MITT.ÖSTERR.MINER.GES. 148 (2003)

THE PETROLOGICAL EVOLUTION OF HIGH-GRADE METAPELITES FROM THE SAUWALD, SOUTHERN BOHEMIAN MASSIF

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The Sauwald area is located at the southern rim of the Bohemian Massif in Upper Austria and contains S-type granites and migmatites (meta- and diatexites) with some inlayers of high-grade metapelitic paragneisses. These rocks formed during the post-collisional high T/low P stage of the Variscan orogeny (~320–330 Ma). Metapelitic samples from two localities near Kößldorf and Pyret were investigated. They contain the mineral assemblage garnet + cordierite + spinel + sillimanite + K-feldspar + plagioclase + quartz + biotite + muscovite + magnetite + graphite. The peak metamorphic assemblage is: garnet + cordierite + spinel + sillimanite + plagioclase + quartz and occurs either as inclusion assemblage in garnet or in the matrix. The absence of muscovite and the presence of K-feldspar porphyroblasts and sillimanite needles, suggests that the dehydration of muscovite took place already. The biotites show textures indicating partial melting (e.g. biotite-quartz myrmekites) but the absence of orthopyroxene indicates that the P-T conditions did not exceed the thermal limit (e.g. dehydration breakdown) of the biotite stability field.

Garnet exhibits a slight chemical zoning with increasing Fe contents towards the rims. Cordierite shows no obvious chemical zoning in Fe and Mg, but shows a slight increase in the Na content from the core to the rims from 0.029 to 0.043 Na a.p.f.u. Within plagioclase analyses, three groups can be distinguished: plagioclase inclusions in garnet show An-contents of 35–65, plagioclase porphyroblasts in the matrix show An-contents of 10 – 45 and albite rims around the matrix porphyroblasts show An-contents of 0–15. Also, two groups of sillimanite can be distinguished. The texturally older, coarse grained sillimanite needles contain >1 wt.% FeO, while the younger, finer grained needles show smaller FeO contents of < 1 wt.% Spinel occurs either as green, brown-green or brown grains. The green spinel grains are the only ones, that contain sillimanite inclusions. The chemical composition of these grains shows differences in the ZnO and Cr_2O_3 contents, which increase from the green to the brown spinel. Relict old biotite grains from the matrix show high TiO_2 contents of up to 6.74 wt.% TiO_2. Mineral chemical and textural data indicate the following stages of mineral, growth: peak assemblage garnet + cordierite + spinel (green) + sillimanite + plagioclase (An_{35-65}) + quartz. This peak assemblage continuously changes mineral compositions and thus subsequently the post-peak assemblages: garnet + cordierite + spinel (brown-green and brown) ± sillimanite + plagioclase (An_{10-45} and An_{0-15}) + quartz forms. The last stage of mineral growth is indicated by the growth of muscovite.

The P-T conditions of the assemblage garnet + cordierite + spinel + sillimanite + quartz were calculated by using (1.) the garnet – cordierite – spinel – sillimanite – quartz thermobarometry as calibrated by [1], who considered equilibria among the assemblages garnet – spinel – sillimanite – quartz , cordierite – spinel – sillimanite – quartz and garnet – cordierite – sillimanite – quartz for thermobarometric calculations. This yields pressures ranging from 2.9–5.3 kbar and temperatures of 752°C–764°C for calculations in the systems FAS and FASH. (2.) We also used the inverse equilibrium approach by [2] and obtained pressures of 2.8–3.9 kbar and temperatures of 645–814°C. These data are in good agreement with the P-T results of [3] which yielded P-T conditions of 780°C and 3.8 kbar. Our observed phase relations indicate heating along a clockwise P-T path into the stability field of the assemblage garnet + cordierite + spinel.
During the retrograde portion of the P-T path, the Fe# in garnet increases due to the backreactions of the melt such as: garnet + K-feldspar + melt ⇔ cordierite + biotite and garnet + sillimanite + melt ⇔ cordierite + biotite. These reactions are indicated by resorbed garnets and newly grown cordierite and biotite at the rims of some garnets. Based on the absence of retrograde muscovite, it can also be deduced that the rocks were cooled below 3.8 kbar [4].

References

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