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## **P-T-fluid conditions of mineral equilibria in garnet-biotite crustal xenoliths from the Yubileinaya and Sytykanskaya kimberlite pipes, Yakutian kimberlite province.**

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This study provides the results of research of the garnet-biotite crustal xenoliths from the Yubileinaya (372±4.8 Ma) and Sytykanskaya (363±13 Ma) kimberlite pipes of the Alakit-Markhinsky field (Siberian craton). Isotopic evidence on zircons from similar crustal xenoliths (Grt+Bt+Pl+Kfs+Qtz±Scp) showed Archean Hf model ages (TDM = 3.13-2.5 Ga) and thus indicated that most of the lower and middle crust beneath the Markha terrane was produced in the Archean time (Shatsky et al., 2016).

The xenoliths are represented by the assemblage Grt+Bt+Pl+Kfs±Opx. Quartz is present only as rare inclusions in garnets. The rocks are coarse-grained, slightly foliated with garnets porphyroblasts of up to 5 cm in size. A spectacular feature of the rocks is an abundance of K-feldspar. Garnet grains are almost compositionally homogeneous, although they show a rimward decrease of the Mg and Ca contents indicating exchange reactions during cooling. Biotites are characterized by high F increasing from 1.5 wt.% in cores up to 2.2 wt.% in rims, as well as TiO<sub>2</sub> up to 7.8 wt.%, which is typical for high-grade rocks. Orthopyroxene (up to 5.5 wt. % Al<sub>2</sub>O<sub>3</sub>) relics are preserved both as inclusions in garnet and as individual grains in the rock matrix. Plagioclase occurs both as separate grains and as lamellae in potassium feldspar.

The bulk chemical compositions correspond to a metagraywacke. The REE spectra in these rocks are rather flat with slight enrichment in LREE. All the studied rocks are characterized by a distinct negative Eu anomaly (Eu/Eu\* = 0.31-0.45).

Calculations using the PERPLEX software version 6.7.6 (Connolly, 2005) for Mg and Ca in Grt, Mg in Bt, and Ca in Pl indicated temperatures 630-730°C and pressures 5.8-7.2 kbar for the rocks. However, equilibria involving Al<sub>2</sub>O<sub>3</sub> in orthopyroxene corresponds to temperatures of 750-800°C at a similar pressure. It indicates that metamorphism of the garnet-biotite rocks reached higher temperatures, but they were actively modified later during cooling and insignificant decompression (by about 1 kbar). Calculations using the TWQ software version 2.3 (Berman, 2007)

indicate consistent temperatures 610-680°C for the garnet-orthopyroxene and 640-690°C for garnet-biotite Mg-Fe exchange equilibria. Calculations using the  $\text{Grs}+2\text{Prp}+\text{Kfs}+\text{H}_2\text{O}=\text{Phl}+3\text{En}+3\text{An}$  equilibrium demonstrated water activity below 0.1. Such low water activity could indicate an influence of highly concentrated alkaline Cl-F-bearing brines. This assumption is confirmed by extensive development of potassium feldspar, absence of quartz in the matrix, and elevated Cl contents of biotite, 0.1-0.3 wt. % at high #Mg (>0.7) and F content.

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