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Autor: Hoinkes, Georg

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Eoalpine metamorphism of the Austroalpine Schneeberg-Complex and the adjacent Ötztal crystalline basement (summary)

by *Georg Hoinkes*[1]

Abstract

The progressive trend of eoalpine metamorphism in the Ötztal crystalline basement from NW to SE culminates with amphibolite facies conditions of about 600 °C at 6–7 kb in the basement rocks of the Texel-Gruppe south of the paleozoic synclines of the Schneeberg complex but north of Meran.

Keywords: Eoalpine metamorphism, amphibolite facies, geothermometry, geobarometry, Ötztal basement.

The Schneeberg complex is part of the southern Ötztal-Stubai unit and consists of at least 4 different narrow synclines of paleozoic metasediments of various lithology which are steeply folded into the monotoneous quartzofeldspatic polymetamorphic basement. The most abundant rock type are extremely schistose garnet mica schists but the most characteristic rocks are metacarbonates which are almost lacking in the basement.

The metamorphic overprinting of the Schneeberg synclines was proofed to be dominantly of eoalpine age by SATIR (1975), PESCHEL (1979), MAURACHER (1980), which was to be expected since the first report on cretaceous biotite cooling ages in the southern Ötztal basement and the "Brenner mesozoics" by SCHMIDT et al. (1967). Recent age dating by THÖNI (1981, 1983) on a widespread sample material from the whole Austroalpine basement west of the Tauern window confirmed the younging trend from hercynian in the northwest to eoalpine ages in the southeast by means of the Rb/Sr- and K/Ar-method on micas. This trend culminates in a small egg-shaped area north of Meran where both, white mica and biotite exhibit eoalpine ages. The Rb/Sr age group of white micas

[1] Institut für Mineralogie und Petrographie der Universität Innsbruck, Innrain 52, A-6020 Innsbruck.

