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Peridotite xenoliths from the Udachnaya-East kimberlite: clues on the P-T structure and composition of the Siberian sub-cratonic lithospheric mantle

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Together with diamonds, peridotite xenoliths are the best probes for unravelling the architecture and composition of the thick sub-cratonic lithosphere, as they reveal the physico-chemical environment in which they were formed and equilibrated. Here, we present a detailed chemical-textural characterization of a new suite of fresh spinel- to garnet-bearing peridotite xenoliths from the Udachnaya-East kimberlite (Siberian craton). The samples are mostly harzburgites to dunites, with subordinated lherzolites, orthopyroxene-rich harzburgites (up to 40 vol.% orthopyroxene) and rare wehrlites. Their texture is variable, ranging from protogranular (typical of dunites and harzburgites) to highly recrystallized and/or sheared (typical of the more clinopyroxene-rich varieties).

Spinel-bearing rocks have generally refractory composition, with primary Mg-Ni-rich olivine (Fo_{90-93}; NiO = 0.34-0.46 wt%), Mg-rich and Al-poor primary orthopyroxene (Mg# = 92-94; Al_2O_3 = 0.3-3.0 wt%) and clinopyroxene (Mg# = 94-96; Al_2O_3 = 1.0-3.5 wt%). In garnet-bearing peridotites, primary olivine ranges from Mg-Ni-rich (Fo_{92}; NiO = 0.45 wt%) to relatively Fe-rich and Ni-poor varieties (Fo_{87}; NiO = 0.25 wt%), mirrored by primary pyroxenes (Mg# from 93 to 87-88; Al_2O_3 in orthopyroxene = 0.5-1.1 wt%; Al_2O_3 in clinopyroxene = 0.8-2.2 wt%). Thermobarometric estimates, primarily obtained by a combination of the two-pyroxene thermometry and the Al-in-orthopyroxene barometry and validated against other methods, indicate that garnet-bearing peridotites equilibrated in the *P* range of ~3.2 to ~6.3 GPa, at T comprised between ~800 and ~1350 °C. On the other hand, spinel-bearing peridotites originate from shallower depths (~2.8 to 3.8 GPa), postulated that they equilibrated at conditions consistent with the 40 mWm^{-2} geotherm. These results, together with a review of robust *P-T* estimates for xenoliths from literature (Liu et al. 2022; Faccincani et al. 2022) will be used to model the thermo-chemical log of the Siberian sub-cratonic mantle and place constraints on the origin of modal, chemical and temperature variations in the sub-cratonic lithosphere.

Faccincani, L., et al. 2022. Relatively oxidized conditions for diamond- formation at Udachnaya (Siberia). European Journal of Mineralogy, 34(6), 549-561.

Liu, Z., et al. 2022. Thermal and compositional anomalies in a detailed xenolith-based lithospheric mantle profile of the Siberian craton and the origin of seismic midlithosphere discontinuities. Geology, 50(8), 891-896.