Structural and metamorphic evolution of the Valpelline Unit (Austroalpine Domain, Western Italian Alps)

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High temperature (HT) processes culminating in granulitization and partial melting significantly contribute to the growth and internal differentiation of the continental crust. These processes may occur in different geodynamic contexts, under both extensional and compressional regimes, but are often difficult to study in the field due to the challenge of exhuming deeper crustal levels. The Valpelline Unit (Dent-Blanche Tectonic System) represents a fragment of pre-Alpine lower continental crust preserving both the regional Permian HT metamorphism and its associated structures. This unit comprises migmatite gneiss and granulites displaying heterogeneous mineral assemblages (i.e., Bt-Sil-Grt; Bt-Sil-Crd; Bt-Sil-Opx), together with minor amphibolites and marbles. The migmatitic structures of the Valpelline Unit, only intersected by late granitic-pegmatite dykes, testify the Permian HT extensional tectonics predating the Alpine convergence (Manzotti & Zucali, 2013). This work presents a detailed lithological, structural and geochemical analysis of the rock types, thus representing the necessary first step towards the implementation of a multidisciplinary study (e.g., P–T–D paths, geochronology and geochemical surveys) aimed to unveil the processes of crustal differentiation and shed light into Permian HT tectonics. Meso- and microstructural analysis allows the reconstruction of three deformation phases related to the HT evolution. The D_1 is preserved as an S_1 foliation in metabasite lenses and locally within metapelites; the regional foliation S_2 developed during the D_2 phase is related to widespread melt production and is locally transposed during the D_3 into an S_3 foliation which is sillimanite-rich and wraps garnet, cordierite and orthopyroxene. The P–T conditions of the Valpelline Unit during melt-production (D_2) and melt-consumption (D_3) range between 800–900°C and 0.5–0.8 GPa. Preliminary U–Pb zircon geochronology yielded Permian ages consistently older in Opx-bearing leucosomes (293 ± 2 Ma) than in Crd-bearing ones (285 ± 2 Ma) and late pegmatites (277 ± 2 Ma). Our work highlights spatial, compositional and chronological heterogeneities of this lower crust sector affected by lithospheric crustal extension during Permian times.

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