

Metasomatised Lithospheric Peridotite from Continental Arc Mantle of Kamchatka Peninsula

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Alkali basalt host magmas have facilitated the transport of lithospheric mantle peridotite as xenoliths. Frequently, these xenoliths exhibit evidence of multi-stage interactions with melts and fluids, either within the source region or during entrainment. The mantle beneath continental arcs is particularly susceptible to modifications induced by subducting slabs. Common metasomatic agents, such as silicate and carbonatitic melts, react with peridotite on path leading to significant mineralogical and geochemical alterations. To advance the understanding of metasomatism in sub-arc mantle, we report reacted mantle peridotites sourced from the Shiveluch volcano in Kamchatka.

Our andesite-hosted samples consist of spinel harzburgite. Two types of metasomatic reactions can be identified based on their products. In anhydrous reactions, the dissolution of orthopyroxene precipitated secondary pyroxenes (opx/cpx $\sim$ 1:1) accompanied by minor spinel and silica-rich glass. Orthopyroxene that has not fully broken down exhibits spongy textures. Olivine, which dissolves more slowly, displays reduced Fo# due to diffusion. In hydrous reactions, the samples exhibit either disseminated phlogopite or the replacement of orthopyroxene by secondary amphibole and pyroxenes. Hydrous pyroxenite veins, containing both amphibole and phlogopite, are also observed. Olivine in these samples shows ranged NiO content (0.02–0.5 wt%) and Fo# (86–93). Non-reacted orthopyroxene is more homogeneous (Δ En# < 3) compared to both sieved and secondary varieties (En# = 84–96). The latter variety shares similar compositions and exhibits decreasing CaO and MnO with increasing En#. Secondary clinopyroxene, identified as diopside, displays a negative correlation between Na₂O (0.1–0.5 wt%) and MgO (17–21 wt%). Notably, all samples contain sieved Cr-spinel which displays a wide range of Cr/(Cr+Al) ratios (0.50–0.92), which correlate positively with MgO content (5–14 wt%). The rims are enriched in Fe³⁺/Fe^T and FeO, with Fe³⁺/Fe^T differing by up to 0.3 compared to the cores.

Based on two-pyroxene thermometry and common geotherm, the dissolution of orthopyroxene occurred at approximately 1025°C and 1.38 GPa. Overall, the metasomatic reactions have increased the volume of pyroxenes, driving the transformation of harzburgite into pyroxenite. The presence of sieved spinel with elevated ferric iron contents around the rims, suggests that this transformation is an oxidation-driven process.