(e.g. discontinuous garnet zoning) have been found in the samples so far. Cordierite very rarely occurs within pseudomorphs of biotite + muscovite + aluminium silicate (sillimanite?) aggregates suggesting a breakdown reaction such as cordierite + K-feldspar = biotite + aluminium silicate.

Thermobarometry involving the assemblage garnet + biotite + plagioclase + K-feldspar + muscovite + quartz was performed using the thermodynamic data bases and phase diagram calculation programs THERMOCALC v. 2.7 (Holland and Powell, 1998), TWQ v. 2.02 (Berman, 1988) and WEBINVEQ (Gordon, 1992). Our results yield temperatures of 550 – 620° C and pressures of 6 – 7 kbar and low $a(H_2O)$ of 0.2 – 0.4 for mesosome samples. These P-T conditions are very similar to the Variscan P-T conditions obtained by Tropper and Hoinkes (1996) from metapelites from the southern Kaunertal area ca. 10 km to the south of the migmatite. Therefore, these conditions seem to represent the Variscan metamorphic overprint rather than the conditions of the pre-Variscan high-T migmatization (Klötzli-Chowanetz, 2001).

Based on the textural evidence and the obtained P-T esimates from these samples, cordierite is thought to be the only relict of the pre-Variscan metamorphic overprint since the possible formation of cordierite due to a possible reaction such as biotite + sillimanite + quartz = cordierite + garnet +H_2O/melt requires temperatures of at least 650 – 750° C between pressures of 3 and 6 kbar (Spear et al., 1999).

Berman, R.G., 1988: J. Petrol., 29, 445-522.
Gordon, T., 1992: Geochim. Cosmochim. Acta 56, 1793-1800.
Hoinkes, G. et al., 1997: SMPM, 77, 299-314.
Holland, T.J.B. & Powell, R., 1998: J. Metam. Geol. 8, 89-124.
Klötzli-Chowanetz, E., 2001: Unpublished PhD Thesis, University Vienna, 155 p.
Spear, F.S., Kohn, M.J. & Cheney, J.T., 1999: Contrib. Mineral. Petrol 134, 17-32.
Tropper, P. & Hoinkes, G., 1996: Mineral. Petrol., 58, 145-170.

How close can we resemble nature? experimental investigations on high-P dehydration melting of biotite and the comparison to high-P/high-T granulites

P. Tropper[1], J. Konzett[1], Ch. Bertoldi[2], R. Cooke[2], F. Finger[2]

[1] *Institute of Mineralogy and Petrography, University of Innsbruck, Innrain 52, 6020 Innsbruck, Austria*
[2] *Institute of Mineralogy, University of Salzburg,, Hellbrunnerstr. 34 , 5020 Salzburg, Austria*

High-P/high-T granulites are the prominent rock type in the Moldanubian Zone of the Variscan Orogen in Lower Austria. These rocks are thought to have formed during the Variscan orogeny in a Carboniferous subduction setting at 950 – 1050°C and 15 – 19 kbar from mainly granitoid protoliths (O´Brien and Carswell 1993). During subsequent rapid exhumation, the original peak P-T assemblage garnet + ternary feldspar + quartz ± kyanite ± clinopyroxene was variably retrogressed.

One important question of this investigation with considerable petrological implications concerns the reproducibility of the natural mineral assemblages of the South Bohemian high-P/high-T granulites in the experiments. In order to place further constraints on this particular problem, dry piston cylinder experiments were conducted in the temperature range of 800 – 1000°C and in the pressure range of 12 to 16 kbar. The experimental conditions were chosen to simulate the metamorphic P-T path of these granulites, with peak conditions of 1000°C, 16 kbar and the subsequent stage of nearly isothermal compression (950°C, 14 kbar and 900°C, 12 kbar). In addition, experiments at 800°C, 12 kbar and 850°C, 16 kbar were performed to investigate the upper T-limit of biotite stability. We used a natural felsic granite gneiss as starting material with the assemblage plagioclase + K-feldspar + biotite + quartz ± sillimanite which is geochemically similar to the main granulite type in South Bohemia. The experiments in the temperature range of 900 – 1000°C all yielded the assemblage garnet + ternary feldspar + quartz + melt ± kyanite. Biotite is only stable in the experiment at 800°C and 12 kbar. The amount of melt in the 1000°C, 16 kbar experiment is approximately 20 volume% and decreases with temperature. The possible melt-forming reaction observed is:

Biotite + Sillimanite + Quartz = Garnet + ternary Feldspar + Melt

At pressures of 1.2 GPa this reaction takes place between temperatures of 800 and 900°C. At pressures of 1.6 GPa this reaction probably starts at temperatures <750°C and takes place between 750 and 800°C, thus indicating a negative slope of this reaction similar to the investigations of dehydration melting of metapelites by Vielzeuf and Montel (1994). The biotite-breakdown to form orthopyroxene was never observed in any of the experiments.

