Geophysical Research Abstracts
Vol. 21, EGU2019-13341, 2019
EGU General Assembly 2019

Polyphase P-T-t evolution of the Wildkogel Nappe ("Steinkogel unit," Eastern Alps, Austria)

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The Wildkogel Nappe is a tectonic unit of the Upper Austroalpine Unit in the Eastern Alps, located north of the Tauern Window in the Kitzbühl Mountains (Austria). It corresponds to the previously defined Steinkogel lithological unit and is considered as part of the Innsbruck Quartzphyllite Zone. However, the rocks of the Wildkogel Nappe can be differentiated from the rest of the Innsbruck Quartzphyllite Zone by their lithological assemblages (micaschist, para- and orthogneiss, dolomitic and calcitic marble, amphibolite) and upper greenschist facies metamorphic grade (parageneses with garnet and/or biotite). The upper greenschist facies metamorphism is attributed to the Variscan orogeny, whereas the Alpine signature is thought to be restricted to limited overprint in the lower greenschist facies. In this contribution, we present new pressure, temperature and time data in order to constrain the Pre-Variscan, Variscan, Eo-Alpine and Neo-Alpine history of the rocks belonging to the Wildkogel Nappe.

Two representative samples of garnet-micaschists were selected for petrographic characterization, mineral analyses, garnet elemental mapping and forward thermodynamic modelling. One sample is characterized by two-phased garnet with healed cracks. The Ca-poor garnet core is part of a primary assemblage with An-rich plagioclase, biotite, muscovite and ilmenite. The Ca-rich rim and the healed cracks are part of a secondary assemblage with An-poor plagioclase, biotite, muscovite, epidote and titanite. The second sample possesses fine-grained chloritoid aggregates and one-phased garnet. The chloritoid aggregates are prismatic and interpreted as pseudomorphs after staurolite, belonging to a poorly determined garnet-absent primary assemblage. The garnet, interpreted as secondary, is in equilibrium with chloritoid, paragonite, muscovite, chlorite and ilmenite. Pseudosections indicate that the primary assemblages of both samples are consistent with conditions of $\sim$530°C – 4 kbar whereas the secondary assemblages indicate $\sim$530°C – 10 kbar.

Zircon U-Pb ages in orthogneiss pin the intrusion age of the protolith to the Early to Middle Ordovician. The initial Sr isotopic ratio of a marble sample and apatite U-Pb ages interpreted as detrital (and not reset) in a chlorite-carbonate schist are consistent with deposition in the Silurian to Devonian. An apatite U-Pb age at 293$\pm$12 Ma in a garnet-bearing paragneiss indicates Variscan metamorphism. This is in marked contrast to Cretaceous Eo-Alpine metamorphism ranging between 125 Ma and 95 Ma, which is documented by a garnet Sm-Nd age in a garnet micaschist, an apatite U-Pb age in an orthogneiss, a rutile U-Pb age in a garnet-bearing paragneiss and a muscovite Rb-Sr age in a marble. White mica Ar-Ar ages date greenschist facies deformation between 105 Ma and 90 Ma. Biotite Rb-Sr ages at c. 80 Ma, zircon (U-Th)/He ages from 80-35 Ma and apatite (U-Th)/He ages from 55-2 Ma indicate protracted cooling through the middle and shallow crust during Eo-Alpine exhumation and, likely, Neo-Alpine thermal resetting during exhumation of the nearby Tauern Window.

This dataset documents the complex history of the rocks belonging to the Eo-Alpine Wildkogel Nappe. It indicates that the Alpine imprint was much more significant than previously recognized. It also shows that the Innsbruck Quartzphyllite Zone cannot be a single coherent tectonic unit.