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Pyroxenite and eclogite xenoliths from Udachnaya kimberlite pipe: metasomatism and paleosubduction

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The study of mantle xenoliths from kimberlite pipes allows to establish the composition, evolution processes and thermal condition of the lithospheric mantle under ancient cratons. The Udachnaua pipe kimberlite belongs to the diamond-bearing kimberlite fields in the center of the Siberian craton. The collection of mantle xenoliths from the pipe (57 samples) was investigated by authors. Four main petrographic groups were identified: peridotites (Grt lherzolites), Grt websterites, Grt clinopyroxenites and eclogites. The pyroxenite xenoliths attract the special attention.

Garnets from lherzolites and websterites are characterized by a relatively high Mg# content (75–83) and low TiO_2 contents (up to 0.2 wt %). Eclogites are characterized by high-calcium (3.78 - 9.46 wt.%) and high-iron (7.77 - 17.20 wt.%) composition of garnet getting into the wehrlite paragenesis area.

In addition, websterites and lherzolites show a wide range of crystallization parameters (600 - 1200°C; 2 - 6 GPa) probably due to their gradual cooling after magmatic crystallization and the exsolution structures formation. Clinopyroxenites are characterized by narrow variations in the P-T crystallization parameters (812 - 960°C; 3-4 GPa) indicated their later crystallization from asthenospheric melts. Eclogites are characterized by relatively low calculated temperature parameters (720–840°C; 2.2–3.7 GPa) confirming their origin in subduction zones at shallow depths. The sporadic calculated values for websterites and clinopyroxenites are locating within the diamond stability area. The use of the Opx - thermobarometer (in samples founding Opx) revealed 2 trends in the crystallization of orthopyroxene. Crystallization of individual Opx grains in websterites occurred earlier than Cpx with higher P-T parameters - higher by ~100C and ~0.5 Ha. The second trend (pressure reduction with a slight decrease in temperature) notes the formation of Opx decay structures in an initially homogeneous crystal of monoclinic pyroxene. Minerals from pyroxenites demonstrate a wide development of melting processes in the lithospheric mantle in the south of the Siberian craton and the formation of megacrystalline pyroxene cumulates. The origin of eclogites is assumed from subducted oceanic crust marking the subduction component in the process of formation of the lithospheric mantle.

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