THE ORIGIN OF AMPHIBOLES OCCURRING IN MAFIC AND ULTRAMAFIC ROCKS OF THE DITRĂU ALKALINE MASSIF (EASTERN CARPATHIANS, ROMANIA)

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The Ditrău Alkaline Massif, Middle Triassic to Lower Cretaceous in age (PÁL MOLNÁR & ÁRVA-SÓS, 1995; DALLMEYER *et al.*, 1997; KRÄUTNER & BINDEA, 1998; STRECKEISEN & HUNZIKER, 1974), intruded into the pre-Alpine metamorphic rocks of the Bucovina Nappe in several phases. This series are related to the Alpine extensional tectonism, which began with the detachment of the Getic-Bucovinian microplate from the margin of the Eurasian platform (KRÄUTNER & BINDEA, 1998).

The mafic and ultramafic rocks of the massif occur in a well-defined area (Tarnica Complex), interdigited, with gradual transitions or forming intercalations (PÁL MOLNÁR, 2000). MOROGAN *et al.* (2000) suggest that the ultramafic rocks (clinopyroxenites and olivine-clinopyroxenites) are cumulates of mantle origin and they have been carried to higher crustal levels by the first intrusion of dioritic-gabbroic magmas.

The goal of our study is to describe samples from the ultramafic and mafic rocks, using detailed petrographic observations and mineral chemistry analyses, trying to express the characteristics of different rock types, focusing mostly on the genesis of the most abundant rock-forming component, the amphibole.

Detailed petrographic study shows that the occurrence of amphiboles varies in different rock types. In alkaline diorites and hornblendites, with shape-preferred orientation, their habitat is euhedral, prismatic indicating their primary magmatic origin. Amphiboles in clinopyroxenites and olivine clinopyroxenites display typical textural features: 1) small, oriented crystals along clinopyroxene cleavages; 2) replacing and enclosing clinopyroxenes which cause poikilitic-like textures; and 3) large amphiboles containing tiny relicts of clinopyroxene. These textural features from type 1 to type 3 suggest a pro-grading amphibole metasomatism. Amphiboles are *pargasites, kaersutites, ferro-kaersutites and magnesium-hastingsites*. Amphiboles differ in their compositions with respect to their occurrence in different rock types. Amphiboles in the hornblendites, with shape-preferred orientation, display strong chemical zonation, with high Si, Ti, Fe, and K enrichment and Al, Mg, and Na depletion at the rims.

Compositional profiles through clinopyroxenes from clinopyroxenites suggest that infiltrated Na-Fe-K-Ti enriched fluids reacting along with clinopyroxene cleavages formed amphiboles. It is typical in some cases for clinopyroxenes in contact with amphiboles, that directly next to the amphibole they suddenly get depleted in mobile elements such as Na, Fe, K and Ti, which may be related to the metasomatic "front effect".

The experimental results of SEN & DUNN (1994) for modal metasomatism were applied to constrain the amphibole forming reactions. The reaction equation indicates that an infiltrating alkaline/syenitic metasomatic melts give rise to continuous change in the composition of the origin ultramafic rocks, and that the production of amphiboles was controlled by the original clinopyroxene-olivine (-spinel) modal ratio. These "metasomatic amphiboles" have very similar compositions in all samples, indicating that the chemical character of fluids below the amphibolitisation was still the same and only the proportion of component minerals has changed.

The P-T conditions of formation of amphiboles are estimated to be in the interval of 1030–820 °C and 7–10 kbar. NIIDA & GREEN (1999) presented experimental results defining the water-undersaturated solidus and the amphibole stability limits of MORB pyrolite compositions. In this terms the genesis of DAM ultramafites could be explained as follows: (1) among upper mantle - crustal limit conditions clinopyroxenite cumulate containing no amphiboles was formed in equilibrium with melt, (2) with the evolution of processes (P-T change) from this melt the crystallization of amphiboles has started. These amphiboles on the one hand were formed as new - nucleated crystals and on the other hand because the melt has changed its composition by evolution, being to aggressive replacing and enclosing the pre-existent minerals some other type ("metasomatised") amphiboles were formed along the cleavage and contacts of clinopyroxene (olivine, spinel) crystals. From this point of view the described metasomatism is suitable for the processes of the magmatic evolution, being a mechanism of it, appearing on the microstructural scale of the rock.

References

DALLMEYER, R. D., KRÄUTNER, H. G. & NEUBAUER, F. (1997). Geol. Carpathica, 48: 347-352.
KRÄUTNER, H. G. & BINDEA, G. (1998). Slovak Geol. Mag., 4: 213-223.
MOROGAN, V., UPTON, B. G. & FITTON, J. G. (2000). Miner. Petrol., 69: 227-265.
NIIDA, K. & GREEN, D. H. (1999). Contrib. Mineral. Petrol., 135: 18-40.
PÁL MOLNÁR, E. (2000). *Hornblendites and diorites of the Ditró syenite massif.*, Szeged, 172 p.
PÁL MOLNÁR, E. & ÁRVA-SÓS, E. (1995). Acta. Mineral. Petrogr., Szeged, 36: 101-116.
SEN, C. & DUNN, T. (1994). Mineral. Petrol., 119: 422-432.
STRECKEISEN, A. & HUNZIKER, I. C. (1974). Schweiz. Mineral. Petr. Mitt., 54: 59-77.