THE PALEOZOIC EVOLUTION OF THE EASTERN ALPS SEEN THROUGH $^{40}Ar/^{39}Ar$ AGES OF DETRITAL MICA, SANDSTONE MODE AND GEOCHEMISTRY

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The principal goal of the project was to monitor the tectonic evolution of various types of Paleozoic sedimentary basins of the Eastern Alps (Austroalpine and Southalpine units) with $^{40}Ar/^{39}Ar$ ages of detrital white mica. This was done by dating of concentrates of 2-6 grains and single grains in the Salzburg $^{40}Ar/^{39}Ar$ laboratory which has been set up during the course of the project. The age determination of white mica was accompanied by analyses of detrital mode of sandstones, geochemical characteristics, and chemical characterization of white mica and feldspar by microprobe. Ca. 450 sandstones samples of Ordovician to Late Carboniferous age were counted using the Dickinson-Gazzi method. The results show a large variation of sandstone composition through time and space. Variable sources in some regions argue for new geodynamic models for these regions, especially for Silurian-Devonian successions of the Graz and Gurktal nappe complexes. However, in a regional scale, the tectonic evolution of Southalpine and Austroalpine units was similar. The following principal results were obtained:

The lowermost Middle to early Late Ordovician sandstones record combined volcanic and mature sources interpreted to record extension in a supra-subduction zone environment. Detrital mica ages consistently record Cadomian sources which argue for a close linkage to Cadomian/Panafrican terrains. The development switched to very mature Late Ordovician to Middle Devonian sandstones deposited in epicontinental and later passive continental margin settings and a still Cadomian hinterland. However, major proportions of sandstones, which were deposited in distal portions of Late Silurian to Early Devonian deep sea fan enviroments of the Graz and Gurktal Paleozoic units, are extremely immature, rich in feldspar, volcanic and few low-grade metamorphic clasts. These sandstones are interpreted to record the proximity of another terrestrial source region respectively passive continental margin which we call here "Morgon" margin.

Lower Carboniferous syn-orogenic flysch deposits are exposed both, within Southalpine and Austroalpine units. Both areas mainly comprise graywackes with a large proportion of acidic and intermediate volcanic and sedimentary clasts. $^{40}Ar/^{30}Ar$ white ages of the Carnic Alps range between ca. 410 to 360 reflecting a "Caledonian" source. Similar ages have been reported from various nappes of the Grauwackenzone within the Austroalpine unit. These graywackes are interpreted to form the infilling of a trench which formed during accretion and early stages of collision between Gondwana-derived and microplates accreted to the southern sectors of the Central-European Variscan orogen. Furthermore, the sandstone compositions of the Early Carboniferous Nötsch Group are dominated by metamorphic sources and are, therefore, entirely different from the synorogenic flysch sequences. Thus a palaeogeographic linkage between the Nötsch Group and synorogenic flysch sequences appears to be unlikely.

In both Austroalpine and Southalpine regions, post-orogenic Late Carboniferous molasse-type sequences are quartz-dominated, more or less free of feldspar, and rich in detrital white mica. New $^{40}Ar/^{39}Ar$ ages from both, the Gurktal nappe complex, and Carnic Alps are within the range of c. 315 and 300 Ma suggesting throughout rejuvenation of sources during the Variscan orogeny. Similar ages have been reported from the Veitsch nappe and the Permian sequences of the eastern Grauwackenzone. Low time intervals between the $^{40}Ar/^{39}Ar$ ages reflecting cooling of exhuming crustal rocks in central zones of the Variscan orogen and depositional ages indicate rapid exhumation and denudation. $^{40}Ar/^{39}Ar$ ages of overlying Permian sandstones are more variable in ages ranging between ca. 320 and 280 Ma. This is interpreted to reflect a higher diversity of denudation levels in respective source regions.

These new data combined with biogeographic data from the literature indicate that most Alpine Paleozoic units represent parts of an exotic terrane which accreted to an active continental margin of the Central European Variscides during Variscan orogenic events. Throughout crustal rejuvenation in a very broad zone suggests that the Variscan orogeny represents a Himalaya-type orogen within which exhumation of middle-deep crustal levels dominates the structure.