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Sapphirine-bearing gabbroic dykes in the Finero mantle unit: magmatism or auto-inducted metasomatism?

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Late sapphirine-bearing gabbroic dykes discordantly crosscut the layering of the Finero phlogopite-peridotite massif, Western Alps, Italy. These dykes represent the last event of melt migrations in a completely recrystallized mantle sequence which was percolated by high-K melts probably related to Supra-Subduction setting.

Dykes have a symmetrical structure, with a leucocratc zone at the centre and melanocratic zones to the rims which proceed into the host peridotite. Moreover the melanocratic zone can be possibly distinguish in three different zone: within the ambient peridotite a i) orthopyroxene zone (opx zone), domain by replacement of host olivine by crystallization of orthopyroxene; ii) an early amphibole zone, where magmatic texture is preserved, formed by dark-brown amphibole, apatite and phlogopite, which represent the first stage of cumulous crystallization of the melt; iii) a late amphibole zone formed by greenish amphibole, green spinel and sapphirine which replaced locally the early amphibole zone. The leucocratic zone derived by a successive evolved-melt intrusion in the dykes as demonstrated by the presence of residual dark-brown amphibole within and by optical continuity of crystals of early amphibole zone at two side of the leucograbboic vein. The latter is formed by plagioclase, greenish and residual dark-brown amphibole and apatite.

Sapphirine occurs only in late amphibole zones, in two different texture positions: associated to green spinel or as single crystals in interstitial positions. Petrographichal evidence suggest that sapphirine has a magmatic origin.

EMPA and LA-ICP-MS analyses of minerals from the melanocratic and leucocratic bands evidence significant differences in terms of both major and trace elements in the composition of the parent melts with respect to other Finero mantle sequence lithologies. In particular minerals are highly enriched in Al_2O_3, MgO, TiO_2 and Na_2O, suggesting a alkaline geochemical affinities for the parent melts as also revealed from the typical convex-upward pattern of REE. Chemical differences between minerals of different zones of the dyke show also a progressive evolution of the parent melt which result enriched by host interaction-cumulous crystallization in MgO and Al_2O_3 up to reach the required values for the crystallization of magmatic sapphirine.

Proposed model for the dykes formation provides for two step of basaltic melt intrusion and interaction: the first step has originated for interaction in the host peridotite the orthopyroxene layers at the expense of host olivine and from this first modified melt occurred the crystallization of the early amphibole zone. A successive melt intrusion of more evolved modified melt induced the crystallization of the leucocratic zone and, by reaction with the early amphibole, the segregation of secondary late amphibole, spinel and sapphirine as the result of auto-inducted metasomatism.