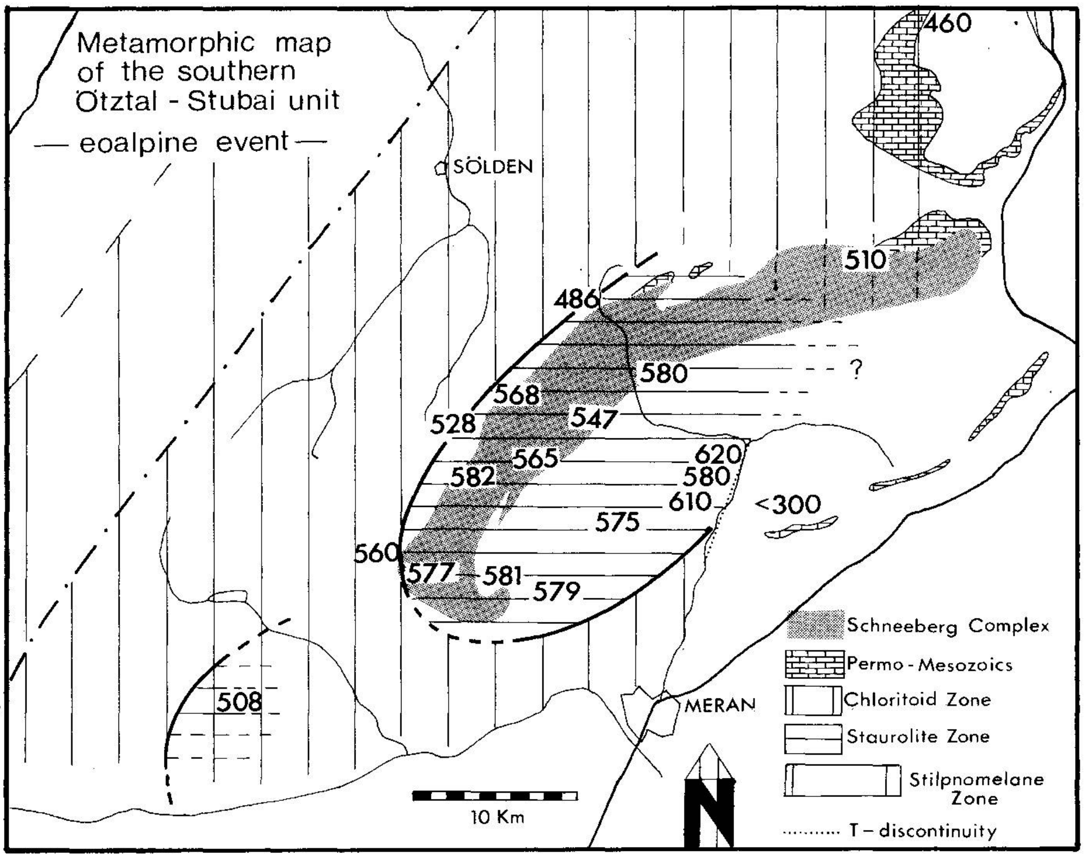

Fig. 1 Metamorphic map of the southern Ötztal-Stubai unit, showing the eoalpine metamorphic overprinting. Numbers are temperatures in °C. Data from E. DACHS, H. DIETRICH, RUTH HAAS, G. HOINKES, F. PURTSCHELLER, R. TESSADRI and M. THÖNI.

between 85 and 95 m.y. is thought to trace the time of eoalpine climax conditions (THÖNI 1983).

Besides a few observations of stilpnomelane and a finegrained phengite generation in orthogneisses of the northern Ötztal unit, chloritoid at the expense of hercynian staurolite is the most significant indication for the retrograde eoalpine metamorphic effect in the central Ötztal unit (Fig. 1). Increasing eoalpine grade to the southeast is indicated by the occurrence of a second finegrained staurolite generation and the lack of retrograde effects on the hercynian mineral generation. First appearance of eoalpine staurolites is favoured by high ZnO-contents. From the correlation of X_{Zn}^{St} with $K_{D,Mg/Fe}^{Gt\text{-}Bi}$ a systematic increase in formation temperature from 486 °C for the staurolite with the highest amount of ZnO (5.6 wt%) to about 580 °C for Zn-free staurolite is indicated.

In course of the application of the FERRY & SPEAR (1978) geothermometer to garnet biotite pairs the pronounced effect of grossular on the almandine-pyrope solid solution could be evaluated empirically. The following corrected expression of the FERRY & SPEAR calibration was used to derive the equilibrium temperatures (HOINKES 1986):

$$T°C = \frac{2089 + 0.00956\,(\text{bars})}{0.7821 - \ln K_{D.\,Mg/Fe}^{Gt-Bi} - 2.978\,X_{Ca}^{Gt} + 5.906\,(X_{Ca}^{Gt})^2} - 273$$

These temperatures of the eoalpine metamorphic overprinting are shown in Fig. 1 and indicate climax conditions of 620 °C at 6–7 kb (Tab. 1, DACHS 1985). This range in pressure results from mean values derived from the assemblage kyanite-plagioclase-garnet-quartz using the GHENT (1976) barometer and the plagioclase activity model by GANGULY & SAXENA (1984).

Tab. 1 Chemical parameters of garnet and plagioclase and eoalpine P-T-conditions of the southern Ötztal basement.

Sample (location)	X_{Fe}^{Gt}	X_{Mg}^{Gt}	X_{Ca}^{Gt}	X_{Mn}^{Gt}	X_{Ca}^{Plg}	$K_{D,\,Mg/Fe}^{Gt-Bi}$	T(°C)	P(kb)
Pl 227 (St. Leonhard)	0.701	0.121	0.085	0.093	0.296	0.143	610	5.8
Tl 200 (St. Leonhard)	0.709	0.125	0.093	0.072	0.287	0.151	620	6.5
Tl 205 (Kolben-Hof)	0.698	0.112	0.112	0.079	0.276	0.129	580	6.6
PA 240 (Kolben-Spitze)	0.728	0.109	0.109	0.060	0.265	0.146	610	7.1

The celadonite contents of eoalpine muscovites coexisting with biotite, orthoclase and quartz change from ~3.36 Si / 11 oxygens (for eoalpine low greenschist facies conditions in the NW) to ~3.30 Si / 11 oxygens (for eoalpine amphibolite facies conditions in the SE). Using the experimental calibration of MASSONNE (1981) these Si values correspond to ~7.5 kb in the NW and ~8.5 kb in the SE. The absolute values seem to be too high but however a relative eoalpine pressure difference of ~1 kb from NW to SE in the Ötztal unit is indicated (provided that the slope of the Massonne-calibration is correct).

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