

THE PHLOGOPITE PERIDOTITE OF THE FINERO ULTRAMAFIC COMPLEX (IVREA ZONE, NW ALPS): NEW EVIDENCE OF A METASOMATIZED MANTLE SLAB

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ABSTRACT

The Finero femic-ultrafemic complex, at the northern tip of the Ivrea-Verbanò Zone, northern Italy, is made up of a peridotitic slice, enveloped by a magmatic sequence of femic and ultrafemic rocks.

The central peridotitic unit, named Phlogopite Peridotite, shows peculiar features related to later re-fertilization of a primary restitic mantle slice.

The most evident feature is the widespread crystallization of hydrated phases, namely pargasitic to edenitic amphibole and phlogopitic mica. Hydrated phases growth is associated to enrichment in minor and trace incompatible elements.

Harzburgite hosts two associations that can be both suspected to be the carriers of the metasomatic agents into the harzburgite. The first one is a dunite+chromitite assemblage, hosting PGE mineralizations, that forms irregular bodies transitionally grading into harzburgite. The second one is made up of pyroxenitic thin dykes that sharply cut peridotite.

Textural, mineralogical, petrographical and geochemical data confirm that both assemblages were able to metasomatize host harzburgite in different times and with differing processes.

Lead isotope data on zircons from chromitites provided age informations on the dunite+chromitite metasomatic event.

Field evidences, related to multi-stage tectonic history of Phlogopite Peridotite, show that the dunite+chromitite assemblage is older than pyroxenitic dykes.

Mineral chemistry of the dunite+chromitite assemblage is quite different from that of hosting harzburgite, with olivines richer in MgO and orthopyroxene richer in MgO and TiO₂, but main differences are related to spinel composition. Spinel in chromitite is a high Mg and Cr chromite rich in TiO₂ while in harzburgite it is a low Mg chromite poor in TiO₂. Clinopyroxene and amphibole are similar in both dunite+chromitite assemblage and harzburgite.

REE patterns of chromitites show a wide range of trends, from almost flat to highly LREE enriched, with (La/Yb)_N over 100. This range of LREE content is positively correlated to modal content of clinopyroxene and amphibole. Harzburgites show similar trends, but do not reach the LREE contents and (La/Yb)_N of chromitites. Highest LREE contents of harzburgites are shown by samples collected next to dunite+chromitite assemblages.

PGE patterns of chromitites show always but in two samples a strong depletion in Pt and Pd. Trends between Os and Rh are highly variable, with Rh/Ir ratio ranging between 0.2 and 6. Rh/Ir ratio is negatively correlated to clinopyroxene and amphibole modal content and to LREE content of chromitite.

Strongly metasomatized, clinopyroxene and amphibole

rich samples of chromitite show evidences of reaction between chromite and pyroxene with formation of a secondary Ti rich and K-poor amphibole. This reaction is able to modify chromite composition from the rim towards the core, enriching it in Cr and lowering Mg/FeO ratio.

Lead isotope analyses were carried out on four grain size fractions which included also fragments of coarser zircon crystals. The U-concentrations vary between 1100 and 1240 ppm. One fraction yielded concordant ages of 204 ± 4 Ma, whereas the others are slightly discordant. The data points define a discordia with an upper intercept at 207 ± 5 and a lower at zero Ma. No evidence of an older inherited zircon component was detected.

Mineral chemistry, REE and PGE data confirm that the dunite+chromite assemblage formed from a basic melt percolating into the depleted harzburgite. Intrusion of a basic melt at high depth in almost isenthalpic conditions can explain the formation of a high Mg assemblage, due to assimilation of pyroxene from host rock and consequent SiO₂ increase in the melt. This leads melt into the olivine field of the pseudo-ternary Ol-Di-Qz triangle (Kelemen, 1990) and subsequent formation of dunite patches. SiO₂ increase can also explain chromite crystallization due to shifting of melt composition into the chromite field (Zhou and Robinson, 1997) of the Cr-Ol-Qz triangle. Chromite crystallization is enhanced by the presence of water (Nicholson and Mathez, 1991). Crystallization of olivine and dunite left a residual melt strongly enriched in incompatible elements, that crystallized clinopyroxene and, after reaching water saturation, amphibole. Formation of a strongly evolved melt was a dishomogeneous, locally influenced, process that was not attained in all dunite+chromite domains.

Phlogopite is very rare and texturally a later phase in dunite-chromite assemblages and its crystallization is attributed to intrusion of later pyroxenitic dykes.

Primary PGE pattern is that typical of mantle peridotites, with negative slope. The strong decoupling between Os, Ir, Ru and Rh on one side and Pt and Pd on the other can be due to different Kd values between sulphur liquid and mss, with Pt and Pd behaving as incompatible and the others as compatible elements (Fleet et al., 1993).

Progressive depletion of Os, Ir, Ru and Rh with increasing metasomatic overprint of chromites, in the order of Os>Ir>Ru>>Rh could be due to higher solubility of laurite, the main phase containing Os, Ir and Ru, than alloys, where Rh is hosted, in the metasomatic fluid. This process led to a depletion and rotation of patterns, that can mimic those of other PGE genetic environments.

Finero Phlogopite Peridotite underwent two major metasomatic events. The first one, related to dunite+chromite assemblage formation, occurred about 205 Ma ago, at high

depth and affected harzburgite by crystallization of clinopyroxene and amphibole and by enrichment in incompatible elements. The second one, that occurred later at lower depth, is related to pyroxenitic dykes and affected harzburgite mainly by phlogopite crystallization.

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