Primary characteristics and metamorphic evolution of pyroxenite and gabbro layers from a mantle sequence enclosed in the middle continental crust (Ivrea-Verbano Zone, Italy)

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The South Alpine domain of northwest Italy exposes a nearly complete section of the continental crust. The present study deals with a mantle sequence enclosed at mid crustal levels (Alpe Morello locality), along the tectonic boundary separating the Ivrea-Verbano Zone from the Strona-Ceneri Zone. The sequence is surrounded by sillimanite-bearing, amphibolite facies metasediments. The amphibolite facies metamorphism developed in response to the post-collisional Variscan evolution. The Alpe Morello mantle peridotites show a widespread recrystallization under tremolite-chlorite facies metamorphic conditions, and include pyroxenite and gabbro layers that locally retain relics of mineral assemblages predating the regional amphibolite facies metamorphism.

This study aims at defining the primary magmatic characteristics and the metamorphic evolution of Alpe Morello mafic-ultramafic rock sequence, to shed light on the geodynamic evolution leading to incorporation of the mantle sequence into the middle continental crust. Primary structures and mineral chemical compositions document that the pyroxenite/gabbro layers within the peridotites formed by intrusion of variably evolved MORB-type melts at ~0.1 GPa. The Nd-Hf isotopic whole-rock compositions of the pyroxenite/gabbro layers are consistent with formation by MORB-type melts in the Lower Carboniferous. Transition of the pyroxenite/gabbro layers to eclogite facies conditions is shown by formation of Mg-rich garnet in Al-rich pyroxenites, and of Mg-rich garnet + Na-Ca-clinopyroxene (+ accessory rutile and kyanite) in the gabbros. The eclogite facies metamorphism was followed by development of granulite facies assemblages, characterized by accessory spinel and sapphyrine in the pyroxenites and the gabbros, respectively, which predated the re-equilibration in the amphibolite facies.