LOWER-, MIDDLE-, AND UPPER-AUSTROALPINE NAPPES IN THE EASTERN ALPS: NEW DATA ON AN OLD PROBLEM

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Since c. 60 years, there is an ongoing debate on the existence and significance of Alpine nappes within central sectors of the Austroalpine nappe complex in the Eastern Alps. The existence of internal nappes is specifically not clear for those regions where Permo-Mesozoic cover sequences are missing, like in the section NW of the Tauern window. The main questions are: (1) what determines Austroalpine "nappes"; (2) how many major "independent" Australpine nappes exist, and is it possible to trace them from east to west, (3) can these nappes be distinguished with respect to their Alpine tectonometamorphic evolution, and (4) how can Alpine cover sequence be related to pre-Alpine basement sequences.

At the eastern margin of the Eastern Alps, there is unquestionable evidence for the existence of three major Alpine nappe piles. These were imbricated due to footwall propagation of an Alpine master fault during ongoing contraction. There, Alpine nappes which experienced sub-greenschist- to lower greenschist-facies metamorphic conditions (Upper Austroalpine, UAA) were thrusted over Alpine medium- and partly eclogite-facies metamorphic rocks (Middle Austroalpine, MAA). The present state of the MAA/UAA contact is a late Cretaceous low angle normal fault juxtaposing rocks of different metamorphic overprint to each other. The MAA units were thrusted over Lower Austroalpine (LAA) units which, again, were affected by only greenschist-facies metamorphic conditions along northern margins in Alpine times. As revealed from detailed $^{40}Ar/^{39}Ar$ isotopic studies on white mica and whole-rock samples, deformation started at c. 100 Ma in todays uppermost tectonic units, and commenced in lowermost units at c. 70 Ma.

New $^{40}Ar/^{39}Ar$ isotopic data from central units of the MAA/UAA (e.g. Gurktal nappe complex) and units west of the Tauern Window (e.g. Kellerjoch area) reveal a similar tectonic evolution. In the Kellerjoch area, the Kellerjoch Gneiss is imbricated between LAA Innsbruck quartzphyllite units and UAA Paleozoic clastic sequences of the Graywacke Zone. Both units experienced only a weak overprint under lower greenschist-facies metamorphic condition in Alpine times. Preliminary results from $^{40}Ar/^{39}Ar$ analyses of white mica concentrates from ductile deformed Kellerjoch Gneiss display a concordant age of c. 105.3 ±2.9 Ma, interpreted to date ductile deformation under greenschist-facies metamorphic conditions during Alpine nappe assembly. Because Alpine thermal overprint in underlying LAA Innsbruck quartzphyllite, and overlying UAA Graywacke Zone is missing, this age suggests that the Kellerjoch Gneiss represents an independent tectonic unit. Furthermore, it indicates that the thrust between MAA/LAA units is similar to easternmost Austroalpine regions.

White mica from ductile shear zones along hangingwall margins of the MAA unit beneath the western Gurktal extensional allochthon yielded 99.4 ±5.8 Ma and 89.0 ± 4.8 Ma. Mineral assemblages and state of deformation suggest that deformation started at c. 450°-500°C. By contrast, detrital white mica from Late Carboniferous/lowermost Permian sequences yielded 317.6 ±4.7 Ma. This age indiates lacking Alpine thermal influence of these units, and a break in metamorphic conditions between MAA and UAA units in this particular region. Furthermore, the age of the detrital mica does not support a primary, pre-Alpine linkage between MAA and UAA basement units.

These new data, combined with previously reported geochronological and structural data, suggest the presence of similar contacts between major tectonic units throughout the Austroalpine nappe pile from east to west: These include (1) a Late Cretaceous transport of strongly overprinted MAA units onto nearly unmetamorphic LAA units subsequent to thrusting of UAA onto MAA units; and (2) a Santonian activation of low angle normal faults along the present MAA/UAA nappe contact during orogenic collapse.