TIMING OF ALPINE COLLISION – CONSTRAINTS FROM $^{40}AR/^{39}AR$ DATING FROM THE PENNINIC – AUSTRO-ALPINE BOUNDARY, EASTERN TAUERN WINDOW

Genser [1], Johann, Wijbrans [2], Jan R.

([1]Paris-Lodron-University of Salzburg, Dept. of Geology and Palaeontology, A-5020 Salzburg, Austria; johann.genser@sbg.ac.at. [2]Dept. of Earth Sciences, Vrije Universiteit, De Boelelaan 1085, 1081 HV Amsterdam, The Netherlands)

Single grain $^{40}Ar/^{39}Ar$ laser probe (step-wise heating) dating was carried out on white mica, biotite, and amphibole across the Penninic–Austro-Alpine (AA) suture at the eastern margin of the Tauern Window in order to constrain the timing of the main Alpine deformation events that led to the juxtaposition of the regarded units. Along the investigated section one can distinguish three tectonic units in the hangingwall, mainly basement units, and two major units in the Penninic footwall, a higher ophiolitic and a lower basement unit. The Austro-Alpine nappes are characterised by different amounts of pre-Alpine metamorphic overprints and a generally inverted Alpine metamorphic sequence from lower greenschist to amphibolite facies. In the highest Bundschuh nappe, Alpine metamorphic peak conditions post-date the main tectonic overprint, related to W-directed nappe emplacement, in the two deeper nappes, the Middle Austro-Alpine Aineck nappe and the Lower Austro-Alpine nappe, the main deformational event, related to the same W-directed thrusting, is essentially synmetamorphic. A second, static Alpine metamorphic overprint, related to fluid infiltration, occurred after a folding of the penetrative Alpine foliation. The Penninic units within the window exhibit an increase in metamorphic peak conditions from middle greenschist to amphibolite facies conditions towards the footwall. The first main deformational event, a N-directed thrusting, affected mainly higher parts of the Penninic units and predates the metamorphic peak, the subsequent WNW-directed shearing affected also the deeper Penninic units and occurred up to the thermal climax. An extensional event, detaching the Austro-Alpine from the Penninic base, occurred on the cooling path of the Penninic unit.

A muscovite from the Bundschuh nappe yielded an integrated age of 107.5 ± 1.3 Ma, which is compatible with other age data from this unit, giving a minimum age for the main deformation. The Aineck Nappe gave disturbed Variscan ages for hornblende (integrated ages of 295.1 ± 8.2 Ma and 248.1 ± 2.4 Ma for duplicates) and an integrated age of 83.5 ± 2.3 Ma for muscovite of the peak metamorphic assemblage. Muscovite of a second generation, grown due to the static, fluid-driven metamorphic overprint, gave ages of 80.8 ± 6.1 Ma and 85.1 ± 4.7 Ma, respectively. Two white mica from the Lower Austro-Alpine unit, close to the next higher unit, show late Variscan ages (242.9 ± 2.2 and 239.6 ± 1.1 Ma), one close to the Penninic unit a very disturbed Alpine spectrum (integrated age of ca. 100 Ma).

White mica (phengites) from tectonic higher parts of the Penninic unit display ages between 32 and 22 Ma (32.0±1.4, 27.1±1.3, 22.9±1.1, 21.9±1.1, 29.9±0.2).

Biotites from all units gave too old ages compared to white mica, interpreted to indicate extraneous argon.

These age data support the following points:

- Thrusting in the Austro-Alpine units occurred over an extended time-span. The Alpine thrusting in the highest unit (pre-metamorphic) and the subsequent cooling from the highest greenschist facies to about 350-400 °C predates 100 Ma. In the next lower unit thrusting could have persisted until ca. 85 Ma. Nappe stacking must have propagated from the hangingwall to the footwall, therefore, incorporating successively more external and deeper units.
- The attainment of higher peak temperatures in higher nappes of the Austro-Alpine unit and the subsequent thrusting onto progressively cooler units of the same mega-unit points to a continuous accretion of parts of the footwall to the hangingwall in the stacking process. Thus thrusting could be explained by an intra-Austro-Alpine subduction. This progressive accretion can also explain the observed inverted metamorphic gradient, without need to invoke inverted temperature gradients.
- The beginning of subduction of the oceanic Penninic lithosphere could be dated by the second generation of white mica at the base of the Austro-Alpine unit, that grew due to fluid infiltration. The ages of 80 – 85 Ma indicate a possible interference between intra-Austro-Alpine thrusting and commencing subduction of the Penninic ocean beneath.
- The main deformation in the higher Penninic parts, related to their subduction and intra-Penninic stacking is pre- to syn-metamorphic. Hence the oldest age from that unit, already cooling ages, give a minimum age for N-directed shearing, the oldest, ductile deformation. The ages of about 22 Ma place a lower age limit on the WNW-directed shearing, occurring at about peak metamorphic conditions, and an upper age constraint on the subsequent ESE-directed, extensional shearing.