducted continental crust to the upper part of lower mantle

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It has been suggested that the slab materials composed of oceanic crust, harzburgite and peridotite are heterogeneous components in mantle. But subduction of continental crust materials to the deep mantle with the slab has been suggested from the mineralogical, petrological and geochemical evidences. High-pressure phase relations of upper continental crust (UCC) have been determined from the uppermost mantle to the upper lower mantle conditions (Irifune et al., 1994; Wu et al., 2009). But the phase relations of UCC at around upper-lower mantle boundary conditions have not yet been studied in detail. In this study, we have demonstrated high pressure and high temperature phase relations of UCC at P-T conditions around 660-km discontinuity.

The starting material of UCC was prepared by mixing following oxides and silicates: SiO_2 (68.0), TiO_2 (0.6), Mg_2SiO_4 (2.6), Fe_2SiO_4 (3.0), $NaAlSiO_4$ (11.9), $CaAl_2Si_2O_8$ (4.8), $KAlSiO_4$ (6.8), $CaSiO_3$ (2.3), where numbers in parentheses are contents in mol%. High-pressure experiments using a Kawai-type 6-8 multianvil high-pressure apparatus were made at 20.6-28.0 GPa and 1200-1800C. UCC and pressure marker (one of Mg_2SiO_4, $MgSiO_3$ and $MgAl_2O_4$) were packed in two holes in a Re capsule, kept simultaneously at desired P-T conditions for 2-3 hours, quenched and recovered after the run. Phase identification of each sample was made with a microfocus X-ray diffractometer, and compositional analyses of them were made with a SEM-EDS.

The stability fields of five different mineral asembleges of UCC were found as follows: (1) clinopyroxene (Cpx) + garnet (Gt) + hollandite (Hol) + stishovite (St), (2) $CaAl_4Si_2O_{11}$-rich phase (CAS) + Cpx + Gt + Hol + St, (3) calcium ferrite (Cf) + $CaSiO_3$-perovskite (Cpv) + Gt + Hol + St, (4) CAS + Cf + Cpv + Gt + Hol + St, (5) Cf + Cpv + Hol + St. The mineral assemblages of (1) or (2) change to (3) or (4) at 21-22.5 GPa. The mineral assemblages of (3) or (4) change to (5) at 24-25 GPa. At 1200C, CAS does not exist. At pressures above 24-25 GPa, recovered samples were easily crushable. It indicates that Hol (II) which is probably stable above the pressure transforms to Hol (I) during decompression. We also estimated mineral proportions from the compositions, and densities of UCC were calculated and compared with density profile of PREM. The density of UCC at 1400C is the same as that of PREM at 24-28 GPa. Therefore, we suggest that UCC can be subducted into the lower mantle if the slab surface temperature is lower than 1400C.

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