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Structual, metamorphic and thermal evolution of the southwestern margin of the Tauern Window (Lappach, Southtyrol): Evidence from structual, petrologic and stable isotopic investigations.

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The study area is located in Southtyrol (Italy) and includes the south-western border of the Tauern Window with its Penninic units and the neighbouring Austroalpine basement. Several W-E-trending shear zones and faults subdevide the crystalline basement south of the western Tauern Window. They have been active during Oligocene indentation tectonics. Our interest is directed to the conditions during nappe stacking and subsequent (back)folding with contemporaneous shearing. We interpret these last two deformation stages to be responsible for the formation of an additional structural element on map scale, the so called Lappach structure. We used information from microstructual, textural and differential-stress analysis as well as geothermobarometric and isotopic equilibrium/disequilibrium between calcite, muscovite and quartz.

According to quartz-microstructures we can distinguish four different areas of dynamic recrystallisation:

Low temperature zone (400 C˚): The quartz grains are strongly elongated and show fabrics typical for dislocation creep. In places the quartz grains show highly undulatory extinction and deformation lamellae. The grainboundaries are sutured and the

formation of subgrains are developed along the grainboundaries. This zone is restrictet to the Austroalpine basement units of the study area.

Medium temperature zone(450 C˚): In the southern part of that area which is mainly restricted to the Glockner nappe lobate grain boundaries and low-angle grain boundaries are dominating the microfabric. The formation of deformation lamellae subgrains, and undulatory extinction can be observed in the whole area of the Glockner nappe. The subgrains show uniform grainsize.

High temperature zone (500 C˚): This zone is restricted to the Rote Wand-Modereck Decke (after Kurz et al. 1998). The quartz grains show equilibrated fabrics in form of polygonal grains with straight grain boundaries and 120º triple junctions. Irregular and lobate grain boundaries are weakly developed. “Grain boundary migration recrystallisation” is the main deformationsmechanism.

Very high temperature zone (500 – 550 C˚): This zone is restricted to the Venediger nappe of the studied area. Polygonal quartz grains and straight grain boundaries are the main features which represent an equilibrated and annealed fabric. But the grain boundaries are increasingly ameboid again. That can be interpreted as the beginning of diffusion processes, which are restricted to higher temperatures.

In order to build twin lamellae in calcite the temperature plays an important role (Ferril 1991; Burkhard 1993). We used the grain size and the grain shape, the geometry of calcite twins and compared them to the studies of Burkhard (1993). Hence we can show different temperatur conditions for the formation of calcite twins in different tectonostratigraphic units increasing from the southern Glockner nappe to the Venediger Nappe in the north.

By means of twin density per mm within calcite grains, it is possible to calculate differential stress that produced twinning (Rowe & Rutter 1990). Thus we can observe a clear alteration from 129 MPa in the northern part to 210 MPa to the south of the Tauern Window.

This observation fits well to textural studies that display pure shear dominated deformation in the Venediger nappe and simple shear deformation with sinistral sense of shear at the border to the Austroalpine basement.

The above mentioned determination in four different areas of dynamic recrystallisation can be supportet by geothermobarometric data. Thus we can demonstrate greenschist facies conditions for the Austroalpine basement (375 C˚ - 428 C˚/4,5 – 6,9 kbar) and the Glockner nappe (376 – 440 C˚/3,6 – 6,3 kbar) to amphibolite facies conditions for the Rote Wand-Modereck Nappe (420 – 498 C˚/5,1 – 7,1 kbar) and the Venediger Nappe (440 – 525 C˚/5,8 – 8.7 kbar). Within the Penninic units of the study area we

propose different relationship between deformation and metamorphism. The fabrics of the Glockner Nappe and the Rote Wand-Modereck Nappe show dynamic recrystallisation whereas in the Venediger Nappe the fabric has been overprinted. Rabitsch et al. (2002) used information from isotopic equilibrium/disequilibrium between calcite, muscovite and quartz separated rocks of very similar bulk composition (calcschists). West of the Mühlbach Valley temperatures incease from south to north from ca. 380 – 520 C˚. By contrast east to the Mühlbach Valley temperatures decrease from south to north, i.e. from ca. 520 - 350 C˚. This gradient in syntectonic temperature conditions and variations in differential stresses is interpreted by differential exhumation related to backthrusting of Tauern Window units onto Austroalpine basement. Higher grade units were extruded in the north onto the alpine lower grade Austroalpine basement forming the Lappach structure.

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