Partition coefficients between olivine/peridotite melt up to 15 GPa

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In order to study crystallization of the Earth's magma ocean, we have carried out melting experiments on primitive peridotite KLB-1∗up to 15 GPa and determined olivine/melt element partition coefficients at various pressures. Experiments were performed using a piston-cylinder apparatus and a multi-anvil apparatus at the Magma Factory, Tokyo Institute of Technology. In order to grow large enough crystals (greater than 30 micrometer in diameter), gradual cooling method (ca.200degree/hour) near the liquidus of peridotite was employed in some experiments. Major and minor elements were analyzed by an EPMA (JXA-8800). Three samples were selected for LA-ICP-MS analysis for minor and trace elements. Partition coefficients were calculated from the results and they are plotted on Onuma diagram or PC-IR diagram (Onuma et al.1968).

Our experimental results are compared with Taura et al. (1998) who have determined olivine/melt partition coefficients in similar composition with EPMA and SIMS. When compared at low pressures (this study: 2GPa, Taura et al: 3GPa), Onuma diagrams for mono-valent, di-valent and tri-valent cations are very similar, except for D(Ba) and D(K) are order of magnitudes higher in Taura et al. Results at 10 GPa are also very similar between the two studies except for D(Cr) and D(Ti) are several factors higher in the present experiments. Our experiment at 14.5 GPa was terminated after 3 min at ca.2300degree C because of a blow out. Obtained partition coefficients for major and minor elements are similar with those by Taura et al at 15 GPa. However, partition coefficients for REE are close to unity in our experiment and are several orders of magnitudes higher than prediction by Onuma diagram. The discrepancy of the REE partition coefficients from Onuma diagram may be due to the short run duration. The partition coefficients for tetra- and di-valent cations are nearly constant with pressure. The partitions coefficients for mono-valent cations (Na,K) and tri-valent cations (Al) increase with pressure as reported by Taura et al (1998).