Tourmaline as a petrogenetic recorder for the polymetamorphic evolution of the Matsch Nappe (Vinschgau/South Tyrol)

Bernabe, Egon (Universität Innsbruck, Innsbruck, AUT);
Tropper, Peter (Universität Innsbruck, Innsbruck, AUT)

The Austroalpine nappe stack in the investigated area, located in the Vinschgau area (Southern Tyrol), comprises from bottom to top the Campo-Ortler (COC), the Texel (TC), the Ötztal (ÖC) complexes and the Matsch (MN) nappe. These Austroalpine basement units in the Vinschgau valley (e.g. Matsch Nappe, Ötztal Complex) show a clear polymetamorphic evolution history which can be well reconstructed using the observation of chemical zoning patterns in different minerals such as garnet and tourmaline. Especially in the Matsch Unit, a clear spatial distribution of garnet zoning can be observed: in the west, the garnets show only a Variscan composition (Grt I) with a very small Ca-rich eo-Alpine growth rim (Grt II). Further to the east, into the Ötztal Complex, the proportion of this Grt II rim increases until only a residue of the older core Grt I remains. Special attention must be paid to the eastern part of the Matsch Unit where the garnets surprisingly show a third very low calcium generation (Grt Ib), which occurs between the Variscan core Grt I and the eo-Alpine rim Grt II. Geothermobarometry of the Matsch Unit yielded an increase in eo-Alpine temperature conditions of 500°C to 550°C at pressures of 0.80-1.2 GPa. Similar to garnet a clear spatial distribution of tourmaline zoning can be observed. In the east tourmalines show in BSE images only two visible growth zones (brighter core, darker rim) of growth but only a continuous chemical zonation with Ca-poor cores and Ca-enriched inner rims (correlates with the brighter growth zone in BSE image) and a decrease in Ca and Ti in the outermost rims (correlates with the darker growth zone in BSE image). The zoning patterns of Mg/Fe and Al indicate only prograde growth with increasing T. All tourmalines of this area belong to the alkali group and classify as dravites. This simple chemical zoning in conjunction with the increasing metamorphic grade to the east indicates that only the prograde eo-Alpine metamorphic history is preserved in both growth zones but a decrease in Ca and Ti in the outer growth zone most likely correlates with contemporaneous prograde titanite growth. In the western part of the Matsch nappe this tourmaline zoning type still occurs but in addition visibly more complex zoned tourmalines also occur. Latter complexly zoned tourmalines display at least three or more growth zones. Chemically complex patterns with spikes in Ca, Al, Mn and Ti occur. Although Ca increases towards the rims the extent of this increase is lower in the west than in the east, indicating lower eo-Alpine P-T conditions. Some grains exhibit Fe-rich cores which can be classified as schorl while the remaining tourmalines classify as dravites. The visual and chemical zoning patterns indicate a polymetamorphic evolution of these tourmalines with possible Permian- or Variscan relicts in the cores and increasing eo-Alpine recrystallization towards the east.