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Origin of H_2O-rich mantle magmas emplaced in extending continental settings: constraints from the deepest levels of the Ivrea-Verbano Zone (Italian Alps)

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The archetypal lower crustal section of the Ivrea-Verbano Zone (Italian Alps) includes the Mafic Complex, an 8 km-thick gabbronorite-diorite body built during the post-Variscan transtensional tectonics. At its deepest levels, the Mafic Complex encloses several amphibole-rich mafic-ultramafic bodies indicating a crystallization from H_2O-rich melts. The present contribution wishes to define the primary compositional characteristics of the parental magmas and to achieve information about the nature of their mantle sources. For this purpose, we combined trace element, Sr and O isotopic micro-analyses of amphibole from amphibole-bearing dunites and pyroxenites, hornblendites and chemically primitive amphibole-rich gabbros, which were collected from four mafic-ultramafic bodies exposed within the Mafic Complex and from an adjacent mafic-ultramafic lens known as Monte Capio sill. Overall, amphibole has pargasite to titanian pargasite compositions and 67-88 Mg# and is associated with plagioclase having 75-91 mol% anorthite in the gabbroic rocks.

Amphibole from the selected rock samples displays wide variations in incompatible trace element signature and initial $^{87}Sr/^{86}Sr$, which nevertheless remains highly radiogenic. On the other hand, the $\delta^{18}O$ amphibole fingerprint is nearly homogeneous and comparable to that of typical mantle amphibole. We relate these geochemical characteristics to H_2O-rich primary magmas formed by a compositionally heterogeneous, enriched mantle source. Remarkably, one of the investigated rock bodies of the Mafic Complex is crosscut by an amphibole-bearing gabbro dyke providing a depleted geochemical signature. It is concluded that the primary mantle magmas forming the Mafic Complex were derived from a subcontinental lithospheric mantle section, presumably metasomatized and enriched in H_2O during the preceding Variscan subduction. The partial melting of the base of the extending lithosphere was most likely followed by the production of geochemically depleted magmas generated by the rising asthenosphere.