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POLYMETAMORPHISM IN THE AUSTROALPINE ÖTZTAL-STUBAI BASEMENT: PETROLOGICAL AND GEOCHRONOLOGICAL EVIDENCES OF CRETACEOUS AND PRE-CRETACEOUS METAMORPHISM IN THE ECLOGITE-BEARING TEXEL COMPLEX (SOUTH TYROL, ITALY)

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New petrological and geochronological data from the SE part of the Austroalpine Ötztal-Stubai basement — situated W of the Tauern Window in the Eastern Alps — were correlated with structural data in order to decipher the polyphase tectonometamorphic evolution.
Referring to the Cretaceous (eo-Alpine) event, the Ötztal-Stubai basement is divided into i) the Ötztal-Stubai Complex sensu strictu (OSC) having a dominating pre-Cretaceous metamorphic imprint, ii) the Schneeberg/Monteneve Complex (SC), which reached Cretaceous epidote-amphibolite facies metamorphic conditions and iii) the eclogite-bearing Texel Complex (TC) (Sölva 2004), where HP metamorphism has also been assigned to the Cretaceous event (Hoinkes et al. 1991).

Cretaceous metamorphism and deformation:

Metapelites of the central ***Schneeberg / Monteneve Complex*** reflect a monometamorphic evolution of pressure-dominated amphibolite facies metamorphism reaching the PT peak at 0.8-1 GPa / 550-600 °C (Konzett and Hoinkes 1996). Subsequent decompression firstly induced kyanite-, then andalusite-growth as a product of the Pg-breakdown reaction Pg + Qtz = Aluminosilicate + Ab + H_2O. A temperature-range of 450 – 550 °C / 0.2 – 0.35 GPa is supposed to comprise the PT conditions of andalusite formation (assuming a range of aH_2O = 0.4 – 1). The major shear deformation D1 forming a mylonitic foliation and NW-W plunging stretching lineations and fold axes of intrafolial and isoclinal folds (Thiede 2001), took place close to peak pressure conditions and is correlated with Grt 1 (= Grt core) growth in equilibrium with phengitic white mica. Large scale folding with E-W trending fold axes took place during early decompression and is related with Grt 2 growth. In the central SC, these folds were postkinematically overgrown by Grt 3 (= Grt rim), Ky, St, Ab and andalusite.
The single-phase metamorphic imprint of the SC is confirmed by garnet Sm-Nd data and a Rb-Sr biotite-whole rock age from the same sample material. The Grt Sm-Nd data of 94.1±2.2 Ma for the Grt core and 92.7±1.2 Ma for the Garnet rim are supposed to encompass both the P- and T-peaks of metamorphism, in line with further Sm-Nd mineral data from the SC (Thiede, 2001). The time of cooling below 300°C is constrained by a Rb-Sr biotite-whole rock isochron, which yielded 79.6±0.8 Ma. Andalusite formation took place roughly between 90 and 80 Ma ago, using the Grt formation as an upper and the cooling age of Bt as a lower time limit. The entire tectonometamorphic evolution of the Schneeberg/Monteneve Complex is confined to the Cretaceous (eo-Alpine) event and is related with intracontinental subduction/collision and the incipient stages of exhumation of the SC-TC “high pressure” metamorphic complexes (Sölva, 2004).
In the ***Texel Complex*** maximum PT conditions of 560 - 610 °C / 1.2 - 1.4 GPa were derived using conventional thermobarometry on Grt – Omp ± Ab assemblages in eclogites. All the matrix phases except of Grt cores within metapelitic / metapsammitic rocks and Kfs- and Grt-cores of Bt-bearing orthogneisses reequilibrated at peak pressure conditions or during decompression. Zoning trends of Ms show decreasing celadonite-content from core to rim, while the Ca-content of Pl continuously increases from albite-composition in the core to oligoclase or andesine-composition at the rim. Intense Pl and Bt growth at the expense of Grt and phengitic WM is supposed to reflect the dominating decompressional reaction within

