

TECTONO-METAMORPHIC EVOLUTION OF THE PENNINIC UNITS OF THE EASTERN ALPS

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The Penninic unit occur in the Eastern Alps only in form of tectonic windows, starting from the west they are the Lower Engadine Window (LEW), the large Tauern Window (TW) in the central part, and in the east several small windows forming the Rechnitz Window Group (RWG).

Two metamorphic events are recognizable in all windows where the older is regarded as a HP/LT metamorphism and the younger of Barrovian type. Only in the TW an earlier eclogite metamorphism is recorded with an retrograde evolution path entirely different from the rest of the Penninic metamorphics.

The eclogitized metabasics and metasediments passed through a mantle/crust (?) segment in a depth of 70 km. With T_{max} around 600° C they formed in an array of a very low geothermal gradient of 7 - 9° C/km typical for subduction zones. The eclogite formation has to be earlier than the Eocene/Oligocene boundary. Ar/Ar data suggest for the blueschist event an age of late Eocene - early Oligocene. For the eclogitic rocks the HP/LT event is a stage of cooling and uplift from 70 - 85 km to 35 - 40 km. This corresponds to the subduction of other sediments and metavolcanics structurally above the eclogite zone to the same depth and an according heating to 400 - 450° C. Again the low thermal gradient of 10 - 13° C/km suggests a subduction zone environment.

The HP/LT remnants in the LEW and RWG record somewhat lower pressure and lower temperature compared with the TW but indicate also an subduction zone along the same low thermal gradient around 10 - 12° C/km. In the LEW mostly the deeper parts (North Penninic metasediments) are metamorphosed in blueschist facies, for the ophiolites a proof of a HP/LT metamorphism is missing. In the RWG the ophiolites indicate clearly the blueschist event, the metasediments below and above the ophiolites are not investigated.

The subsequent greenschist to amphibolite facies event has its lowest T_{max} with 350° C in the LEW. In the RWG a T_{max} of 450° C is recorded and in the TW between 500 - 600° C. T_{max} is combined with a pressure of 2 - 4 kbar in the LEW, 3 - 4 kbar in the RWG and 5 - 7 kbar in the TW approaching a geothermal gradient of 20 - 35° C/km, typical for a Barrovian type metamorphism. This metamorphic stage was reached shortly after 30 Ma and is further recorded by cooling ages down to 16 Ma. Similar cooling ages are reported from the RWG, the scarce data from the LEW record probably the onset of the low grade metamorphism. The cooling and exhumation in the TW and RWG can be followed through fission track studies of apatites down to 5 and 7 Ma respectively.