

## Genesis of carbonatite melt by partial melting of COH-bearing peridotite

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On the Earth's surface, nutrients are one of the most important factors to hosting life.

The nutrients (C,O,N,P...) have to be supplied sustainably and enough. Carbon, oxygen and nitrogen can be supplied from the atmosphere, but phosphorus must be supplied from the interior of the Earth.

A potential source of phosphorus will be carbonatites, because carbonatites have the highest phosphorous concentrations among igneous rocks on the Earth. The genesis of carbonatites will be a key to understand possible mechanism for supplying phosphorus from the interior to the surface of the Earth.

The most popular theory for the origin of carbonatites is that carbonated silicate liquids generated by deep melting of carbonated mantle materials rises through the mantle and separates immiscibly into silicate melt and carbonatite melt. Veksler et al. (2011) experimentally investigated partitioning behavior of 42 elements between synthetic silicate melt and immiscible carbonate melt. They suggest that phosphorus concentrated to carbonate melt under hydrous conditions much more than under anhydrous conditions. Brooker (1998) experimentally determined the maximum extent of the silicate-carbonate immiscible field in a multicomponent system, and found that under CO<sub>2</sub>-saturated condition the silicate-carbonate immiscible field is wider than under CO<sub>2</sub> undersaturated condition, leading more concentration of phosphorus to carbonate melt. However, it is still unclear whether immiscible separation of silicate and carbonate melt will occur within mantle-derived melt.

In this study, we performed high-pressure melting experiments on primitive mantle + CO<sub>2</sub> + H<sub>2</sub>O in order to examine the possibility of liquid immiscibility in mantle-derived melt and the behavior of phosphorus between those melts.

We packed synthetic KLB-1 peridotite with ~10wt% oxalic acid dehydrate within a Au-Pd capsule, and performed melting experiment at 2.5GPa and 1100 °C for 26 hours using an end-loaded piston cylinder apparatus. The run product contains MgO-rich, SiO<sub>2</sub>-poor partial melt.

The composition of the melt is not plotted within the silicate-carbonate immiscibility field in the (SiO<sub>2</sub>+Al<sub>2</sub>O<sub>3</sub>+TiO<sub>2</sub>)-(Na<sub>2</sub>O+K<sub>2</sub>O)-(CaO+MgO+FeO) pseudoternary system of Brooker (1998), so it is not likely that the melt itself will separate immiscibly into silicate and carbonate melts during ascending in the mantle. However, crystal fractionation of olivine in the melt will lead the composition more alkali rich, which may cause immiscible separation into silicate and carbonate melts.

It is possible to produce carbonatite melt from mantle-derived melt. A further study should be conducted on what conditions are needed to generate immiscible carbonatite melt on the early Earth.

Keywords: phosphorus, carbonatites, partial melting, liquid immiscibility, the early Earth