MITT.ÖSTERR.MINER.GES. 148 (2003)

THERMOBAROMETRIC INVESTIGATIONS OF THE PRE-VARISCAN KLOPAIER MIGMATITE (WESTERN ÖTZTAL CRYSTALLINE, EASTERN ALPS)

F. Schennach & P. Tropper

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

The Austroalpine Ötztal Crystalline (ÖC) in the Eastern Alps provides an excellent opportunity to study a metamorphic core complex which underwent several episodes of metamorphic overprints. Although extensive research has been performed on the two predominant orogenic episodes in the Eastern Alps namely the Variscan and Alpine orogenic events, very little attention has been paid to the pre-Variscan (Caledonian) metamorphic history so far [1]. The pre-Variscan events are manifested in localized migmatite occurrences in the central (Winnebach migmatite) and western ÖC (Verpeil migmatite, Klopaier migmatite). Geochronological investigations by [2] indicate several pre-Variscan metamorphic overprints ranging from 585 to 430 Ma whereas the tonalite gives an age of 490 Ma. The migmatite from the Klopaier area, western ÖC, is also a nebulitic migmatite containing discrete narrow (0.5–1 cm width) bands of leucosome as well as nebulitic areas with schollen of biotite-plagioclase gneiss and calcsilicates. The observed mineral assemblage is garnet ($Alm_{66}Prp_{11}Grs_5Sps_{18}$) + biotite + plagioclase ($An_{21}Ab_{78}$) + K-feldspar ($Or_{89}Ab_{10}An_1$) + quartz + muscovite ± sillimanite. Textures indicate that the assemblage garnet + biotite + plagioclase + muscovite + quartz is the dominant mineral assemblage. In only one sample, fine grained aluminiumsilicate aggregates were found (presumably sillimanite, but further investigations with microraman spectroscopy are on the way) and garnet appears to have grown during the partial melting event due to the end-member reaction: biotite + aluminiumsilicate + plagioclase + quartz = garnet + K-feldspar + melt. In none of the samples has been any textural and chemical evidence for a polyphase metamorphic evolution (e.g. discontinuous garnet zoning, pseudomorphs etc.) found so far.

Thermobarometry involving the assemblage garnet + biotite + plagioclase + muscovite + quartz and garnet + biotite + plagioclase + sillimanite + quartz was performed using the inverse equilibrium approach of the program WEBINVEQ [3]. Our results yield temperatures of 586–615°C and pressures of 4.5–4.7 kbar. Application of the Fe/(Fe + Mg) isopleths of garnet composition from [4] yields pressures of ca. 3–5 kbar at temperatures of 600–700°C for the aluminiumsilicate-bearing sample. The tonalite contains the mineral assemblage: hornblende + biotite + plagioclase + titanite + K-feldspar + quartz. The hornblendes from the Klopaier tonalite show chemical zoning with Al-rich cores (ca. 12 wt.% Al_2O_3) and Al-poor rims (6–7 wt.% Al_2O_3) and application of the Al-in hornblende barometer by [5] yields pressures of 3–7 kbars for the emplacement of the tonalite. Since the geochronological investigations of KLÖTZLI-CHOWANETZ (2001) indicate that the migmatization took place around 531 Ma and therefore pre-dates the intrusion of the Klopaier tonalite it is still unclear whether the obtained P-T estimates reflect the later Caledonian- or possibly a Variscan metamorphic overprint (?).

References

[1] HOINKES, G. ET AL. (1997): SMPM, 77, 299-314.

[2] KLÖTZLI-CHOWANETZ, E. (2001): Unpubl. PhD Thesis, University Vienna, 155 p.

[3] GORDON, T. (1992): Geochim. Cosmochim. Acta 56, 1793-1800.

[5] SCHMIDT, M. W. (1992): Contrib. Mineral. Petrol. 110, 304-310.

[4] SPEAR, F. S. ET AL. (1999): Contrib. Mineral. Petrol 134, 17-32.