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Experimental evidence on partitioning of trace elements in diamond-forming carbonatite, eclogite-carbonatite and peridotite-carbonatite systems at 7-8.5 GPa

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For geochemistry of processes associated with genesis of diamond, experimental study of trace element partition between minerals of peridotite-pyroxenite and eclogite-grosspydite parageneses and completely miscible parental carbonate-silicate melts is of key importance.

Inter-phase trace element partitioning was studied at 7 – 8.5 GPa in partially melted samples of multicomponent peridotite-carbonatite $[[Ol_{36-60}Opx_{16}Cpx_{12-24}Grt_{12-24}]_{30}Carb_{70}]_{99}RE_1$, eclogite-carbonatite $[[CPx_{40-64}Grt_{16-40}(SiO_2)_{20}]_{59.3}Carb_{39.3}]_{98.6}RE_{1.4}$ systems and natural Chagatai silicocarbonatite to which a geochemically representative set of trace elements (Li, Rb, Cs, Ba, Th, U, Ta, Nb, La, Ce, Pb, Pr, Sr, Nd, Zr, Hf, Sm, Eu, Gd, Tb, Dy, Y, Ho, Er, Tm, Yb, Lu, Sc, and Zn) had been added. High pressures and temperatures were generated using a toroidal press “anvil-with-hole”. Experimental samples were examined with SEM, and content of trace elements in minerals and quenched melts were determined using LA-ICP-MS method.

Concentration of trace elements in coexisting olivine, garnet, clinopyroxene and carbonate-silicate melts has been measured. Partition coefficients were calculated and compared with data of available mantle mineral/melt partitioning studies.

The main feature of the trace element partitioning is in that light REE (La, Ce, Pr) are partitioned favorably into olivine (if presents) and melt phase. Medium and heavy REE (Nd, Zr, Hf, Sm, Eu, Gd, Tb, Dy, Y, Ho, Er, Tm, Yb, Lu) and Zr, Hf, Y, Sc are distributed into garnet with D=1-6 and 1-5, correspondingly. Olivine is characterized by intensive partitioning of light RE (Li, Rb, Cs, Ba with D= 2.5–5) as well as Th, U, Pb, and Zn (D=1.5–4.5). It should be noted that clinopyroxene is practically out of trace element partitioning.

Trace element mineral-carbonatite melt partitioning is not significantly influenced by melt composition. In respect to trace element distribution, high-pressure diamond-forming carbonate-silicate melts behave similarly to carbonatite and silicate melts equilibrated with the major mantle silicate minerals. S*upport: RFBR grants 10-05-00654 and 11-05-00401, Grant of the RF President MK- 913.2011.*