Pre-Alpine microstructural and petrographic evolution of the Valpelline Series (Western Italian Alps)

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The Dent Blanche nappe belongs to the Austroalpine domain of the Western Italian Alps. It is classically divided into two units: Valpelline and Arolla Series. The Valpelline Series is mainly composed of metapelites, mafic and carbonate rocks with a dominant metamorphic imprint under amphibolite to granulite facies conditions of pre-Alpine age. The Alpine imprint is localized along meter to hundreds of meters width high strain zones. The Arolla Series is mainly composed of granites, granodiorites, bt-bearing gneisses and schists and amphibolites. It records more of the Alpine tectonometamorphic evolution, whereas the pre-Alpine imprint is restricted to metre-scale relics within preserved magmatic textures in metagranites and amphibolite and bt-bearing gneisses as roof xenolites within metagranites. The northeastern part of the Valpelline valley is characterised by high-grade paragneisses with interlayered basic granulites, Grt-Cpx-bearing amphibolites, and Ol-bearing marbles belonging to the Valpelline Series. We study the tectonometamorphic evolution of metapelites outcropping in a small canyon, situated on the north side of the Valpelline Valley, between the villages of Valpelline and Oyace. The rock association consists of Bt-Grt-Sil-bearing gneisses, migmatitic and granulitic gneisses, Grt-Bt-bearing gneisses, Chl-Wm-bearing gneisses, lenses of metabasites (Cpx-Opx granulites, Grt-bearing amphibolites, horneblendites), Ol-bearing marbles, meter-size lenses of Grt-bearing pegmatites. Seven evolutionary stages have been reconstructed by mesostructural and microstructural analysis: stage 1 as lenses of Opx-bearing basic granulites within migmatitic gneisses; stage 2 as migmatitic foliation S2. D3 structures mainly consist of S3 foliation, in metapelites marked by Bt-Grt±Sil in films and by Qtz-Fd lithons, whereas in metabasites it is marked by Am±Bt levels and by Pl-Cpx levels. D4a structures consist of isoclinal folds, from centimetric to decimetric in size, transposing S2 and S3 foliations into a new pervasive S4. Stage 4b is characterised by the development and intrusion of Qtz-Fd-Grt-bearing pegmatites. Stage 5 is associated to the static growth of Chl and Wm in Bt-Grt-bearing gneisses or, to the growth of Ep and Wm, replacing Pl in basic granulites. During stage 6 fractures, faults and cataclasites affect all lithotypes. We study the tectonometamorphic evolution by means of classical thermobarometry together with the isochemical section (e.g. pseudosections).

The reconstructed pre-Alpine tectonometamorphic evolution of the Valpelline Series shows an early stage under intermediate-pressure granulite facies conditions, well preserved in basic granulites. A rise in temperature produced partial melting in metapelites. A new structural and metamorphic overprint under amphibolitic facies conditions was registered by metapelites, metabasic rocks and metamorphic carbonate rocks. Further stages are related to a decrease in temperature, and these are characterised by greenschist facies assemblages. This evolution is interpreted as the record of the Variscan collision, which followed Permian-Jurassic thinning, i.e. asthenospheric upwelling and high thermal regime caused partial melting processes. The formation of greenschist assemblages marks the end of thinning, which may be related to near-surface conditions or to the beginning of the Alpine evolution