



An integrated petrological and geochemical approach to unravel contrasting P-T-t paths during subduction and exhumation of the Adula Nappe (Central Alps)

Nadia Malaspina (1), Luca Pellegrino (1), Stefano Zanchetta (1), and Simone Tumciati (2)

(1) Department of Earth and Environmental Sciences, University of Milano Bicocca, Milano, Italy (nadia.malaspina@unimib.it), (2) Department of Earth Sciences, University of Milano, Milano, Italy

The Adula–Cima Lunga unit (Central Alps) belongs to the lower Penninic domain, which is considered to derive from the former European continental margin. It consists of orthogneiss and paragneiss of pre-Mesozoic origin hosting lenses of metacarbonates, partly retrogressed eclogites and garnet/chlorite peridotites. During the Alpine orogenesis, in late Cenozoic, rocks now part of the Adula Nappe were subducted to mantle depths. The peak conditions of the HP metamorphism increase from north to south from 1.7 GPa and 650 °C up to 3 GPa and 800 °C, even if an older HP event of Variscan age is preserved within eclogite boudins of the central and northern portion of the Adula Nappe (Liati et al., 2009; Herwartz et al., 2011). After the European margin subduction beneath Adria, the HP rocks of the Adula Nappe were overprinted by an amphibolite-facies metamorphism, postdating the main phase of nappe-stacking.

The highest P–T conditions were recorded by garnet lherzolites cropping out at three localities: Cima di Gagnone (CdG), Alpe Arami (AA), and Monte Duria (MD). These peridotites show transitions to eclogite and occur as lenses surrounded by meta-ophicalcite rocks (CdG), marbles, kyanite eclogites (AA) and migmatitic gneisses (MD). In this work we present a petrological study of peridotites and different types of eclogites occurring in the MD area, which share a common eclogite-facies peak at P=2.6–3.0 GPa and T=710–750 °C. Differently from CdG and AA, the HP minerals of MD peridotites and eclogites are replaced by lower-P and high-T assemblages. In peridotites, the zirconium titanate srilankite occurs as μm -sized crystals in textural equilibrium with spinel, clinopyroxene and orthopyroxene in kelyphites developed between garnet and olivine. By using a new ZrO_2 – TiO_2 solid-solution model, we demonstrated that srilankite is stable in peridotites at T>810 °C at P \approx 0.9 GPa, consistent with estimates of T \approx 850 °C retrieved from symplectites in garnet fractures consisting of sapphirine+spinel+Al-orthopyroxene+amphibole. In eclogites, kyanite is replaced by symplectites made of anorthite-rich plagioclase+spinel \pm sapphirine \pm corundum, formed at T \approx 850 °C and P=0.8–1.0 GPa, coincident with the high-T overprint recorded by the peridotites. Contrary to the consistency between these estimates for the HP peak in MD and previous ones on garnet peridotites and some eclogites of the Adula–Cima Lunga Nappe, the observed HT granulite-facies overprint postdating the eclogite-facies stage was never reported so far in the Central Alps. This evolution from eclogite- to granulite-facies conditions is known from the orogenic evolution of the Variscan cycle (O'Brien and Rötzler, 2003). Particularly, HT conditions are attributed to the Permian–Triassic igneous activity resulting from rifting activity that followed the collapse of the Variscan belt. Our new data add one more piece to the puzzle of the Central Alps, where the interplay of Variscan and Alpine geodynamics conceals the tectonometamorphic evolution and age of metamorphism of each unit.

References:

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