metapelitic / metapsammitic rocks. Within eclogites, the Grt core and rim domains are in equilibrium with Omp and there are microstructural evidences of a Grt-consuming Omp-producing mineral reaction at eclogite facies metamorphic conditions (partly forming atoll-microstructures of Grt). These observations are concordant with results of Sm-Nd isotopic investigations, which indicate that Grt-formation in eclogite pertains entirely to the Cretaceous metamorphic event. Different Grt generations of eclogite and the inclusions within Grt seem to be isotopically quite well equilibrated, as shown by Sm-Nd data from 6 Grt fractions (including hand-picked fractions, leachates and residues) yielding an age result of 82 ± 9 Ma. Rb-Sr Bt-WR ages of Grt-two mica gneiss and Amp-Bt-Pl orthogneiss forming the immediate host rocks of eclogite yielded 73.1 ± 0.7 Ma and 78.1 ± 0.8 Ma, respectively, and are interpreted to indicate cooling below c. 300°C.

The first major deformational imprint (D1) observed at meso- and microscale within all the lithologies of the TC represents the development of a mylonitic foliation and a new compositional layering related with isoclinal and intrafolial folding with fold axes parallel to the stretching lineation. The mylonitic foliation planes and the Ls1 stretching lineation are reflected by the HP mineral phases (Omp, Zo, Amp, phengitic WM, Ab). Domains, which were affected predominantly by D1 and escaped further deformation, show the best preservation of the high-pressure assemblages. The spatial trends of the Ls1 stretching lineations and Lf1 fold axes scatters widely from SW over W to NW. This is partly due to refolding during the subsequent deformation stages. D1 structures were overprinted by close or tight folding (D2) with N-S trending Lf2 fold axes. The Sf2 axial plane foliation at present dips towards north parallel to the axial planes of subsequently formed close D3 folds. The latter have E-W trending Lf3 fold axes (subparallel to Ls1 and Lf1 lineations). Both D2 and D3 represent amphibolite facies deformation stages postdating Grt growth. While D1 structures were outlasted by complete mineral (re)crystallization (medium-grained static Qtz recrystallization; Pl, St and Ky enclosing F1 fold hinges postkinematically), within D2 and D3 fold hinges dynamic Qtz recrystallization by grain boundary migration was observed. Pl-growth outlasted D2 and D3 folding. Partitioned shear deformation continued at upper greenschist facies conditions within distinct domains of intense D3 folding.

Deformation stages predating the Cretaceous high-pressure stage are confined to inclusion trails of graphitic pigment, Ilm or Qtz layers within Grt cores of metapelites, and thus the dominating structural imprint is related with the eo-Alpine tectonometamorphic event.

Pre-Cretaceous metamorphism

In contrast to the eclogites, Grt-two mica-gneiss representing the immediate host rock of eclogite, as well as Amp-Bt-Pl orthogneiss yielded evidences for a significant age difference of the Grt core and rim formation. A clear compositional hiatus related with a stage of Grt-resorption was observed at the Grt core / Grt rim boundary although both Grt core and rim domains in metapelites show quite similar compositional zoning trends and may not be distinguished by characteristic inclusion-phases.

Sm-Nd Grt-WR regression for Grt two mica gneiss and Amp-Bt-Pl orthogneiss, both forming the host rock of eclogites, yielded "age" values of 208.5 ± 8.4 Ma, respectively 205.7 ± 5.3 Ma. These data indicate the presence of mineral relics predating the eo-Alpine high-pressure metamorphic event. Either micro-inclusions not isotopically equilibrated with the enclosing Grt core, or/and the Grt core itself have retained a pre-Cretaceous isotopic memory. However, more detailed geochronological data are required in order to constrain the age of the Grt core formation. By comparison with the wider study area, Silurian-Ordovician magmatic processes as well as Carboniferous (Variscan) metamorphism have been documented from the OSC s.str. (Thöni 1999, and references therein), while new Grt Sm-Nd data of pegmatites from the Matsch Unit W of the Texel Complex indicate a Permian age of pegmatite-formation. The extent of metamorphism in relation with pegmatite-formation and emplacement as well as the

regional distribution of Permian mineral formation in the Ötztal-Stubai basement is the object of current investigations. Evidences of a relic pre-Cretaceous mineral content in the TC indicate a polymetamorphic evolution and are in clear contrast with the monometamorphic imprint of the SC.

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