Unrevealing the internal structure of Austroalpine basement nappes by using the mineral compositions and fractionation trends of Permian pegmatites (Eastern Alps/Austria)

Ralf Schuster[1*], Tanja Ilickovic[1*], Heinrich Mali[2]

[1] – Department of Hard-Rock Geology, Geological Survey of Austria, Vienna, Austria; [2] – Department of Applied Geosciences and Geophysics, University of Leoben, Austria; [*] ralf.schuster@geologie.ac.at

The Austroalpine Unit represents a complex nappe stack formed during the Eoalpine tectono-metamorphic event in Cretaceous time. In variable portions, the nappes consist of metamorphic basement rocks and Paleozoic and Mesozoic (meta)sediments. If slices of Mesozoic (meta)sediments are present it can be used to separate individual basement dominated nappes, but when they are missing the subdivision has to be based on the internal structure, metamorphic imprint and lithological composition of the basement rocks. Especially in the Cretaceous amphibolite to eclogite facies rocks of the Koralpe-Wölz nappe system in the Saualpe and Koralpe area, the subdivision is tricky. Recent studies reveal that the mineral compositions and fractionation trends of Permian pegmatites and newly found indications for initial migmatisation in the surrounding metapelites give an additional opportunity to determine the nappe boundaries more precise and give hints on the internal structure of the individual nappes. In the following three examples are given:
The basement in the area of St. Radegund (Styria) consists of two nappes with gneisses formed from Permian pegmatites only occurring in the lower Radegund nappe. In the southeastern part of the latter pegmatite gneisses composed of feldspar and quartz with minor muscovite and extremely scarce garnet and tourmaline appear. The surrounding mica schists are biotite rich, medium-grained and show indications of pre-Alpine migmatisation and andalusite/sillimanite bearing assemblages. In contrast, at the top of the unit along the tectonic contacts to the overlying nappes additionally spodumene and beryl occur in the pegmatite gneisses, which are situated in more fine-grained staurolite bearing mica schists. Chemical compositions (e.g. Li content, K/Rb ratio) of cm-sized magmatic muscovites from pegmatite gneisses indicate increasing fractionation towards the top of the unit and an upright position of the rock series with respect to the Permian situation.

The Plattengneis shear zone represents a major structural element within the eclogite bearing rock series of the Koralpe Mountains (Styria/Carinthia). It is still a matter of discussion with respect to its kinematics and geological significance. Rock series below the shear zone include schists with dm-sized kyanite pseudomorphs after Permian chiastolitic andalusite. Pegmatite gneisses therein contain frequent garnet and tourmaline and spodumene at one locality. Within the structural lower part of the Plattengneis shear zone pegmatite mylonites are rich in garnet and tourmaline, whereas those in the upper part are composed only of feldspar and quartz and even muscovite is extremely scarce. It seems that an important nappe boundary is situated within the shear zone.

At the southern slopes of the Koralpe Mountains the Plankogel Complex is overlying the eclogite bearing rock series. It is mainly formed by mica schists with intercalations of serpentinites, amphibolites and quartzites. Further Permian pegmatite gneisses containing cm-sized magmatic muscovite and scarce garnet and tourmaline are present. Based on the K/Rb ratios in muscovites they are moderately fractionated. The mica schists are characterised by complex textures which formed during Permian HT/LP metamorphism and a pressure dominated Eoalpine (Cretaceous) overprint. Textures of the mica schists indicate a first Permian assemblage including garnet1 + staurolite1. Still during the Permian HT/LP event staurolite1 broke down to andalusite. During the Eoalpine overprint garnet2 + staurolite2 formed, and in the lower part of the section, andalusite was transformed into fine-grained kyanite patches. The interpretation of the textures implies an upright position of the Plankogel Complex with respect to the Permian situation.