Polymetamorphism in the Austroalpine Matsch Unit (S Ötztal-Stubai Complex): P-T-t-d constraints on Variscan metamorphism, Permian pegmatite-emplacement and the influence of the Cretaceous overprint

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The Matsch Unit provides insight into the geodynamic evolution of the Austroalpine basement units during the Carboniferous, Permo-Triassic and Cretaceous events. Representing the southernmost part of the Ötztal-Stubai Complex (ÖSC), the Matsch Unit may yield information on the tectonic relation with the Campo Complex further south. Whereas the Ötztal-Stubai Complex (ÖSC) has a predominant pre-Permian metamorphic and magmatic imprint, the Matsch Unit and the Campo Complex have lithological similarities and show evidences of Permo-Triassic magmatism and metamorphism. Furthermore, the Matsch Unit may help to decipher Cretaceous tectonic processes, as it is supposed to be part of the hangingwall of the eclogite facies metamorphic Texel Complex extruding further east (*Sölva et al.*, 2005). *Schmid and Haas* (1989) have described a major Cretaceous tectonic boundary at the base of the Matsch Unit, the Vinschgau Shear Zone, which may be related with extrusion of the Texel Complex.
Garnet Sm-Nd geochronology, correlated with field, (micro)structural and mineral compositional data yielded constraints on the polymetamorphic evolution. The Matsch Unit consists of three lithological subunits, i) the structurally lowermost Bt-Sil gneisses, and ii) the overlying Al-rich metapelitic Grt-St-micaschists, both bearing pegmatite-intrusions, as well as iii) the structurally highest phyllitic Grt-Ms-schists. The pegmatites form several 10 meters sized bodies, which mainly discordantly cut the major foliation in the host rock. Sm-Nd data of magmatic pegmatite garnet from two samples gave 276 ± 4.2 Ma and 270.1 ± 3.2 Ma, respectively, and constrain the Permian age of pegmatite-emplacement. Mineral compositional data allow excluding any influence of the Cretaceous overprint on these age results.
The metapelitic pegmatite host rocks show a polyphase evolution of deformation and mineral (re)crystallization stages. Garnet and its inclusions represent the oldest mineral phases observed. From an andalusite-bearing Grt-St micaschist three garnet fractions were separated for Sm-Nd age dating. An HCl leached garnet fraction and the leachate gave a result of 325 ± 4 Ma. Both unleached garnet fractions have significantly lower Sm/Nd ratios, presumably indicating a contribution of LREE-rich inclusions. All garnet fractions and the WR (excluding the leachate) gave 311 ± 10 Ma (n = 4; MSWD = 3.1). Despite of uncertainties concerning contaminating inclusions or partial reopening of the garnet isotopic

system during the Permian event, this result indicates Variscan metamorphism in the pegmatite host rock. Garnet growth was followed by intense deformation as well as St and Ky growth still representing part of the Variscan amphibolite facies metamorphic cycle. Subsequently Grt, St and Ky were decomposed to sillimante, plagioclase and biotite equivalent to identical phase relations observed in metapelites from the Ötztal-Stubai Complex further north, where final cooling took place already in late Carboniferous times (*Thöni*, 1981). In the Matsch Unit sillimanite formation was related with the generation of the major foliation accompanied by intrafolial folds with ENE-WSW or NE-SW-trending fold axes parallel to the stretching lineations. As this foliation was discordantly cut by the pegmatites, a still pre-Permian age is presumed. In contrast with the pegmatite bearing metapelites, garnet decomposition in the phyllitic Grt-Ms schists produced Bt and/or Chl, and is related with retrogression/cooling as indicated by the compositional zoning. Either during the late Variscan, or early Permian stage, coarse grained metamorphic andalusite crystallized in metapelites, and andalusite bearing Qtz-Ab mobilisates formed. Progressive heating related with the pegmatite formation later caused andalusite-decomposition to sillimanite, indicating Permian metamorphism.

During the Cretaceous, lower to upper greenschist facies metamorphic conditions increasing from W to E have been reached in the Matsch Unit, which supposedly were related with metamorphism in the Texel Complex. The Vinschgau Shear Zone (*Schmid and Haas*, 1989) represents a major Cretaceous tectonic element, which forms the base of the Matsch Unit. Related deformation is reflected by pegmatite-mylonites and Qtz-mylonites, which occur strongly partitioned at the margins and the lithological boundaries of the Matsch Unit. These shear zones show E-W trending stretching lineations and indicate W-directed shear deformation, which may also be responsible of doubling the subunits in the eastern and central part of the Matsch Unit. New structural data indicate, that Cretaceous shear zones were still overprinted by large scale refolding with E-W trending and NNE-SSW trending axes, representing part of the Cretaceous evolution as well. The Matsch Unit presumably had a Cretaceous tectonic position between the overlying Ötztal-Stubai Complex in the north and the underlying Vinschgau shear zone in the south. Nevertheless, geochronological data yielded already a common pre-Permian metamorphic evolution of the metasediments from the Matsch Unit and the Ötztal-Stubai Complex.

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