Subisobaric cooling of mafic xenoliths from the Udachnaya kimberlite pipe, Siberia

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Crustal xenoliths in the Udachnaya kimberlite pipe are represented predominantly by mafic varieties. In this paper, we show for the first time P-T evolution of representative samples of these rocks. The studied rocks are rather fresh, massive, composed of Grt+Cpx+Pl±Opx±scapolite with accessory amphibole. Clinopyroxenes preserve clear magmatic cores with abundant pigeonite and ilmenite lamellas. Mg-richer outer zones of clinopyroxene are related to the metamorphic stage. Garnets cores are also homogeneous, whereas the narrow outer zones are enriched in Ca and depleted in Ti. Other minerals are homogeneous. Phase equilibria modelling using Perple_X software was applied to 5 orthopyroxene and amphibole-free, as well as orthopyroxene- and amphibole-bearing samples. Mineral compositions and modes were closely reproduced in the modelling only for the effective bulk composition and appropriate amount of free oxygen as monitor of ferric iron. Modeling reveals sub-isobaric cooling from temperatures of 700-750°C to 580-640°C at pressure about 8 kbar for all modeled assemblages. The P-T paths likely record the thermal equilibration of basic magmas with continental geotherm at the middle-lower crust of the Siberian craton.

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