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Pressure effect on element partitioning between minerals and silicate melt

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It is well known that partitioning behavior of elements between minerals and silicate melt is mainly controlled by the crystal structure of mineral. When we plot partition coefficients against ionic radius, the maximum of partition coefficient appears at the optimum ionic radius for each cation sites in crystal structure. However, crystal and cations are both compressed under high pressure, and the position of the maximum of partition coefficients can change with increasing pressure. Since compressibility of alkali elements are larger than other elements, it is expected that partitioning pattern of alkali elements shows large pressure dependence. In this study, pressure dependence of partitioning behavior in Merwinite ($Ca_3MgSi_2O_8$), whose partitioning pattern of alkali elements is easily observed, was measured.
Reagents were mixed to $Ca_3MgSi_2O_8$composition, and 10 wt% of doped basalt glass, which contains 26 trace elements in approximately 2000 ppm, was added to this mixture, and used as starting material. High pressure experiments were performed by using Kawai-type multi anvil press installed at Tokyo Institute of Technology. Sample was contained in a graphite capsule, and melting experiments were performed. Sample was kept for 1 hour at around liquidus temperature, and quenched isobarically. The recovered specimen was polished to a section, and major element contents were measured by EPMA. The concentrations of trace elements were measure by quadrupole type LA-ICP-MS installed at Kyoto University.
The peak position of partition coefficients of alkali elements was calculated by using lattice strain model (Blundy & Wood, 1994). The position of the peak was shifted from 120 pm at 5 GPa to 140 pm at 15 GPa. This result suggests that the peak position of partition coefficients of alkali elements will increase with pressure when we always use ionic radius of ambient pressure condition, because the compressibility of alkali elements are significantly larger than that of Merwinite crystal.

Keywords: high pressure, melting, trace element partitioning