Mineral chemical evolution of metapelites along the prograde Eoalpine metamorphic field gradient in the southern Ötztal Complex (Vinschgau, S-Tyrol, Italy)

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The currently mapped sheet Schlanders (CARG 012) offers the chance to carefully investigate the Austroalpine units in the Vinschgau and their tectonic contacts and to implement them into a tectonic model based on new petrological, geochronological and structural data. 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 (M) Nappe. These Austroalpine basement units in the northern flank of the Vinschgau valley (e.g. Matsch Nappe, Ötztal Complex) show a clear polymetamorphic evolution history which can be well reconstructed using the spatial distribution of the alumosilicates, the chloritoid-isograd and the observation of chemical zoning patterns in garnets, which depending on the geographical position and the geological setting, exhibit single-phase, two-phase or even three-phase compositions. Geothermobarometry yielded a strong increase in eo-Alpine temperature conditions of 500 °C and 0.8 GPa to 650 °C and 1–1.2 GPa. The following mineralogical and chemical changes occur in the metapelites of the Matsch Nappe: Chloritoid isograd: Staurolite breaks down to form either chlorite or chloritoid. West of the isograde the reaction 10fst + 82an + 94H_2O = 8daph + 82ma + 51q can be observed. East of the isograde the reaction 2fst + 10ab + 14H_2O = 10pa + 8fctd + 7q can be observed. With respect to the Ca-phases a change in margarite (west) to grossular-bearing garnets (east) occurs. Garnet: 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 Eoalpine growth rim (Grt II). Further to the east, the proportion of this Grt II rim increases until only a residue of the older core Grt I remains. The garnets surprisingly show a third very low calcium generation (Grt Ib), which occurs between the Variscan core Grt I and the Eoalpine rim Grt II. Since this Grt Ib distribution spatially correlates well with the occurrence of leucocratic othogneisses and pegmatites, a Permian age is supposed. Ilmenite: The chemical composition of ilmenite also changes in accordance with increasing Grt II growth. Ilmenites west of the isograd are Mn-rich (2–3 wt.-% MnO) and east of the isograd MnO decreases to 0.5–1.5 wt-.%. Plagioclase: Anorthite contents also change with increasing metamorphic conditions from 2 mol.-% in the west to 31 mol.-% in the east. Aluminum silicates: All three aluminum silicates also occur in the mapped area. Andalusite and sillimanite show a clear geographical distribution, where andalusite occurs in the western part and sillimanite occurs in the eastern part of the Matsch Nappe. Relict kyanite occurs only isolated in the western part of the region and is thought to represent a relict from the Variscan metamorphic event. The geographical distribution of the aluminum silicates indicates a change of Permian P-T conditions from west towards east, which also correlates well with the occurrence of leucocratic orthogneisses. Tourmaline: Tourmalines west of the chloritoid isograd show a complex chemical zoning pattern with 3–5 zones, whereas east of the isograde only 2–3 zones occur. The Ca-content of tourmaline is indicator of increasing metamorphic conditions and correlates well with an increase from the west (0.6 wt.-% CaO) to the east (0.9 wt.-% CaO).