The obtained melt is strongly peraluminous granitic in composition. Garnets are almandine-pyrope solid solutions but show unusually high Ti contents of approx. 1–2 wt% TiO_2. Ternary feldspars are close to $Ab_{40}Or_{50}An_{10}$. The high Ti-contents found in the experimental garnets are consistent with the presence of rutile exsolutions in some granulite garnets.

These experiments show a remarkable agreement with the natural assemblages of these high-P/high-T granulites, solely based on dehydration experiments. The role of a strongly diluted fluid on the high-P/high-T melting behaviour is the focus of further investigations.

O´Brien, P.J., Carswell D.A., 1993: Geol. Rundschau 82, 531-555.

Vielzeuf, D., Montel, J.M., 1994: Contrib. Mineral. Petrol. 117, 375-393.

Accessory phases as tools for the unraveling of complex polymetamorphic histories: discontinuously zoned titanites in eclogite-facies carbonates from the Austroalpine basement (Ötztal Stubai Crystalline Complex)

P. Tropper, J. Konzett, R. Tessadri

Institute of Mineralogy and Petrology, University of Innsbruck, Innrain 52, A-6020 Innsbruck, Austria

Carbonates are present in the central part of the Ötztal-Stubai Crystalline Basement (ÖSCB). These marbles are intercalated between a thick mass of metabasic units and the surrounding granitic gneisses. This tectonic contact zone also contains amphibolites, eclogites, granitic gneisses, peridotites and calcsilicate lenses. The ÖSCB represents the polymetamorphic Austroalpine basement. The dominant metamorphic overprint in the ÖSCB is the Variscan metamorphic overprint, which occurred from 390–270 Ma (Hoinkes et al., 1997). The first stage of the Variscan event was a high pressure metamorphism around 373-359 Ma, leading to the formation of eclogites in the central part of the ÖSBC (Miller and Thöni, 1995). The conditions of the eclogite facies were estimated to be 700-750°C and 27–28 kbar (Miller and Thöni, 1995). The subsequent dominant amphibolite facies metamorphism occurred around 240–330 Ma (Tropper and Hoinkes, 1996).

The small lenses of eclogite-facies marbles from the Pollestal from the central part of the ÖSCB contain the assemblage calcite + dolomite + phlogopite + clino-pyroxene (diopside and omphacite) + garnet + biotite + geikelite + titanite + apatite. In addition, some of the marbles also contain chromite and exotic accessory phases such as zirconolite and baddelyite (Mogessie et al., 1988; Purtscheller and Tessadri, 1985). The assemb-lage garnet + omphacite + biotite + geikelite + titanite + calcite represents the eclogite facies peak assemblage. Due to subsequent decompression from eclogite-facies conditions to amphibolite-facies conditions, retrogression led to the formation of extensive symplectite rims around garnet and omphacite. Garnet is replaced by Al-rich hornblende (20 wt% Al_2O_3) and omphacite (Jd_{50}) is replaced by either diopside (Jd_{10}) or by a symplectite of hornblende and plagioclase ($An_{40}Ab_{60}$). Garnet shows discontinuous zoning with an older generation of Cr-rich (3–4 wt% Cr_2O_3) garnet in the core and younger overgrowths of Cr-poor (<1 wt% Cr_2O_3) garnet. Thr latter also show complex zoning and occasionally two zones of overgrowth can be distinguished. The Cr-poor garnet overgrowths contain abundant omphacite and titanite inclusions. Titanite also shows discontinuous zoning with Al-poor cores (2 wt.% Al_2O_3) and Al-rich overgrowths (3 – 4 wt.% Al_2O_3).

Textural data indicate that the titanite cores formed from ilmenite/geikelite during the onset of the presu-mably Variscan metamorphic event. The Al-rich titanite inclusions in omphacite and Cr-poor garnet indicate a second growth episode of titanite during eclogite facies conditions. These observations indicate that the Al-rich rims can clearly be attributed to the eclogite facies, whereas the Al-poor cores either represent a pre-Variscan stage or a very early stage of the eclogite facies overprint. To verify to nature of the discontinuous zoning of the titanites (polymorphic overprint vs. single-phase overprint) these chemical and textural data will be compared to ongoing geochronological SHRIMP investigations on discontinuously zoned titanites from this area.

Hoinkes, G. et al., 1997: SMPM, 77, 299-314.

Miller , C. & Thöni, M., 1995: Chem. Geol., 122, 199-225.

Mogessie, A, Purtscheller, F. & Tessadri, R., 1988: Mineral. Mag., 52, 229-236.

Purtscheller, F. & Tessadri, R., 1985:. Mineral. Mag., 49, 523-529.

Tropper, P. & Hoinkes, G., 1996: Mineral. and Petrol., 58, 145-170.