

In-situ U-Pb dating of polymetamorphic garnet from the Adula nappe, Central Alps

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The Adula nappe, Lepontine Alps, Switzerland and Italy, was shaped in a south-dipping subduction zone during the Alpine orogenic cycle. It comprises crustal gneisses, metasediments, and mica schists, as well as eclogites, amphibolites and peridotites. Rocks from the Adula nappe record a gradual increase in pressure and temperature from north to south with high-pressure (HP) metamorphism followed by low-pressure (LP)/high-temperature (HT) conditions. HP metamorphism and the subsequent LP-HT overprint are considered to reflect a single P–T evolution. However, geochronological data from the Adula nappe indicate Variscan and Alpine metamorphism. Eclogites from the southern Adula nappe yielded Alpine ages (garnet Lu–Hf, Sm–Nd; zircon U–Pb), eclogites from the central part record Alpine and Variscan ages (garnet Lu–Hf; zircon U–Pb), and eclogites from the northeastern part record only Variscan ages (garnet Lu–Hf; zircon U–Pb). The P–T conditions recorded by the Adula nappe are thus attributed to Variscan-Alpine polymetamorphism and a polyphase Alpine deformation history, which obscured the mineral equilibria developed during each high-grade event. Polymetamorphism of the Adula nappe is reflected in compositionally and chronologically distinct garnet domains and generations. However, published polymetamorphic garnet ages from the Adula nappe represent maximum and minimum ages, due to potential mixing of different age domains during hand picking and dissolution. In order to unravel the complex metamorphic history of the Adula nappe in more detail, we applied in-situ garnet U–Pb dating by LA-MC-ICPMS to garnet in thin sections and mounted detrital garnet grains.

BSE imaging and major element mapping was applied to resolve different garnet growth zones prior to U–Pb dating. Our preliminary results indicate a plethora of internal garnet textures, sometimes documenting the fragmentation of Variscan garnet and subsequent Alpine overgrowth. We found that the northeastern Adula nappe also records Alpine garnet growth, and that Variscan metamorphism in this area occurred as early as ~370 Ma, similar to the central Adula nappe. Lithologies from the central and southern Adula nappe yielded Alpine garnet U–Pb dates. While most samples yielded either Variscan or Alpine garnet growth ages, a few garnet grains consist of Variscan cores, overgrown by Alpine rims (Fig. 1).

