MITT.ÖSTERR.MINER.GES. 148 (2003)

MINERAL REACTIONS WITHIN THE BIOTITE-PLAGIOCLASE GNEISS SCHOLLEN OF THE POLYMETAMORPHIC WINNEBACH MIGMATITE FROM THE ÖTZTAL CRYSTALLINE, EASTERN ALPS: ADDITIONAL CLUES TO UNRAVELING THE COMPLEX METAMORPHIC HISTORY ?

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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, Nauderer migmatite).

The Winnebach migmatite is built up by granodioritic neosome containing remnants of biotite-plagioclase gneiss and schollen of biotite-plagioclase gneiss and calc-silicate lenses thus indicating a higher degree of melting [2]. Petrological investigations of [3] indicate partial melting at pressures of ca. 8 kbar and at least 750°C during the Caledonian orogeny. The Variscan metamorphic overprint lead to the formation of Ca-rich garnet overgrowths and locally staurolite.

The Eo-Alpine event is characterized by the possible formation of chloritoid. The biotite-plagioclase gneiss lenses contain the assemblage biotite + muscovite + garnet (1) + plagioclase + quartz and seem to preserve important informations about the metamorphic history following the Caledonian migmatic event. Thin section traverses through the gneiss schollen reveal the progression of a reaction front, leading to complete replacement of the protolith assemblage over a distance of few centimeters by the secondary assemblage garnet (2) + clinozoisite + diopside + K-feldspar. Garnet (1) has a chemical composition of $Alm_{72}Pyr_5Grs_5Sps_{18}$ and garnet (2) has a composition of $Alm_{60}Pyr_2Grs_{22}Sps_{16}$.
These petrographic changes can be ascribed to the progression of two end-member reactions such as: plagioclase + biotite + garnet (1) + H_2O ⇔ clinozoisite/zoisite + K-feldspar + diopside and plagioclase + muscovite + garnet (1) + H_2O ⇔ clinozoisite/zoisite + K-feldspar. Both reactions require the influx of an H_2O-rich fluid phase which results in the stabilization of Fe-poor clinozoisite/zoisite.

In addition, mineral chemical investigations reveal features such as complex chemical zoning in garnet porphyroblasts and titanites (core: 2.31 wt.% Al_2O_3; rim 3.24 wt.% Al_2O_3) and zoisite/clinozoisites (core: 8.33 wt.% Fe_2O_3; rim: 1.89 wt.% Fe_2O_3). Discontinuous chemical zoning, indicating a strong increase in the Ca-component was also observed in garnets from leucosome samples. These data indicate a possible later metamorphic overprint accompanyied by an influx of a fluid phase, but it is still unclear whether these reactions can be attributed to the Variscan or the Eo-Alpine metamorphic overprint.

References

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

[2] HOINKES, G. ET AL. (1972): TMPM, 18, 292-311.

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