# Provenance studies using detrital minerals: U-Pb zircon vs. detrital white mica applied to the Neogene Sattnitz Conglomerate, Eastern Alps

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Multi-method mineral-based age-dating provenance studies reveal significant information on the source but depend highly on lithologies and fertility of source. In a pilot study, we investigated U-Pb zircon and Ar-Ar white mica ages from the ca. 400 m thick Upper Miocene to Pliocene Sattnitz Conglomerate of the intra-orogenic flexural Klagenfurt basin in Eastern Alps. The suspected catchment draining along fault-controlled valleys in the west is similar to the present-day drainage patterns except the disconnection from the Karawanken Mts. The Klagenfurt basin was filled by two processes including: (1) transversal infill from the overriding thrust sheet (North Karawanken Nappe), which provided mostly Mesozoic carbonates, and (2) axial infill with Mesozoic carbonatic and siliciclastic sedimentary and greenschist- and amphibolite-grade metamorphic rocks of Austroalpine and subordinate Penninic units. These exhuming and uplifting metamorphic pre-Alpine basement and Mesozoic cover successions provide a good overview of potential sources, which are poorly investigated in bedrocks up to now. For the first time, cataclastic clasts testify preferred erosion of cataclastic rocks of fault-controlled valleys. Ca. 178 (sub-)concordant U-Pb zircon ages indicate erosion of mainly Austroalpine and subordinate Penninic (mainly Variscan metagranites) sources. Three grains with ages between 30.00 ±0.54 Ma and 36.0 ±0.8 Ma relate to erosion of plutons along the Periadriatic fault. Four grains with low Th/U ratio metamorphic zircons of Early Cretaceous age testify erosion of Austroalpine amphibolite-/eclogite facies terrains. A few ages ranging from 255.5 ±4.9 to 286.8 ±5.0 Ma with Th/U ratios typical for magmatic rocks indicate Permian magmatism not known in the catchment. A few grains yield classical Variscan ages between 325.5 ±5.0 Ma and 356.1 ±5.6 Ma, potentially from the Subpenninic Central Gneiss of the Tauern window. A major contribution with Ordovician-Silurian ages (408.8 ±6.8 Ma to 492.4 ±7.9 Ma) seems important. The main peak, however, is represented by Panafrican, Cambrian to Cryogenian, age groups (503 ±11 Ma to 686 ±10 Ma). Only rare magmatic rocks of this age group were identified within Austroalpine and Penninic units until now. Because of the large drainage basin covering all Austroalpine tectonic units, the U-Pb zircon age distribution can be taken as representative for the southeastern part of the Austroalpine tectonic unit, and for the clearly different Penninic and Southalpine units.

Single-grain $^{40}Ar/^{39}Ar$ white mica ages range between 28.3 ±3.3. Ma to 341.9 ±5.1 Ma and well reflect the ages of metamorphism in Austroalpine (79 and 122 Ma) and Penninic (28 and 50 Ma) bedrocks. A subordinate age group is between 202 and 252 Ma reflecting extensional processes in the Austroalpine source region.

Together, U-Pb zircon and $^{40}Ar/^{39}Ar$ white mica age patterns constrain entirely different tectonic processes: the U-Pb zircon ages reflect mainly magmatic and very subordinately metamorphic processes, whereas the $^{40}Ar/^{39}Ar$ white mica constrain metamorphism and post-peak exhumation after metamorphism. Consequently, these methods should be used always in conjunction. The U-Pb zircon signature can entirely miss orogenic processes.