Geophysical Research Abstracts
Vol. 16, EGU2014-5192-1, 2014
EGU General Assembly 2014

Experimental Modeling of Peridotite Melting with Alkali-Carbonate Fluid at P = 3.9 GPa, T=1250°C

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The close association of alkaline and ultramafic rocks with carbonatites, apatite and sulfide mineralization, as well as features of the melt compositions, tell us about the mantle source and the importance of alkaline-carbonate fluids in the genesis of these rocks. Experimental modeling of formation of alkali silicate, carbonate and sulfide melts was carried out in the system peridotite-alkaline-carbonate fluid (K, Na)2CO_3 with additives of apatite, nickel-containing pyrrhotite, ilmenite and zircon as accessory minerals at P= 3.9 GPa and T=1250°C. Composition of coexisting melts, phase relationships, behavior of titanium, phosphorus, sulfur and zircon have been studied in this system.

Liquidus association of phlogopite-clinopyroxene-zircon-X-phase (not diagnosed titanium and phosphorus-containing aluminosilicate phase) cemented by intergranular silicate glass with inclusions of carbonate and sulphide phases at partial (10%) melting of peridotite. Morphology, composition and relations of silicate glass, carbonate and sulfide globules indicate the existence of immiscible silicate, carbonate and sulfide melts at the experimental conditions. The composition of the silicate melt is phonolite, carbonate melt - significantly calcium composition with an admixture of alkali metal and silicate components. Solubility of zircon in silicate melt reached up to 0.8 wt.% of ZrO_2, in coexisting carbonate melt – up to 1.5 wt.%. Absence of ilmenite and apatite in the experimental samples due to their high solubility in the coexisting phases. Concentration of TiO_2 and P2O5 in silicate melt reached 2 wt. %. The concentration of TiO_2 in the carbonate melt up to 1.7 wt.% and P2O5 up to 14 wt.%. The sulfur concentration in these melts does not exceed 0.2 wt.%. Concentrators of titanium and phosphorus among liquidus minerals were X-phase and phlogopite - 8 wt.% TiO_2 and up to 3 wt.% P2O5 in the X-phase; up to 6 wt.% TiO_2 and up to 2.5 wt.% of P2O5 in the phlogopite.

The distribution coefficients of major elements (including Ti, P, S, Zi) between coexisting silicate and carbonate melts demonstrated that Mn, Zr, S, Ca, P preferably concentrated in the carbonate melt; Si, Al, K, Mg, Fe, Ti - in the silicate melt.

Supporting by grant RFBR 14-05-00752a