MITT.ÖSTERR.MINER.GES. 146 (2001)

PARTIAL ANATEXIS IN THE LOWER CRUST – WHERE IS THE MELT ? EXAMPLES FROM THE ÖTZTAL CRYSTALLINE BASEMENT, EASTERN ALPS

by

E. Klötzli-Chowanetz & F. Koller

Institut für Petrologie
Geozentrum, Universität Wien, Althanstrasse 14, A-1090 Wien

Partial anatexis of biotite-plagioclase-paragneisses is known to have taken place in several sites within the Ötztal crystalline complex, a polymetamorphic basement unit of the Eastern Alps in Austria. Petrological investigations were made in the Ordovician Winnebach migmatite [1] and the Cambrian Klopaier migmatite [2]. Both are schollen-migmatites build up by a granodioritic matrix surrounding Bt-Pl-gneiss-schollen.

The genesis of the Winnebach migmatite is currently explained by an in situ melting of paragneisses leading to granodioritic neosome with a nonoriented texture enclosing schollen that have withstood melting and preserved their layering [3]. In another model the schollen have been interpreted as migmatite s. str. and the matrix as tonalitic intrusion [4].

This matrix or "neosome" shows fine-grained aggregates of plagioclase, resorbed K-feldspar and minor amounts of quartz [2]. We interpret these patches as having been the actual melt. Most of the quartz originally present in this melt has precipitated on neighbouring quartz grains, thus forming large quartz-islands surrounding the meltpockets [5]. Biotite in contact with the meltpockets shows beginning of melting. The "neosome" has therefore to be regarded as only partially molten (about 20 %). This low degree of melting and the dispersed distribution of the meltpockets within the "neosome" imply the remaining of the melt in situ.

A first generation of coarse grained kyanite occuring only within the "neosome" in the vicinity of meltpockets and not within the schollen favors a crossing of the muscovite breakdown reaction curve within the stability field of kyanite. This requires pressures above 0.8 GP for the onset of the anatexis. Fe/(Fe+Mg) ratios in garnet below 0.7 suggest temperatures exceeding 750°C [6]. These conditions are achieved for instance in a continent-continent collision regime.

A postanatectic metamorphic overprint, attributed to the Variscan cycle, is marked by a second kyanite generation growing within migmatite and surrounding paragneisses and is thought to have exceeded 500°C (reequilibrated garnets, appearance of staurolite). However, the preservation of Ordovician white mica Rb-Sr ages within the Winnebach migmatite does not permit the temperature to have risen significantly above 550°C.

The anatectic P-T conditions within the Klopaier migmatite have reached a similar state of melting as in the Winnebach migmatite. The melt phase is represented by fine-grained aggregates of plagioclase, K-feldspar and quartz. Biotite is involved in the melting reaction. However the kyanite present can be the result of an anatectic muscovite breakdown as well as of a postanatectic metamorphic overprint, which has lead sillimanite (or even andalusite) to recrystallise. Since the formation of kyanite in the Klopaier migmatite cannot be attributed without doubt to the anatectic event, the pressure estimates for this older anatexis remain uncertain.

Literature

[1] KLÖTZLI-CHOWANETZ, E., KLÖTZLI, U. & KOLLER, F. (1997): Lower Ordovician migmatisation in the Ötztal crystalline basement (Eastern Alps, Austria): linking U-Pb and Pb-Pb dating with zircon morphology. - SMPM, 77, 315-324.

[2] KLÖTZLI-CHOWANETZ, E. (2001): Migmatite des Ötztalkristallins – Petrologie und Geochronologie. - Diss. Univ. Wien, 165 p.

[3] HOINKES, G. (1973): Die Anatexis des Winnebachgranites (Ötztaler Alpen, Österreich) am Beispiel eines Aufschlusses. - TMPM, 20, 225-239.

[4] SCHINDLMAYR, A. (1999): Granitoids and Plutonic Evolution of the Ötztal-Stubai Massif – A Key for Understanding the Early Palaeozoic History of the Austroalpine Crystalline Basement in the Western Eastern Alps - Diss. Univ. Salzburg, 288 p.

[5] CLEMENS, J. D. & HOLNESS, M. B. (2000): Textural evolution and partial melting of arkose in a contact aureole: a case study and implications. - Electronic Geosciences (2000) 5:4 Springer.

[6] SPEAR, F. S., KOHN, M. J. & CHENEY, J. T. (1999): P-T paths from anatectic pelites. - Contr. Mineral. Petrol., 134, 17-32.