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Synthesis of yimengite and K-Cr-priderite as the indicators of modal mantle metasomatos.

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Modal mantle metasomatism results in the formation of uncharacteristic for peridotite and eclogite phases [O'Reilly S.Y., Griffin W.L., 2013]. In addition to the widely common amphiboles, phlogopite, apatite, carbonates, sulfides, titanite, ilmenite, rutile, in the process, have the unique mineral phase. Among them, a special place is occupied by minerals of groups crichtonite, magnetplumbite and hollandite [Haggerty, 1991] – a rare titanates, enriched lithophile (LILE), first of all, K and Ba, high charge elements (HFSE).
Stability of yimengite K (Ti3Cr5Fe2Mg2)O19, K-Ba-priderite and its Fe3+, Fe2+-containing varieties was previously studied only in experiments on synthesis from mixtures of oxides and simple titanates at pressures of 3.5 and 5 GPA [Foley et al., 1994]. Yimengite is stable at 5 GPa and 12000C, and K-Ba priderite at both pressures is formed to temperatures of the order of 1500[U+F0B0]C. These results confirm the possibility of coexistence of these titanates with diamond in the upper mantle. Synthesis of Cr-containing priderite, containing no Ba has not previously been conducted. The possibility of formation of these titanates in the interaction of peridotite minerals with alkaline fluids of different composition was not investigated.
This paper presents the results of the first experiments on the crystallization of chromium priderite and yimengite in the chromite – ilmenite - $K2CO_3$ – H_2O-CO_2 system at 5 GPA and 12000C. As starting substances, mixtures of natural chromite (Mg0.49-0.54Fe0.50-0.54Mn0.01-0.02Zn0.01-0.02)(Al0.17-0.20Cr1.55-1.61Fe0.10-0.22Ti0.03-0.07)O4 (T. Pioneer, Yakutia) and ilmenite (T. Successful, Yakutia) in ratios (1:1; 2:1). The mixture of chromite + ilmenite was mixed with a mixture of $K2CO_3$ and oxalic acid (9:1) in a ratio of 9:1 by weight. The experiments were conducted under 5 GPa and temperature 1200 C with the high-pressure toroidal "anvil-with-hole" apparatus. The time of the experiment was from 20 to 28 hours under predetermined pressure and temperature.
As a result of experiments, for the first time, yimengite and priderite were produced via the reaction of chromite and ilmenite with potassium aqueous-carbonate fluid (melt) under the upper-mantle conditions. Ba-free Cr-bearing priderite was synthesized for the first time. These results directly support the conclusion that the formation of yimengite and K-Cr-priderite, as well as other K-bearing titanates, is a result of the modal mantle metasomatism of the upper mantle peridotites at the highest activities of potassium.
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