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Silica metasomatism in mantle peridotites: a case study of the Finero phlogopite-peridotite massif

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The Finero phlogopite-peridotite massif, Italy is well known as a highly metasomatized peridotite massif which is characterized by abundant hydrous minerals, such as phlogopite and amphibole. Although orthopyroxene-rich rocks, e.g., orthopyroxenite, are commonly observed in the massif, their origins had never been discussed well.

Orthopyroxenite mainly consists of coarse-grained orthopyroxene and medium-grained olivine, clinopyroxene, amphibole with minor amount of spinel. Film-shaped fine-grained olivine is commonly observed at grain boundaried between large orthopyroxene grains in orthopyroxenites. The film-shaped fine-grained olivine is distinctively higher in NiO (0.5-0.7wt.%) contents than coarse-grained olivines in both orthopyroxenites and the host peridotites. The chemical compositions of coarse-grained olivine (0.4 wt.% for NiO content, 90.8-92.0 for forsterite content) are plotted in those expected for olivines in residual peridotites. High-NiO olivines in orthopyroxenites can be explained by preferential incorporation of Ni in resisudal olivine during the reaction between primary mantle olivine with normal NiO contents and SiO_2-rich fluid/melt for the formation of the secondary orthopyroxene because the partition coefficients of Ni between olivine and orthopyroxene is high. This indicates that orthopyroxenites were formed by replacement of the primary residual peridotites due to infiltration of SiO_2-rich metasomatic fluids/melts by the reaction above (Silica metasomatism).

Film-shaped thin orthopyroxene grains are rarely observed at grain boundaries of olivine in host peridotites (dunite or harzburgite) whereas coarse-grained orthopyroxenes are commonly found in the host harzburgites. The film-shaped orthopyroxenes have distinctively lower Cr_2O_3 contents (0.05 wt.%) than others in orthopyroxenites and host peridtites. The Al_2O_3 and Cr_2O_3 contents of coarse-grained orthopyroxene grains decrease from the core to the rim. The systematic chemical zoning of coarse-grained orthopyroxenes was probably cause by decreasing of temperauter during exhumation of the massif. The low-Cr_2O_3 orthopyroxene can be explained by a reaction between olivine and low-Cr_2O_3 fluids. Small amounts of the low-Cr_2O_3 fluids were probably formed from the parent SiO_2-Al_2O_3-Cr_2O_3 fluids/melts, which were metasomatic agents for the formation of orthoypoxenites, via the reaction with the periotites, and were infiltrated along grain boundaries of the host peridotites in the late stage of the silica metasomatism. The presence of the secondary orthopyroxene in the host peridotites indicates that the silica metasomatism may also effect in wider areas in the massif than expected before.