Pl-Spl coronas around kyanite – evidence for HT (granulite facies) metamorphism in the metapelites from the Western slope of Pirin Mnt. (Serbo-Macedonian massif)

Pl-Spl корони около кианит – доказателство за високотемпературен (гранулитов фациес) метаморфизъм в метапелитите от западния склон на Пирин (Сръбско-Македонски масив)

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Introduction

The metamorphic rocks from the western slope of the Pirin Mountain are traditionally interpreted as a part of the metamorphic rocks from the Rhodope massif and they were considered as high grade metamorphic rocks of Precambrian age subdivided into lithostratigraphic units identical with these from the Central Rhodopes (Zagorchev, Dinkova, 1991, etc.). The high grade metamorphic rocks from the western side of the Strymon valley are assigned either to the Serbo-Macedonian Massif (Kockel, Walther, 1965; Bonchev, 1971, etc.), or to the Rhodope massif (Ograzden Supergroup, Zagorchev, Dinkova, 1991). The massifs are separated by a brittle low-angle southwest dipping thrust fault, called the "Strimonüberschiebung" (Kockel, Walther, 1965). A recent geological mapping has established that the "Strimonüberschiebung" is not a thrust, but a major Neogene low-angle normal fault, called the Strymon Valley detachment fault. It accommodates the unroofing of the Rhodope core complex and eventually its exposure between the "Strymon and Nestos rivers" (Dinter, Royden, 1993; Burg et al., 1996; Ivanov, 1998, unpublished). According to this concept, the rocks of the Serbo-Macedonian massif build up the hanging wall of the fault. They were separated as Upper terrain by Burg et al. (1996). Ivanov (1998, unpublished) and Machev et al. (2005) presented evidences that parts from the hanging wall of Strymon detachment (HWMR) cover the metamorphic rocks on the western slope of the Pirin Mountain (PMMR). The aim of this study is to describe the equilibrium mineral assemblages in the metapelites from the hanging wall and to reconstruct its P-T evolution.

Petrology

The rocks crop out in the valley of Sandanska Bistritza River, eastern of Sandanski Town. Together with different type of gneisses, rare marble layers and lenses of ultramafic rocks they present the host rocks of large metagabbro bodies (Machev, Veit, 2001). Three equilibrium assemblages can be distinguished in these metapelites – I – garnet (Grt) + staurolite (St)(?) + kyanite (Ky) + quartz (Qtz), II – spinel (Spl) + plagioclase (Pl) + sillimanite (Sil) + Qtz + orthopyroxene (Opx) and III – biotite (Bt) + white mica (muscovite; Ms) + andalusite (And) + chlorite (Chl) + Qtz. All minerals from the first assemblage are partly resorbed and replaced by "secondary" minerals: the coarse Grt porphyroblasts – mainly by Bt or by Chl + white mica (sericite) aggregates; Ky – by undistinguishable under polarized microscope fine-grain aggregates and St – by sericite. Typical for the rocks are biotite + fibrolite intergrowths and fibrolite formation around the And porphyroblasts. These fabrics are observed only in strongly deformed parts of metapelites.

The "big" Grt porphyroblasts (>0.5 mm) have typical high-temperature plateau-like type of zoning with rapid increasing of Mn and Fe and decreasing of Mg content in the rim area. In opposite, the fine (<0.2 mm) Grt porphyroblasts have typical retrograde type of zoning (Fe and Mn increase from core to rim and Mg decrease in this direction). We interpret this fact as typical diffusion, retrograde zoning. It is well known (Spear, 1993) that diffusion by cooling and exhumation of rocks could affect and change the garnet composition in very narrow zones.

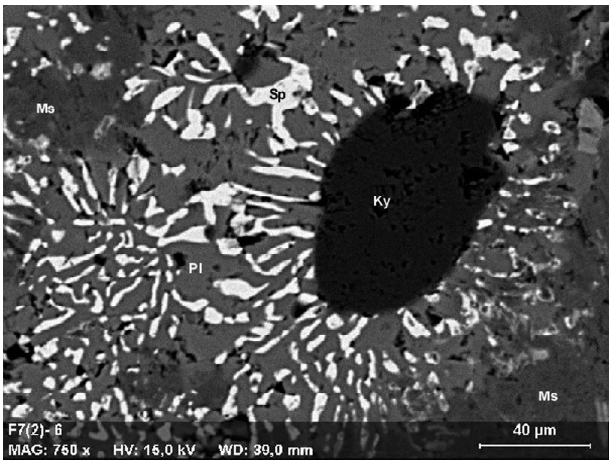

Fig. 1. Plagioclase (Pl)-Spinel (Spl) symplektites around kyanite (Ky) porphyrobalst

The goal of the study is the detailed investigation of the coronas around the Ky porphyroblasts and determination of the P-T conditions of their formation. They present symplectitic intergrowths of Spl (hercynite), basic plagioclase (An_{92-96}) and minor Sil (Fig. 1). In addition the symplectites are surrounded by later white mica (Ms). The assemblage Spl + Qtz in basic plagioclase set is produced by Grt-Ky breakdown (Grt + Ky = Spl + Qtz, indicating temperature >850° C; Bucher, Frey, 2002) and is typical for HT or HP-HT granulites (O'Brien, Rötzler, 2003). By nearly isothermal decompression under "dry" conditions an Opx appears as a product of reactions at pressures lower than the peak record. The most probably Opx producing reaction is Grt + Qtz = Opx + Pl. The exhumation under wet conditions causes replacement of dry assemblage by biotite, muscovite and chlorite and finished in the andalusite field. Up to now is not yet clearly determine the spatial and temporal relation between HT (granulite facies) metamorphism and the retrograde amphibolite-green schist facies changes – i.e. the investigated rocks are polymetamorphic or polyfacial.

Conclusion

It is very difficult to determine the P-T conditions of the metamorphism of the investigated metapelites; because the conventional geothermo-barometers are inapplicable (most minerals are in disequilibrium). Therefore, we used the X_{Fe} isopleths on the P-T grid of Spear (1993) (only data from the core composition of "big" garnets were utilized). The estimated P-T values (650° C and 13–15 kb in the stability field of St) are the lowest for the formation of the first equilibrium assemblage. Prior to the metamorphism of PMMR, the HWMR were thrusted over the Pirin Mountain during the collisional stage of evolution of the Rhodope massif, i. e. they were earlier metamorphosed. It is possible that the prograde Alpine metamorphism of the underlying rocks was retrograde for the HWMR. It caused retrograde replacement of the minerals from the first two equilibrium assemblages and retrograde diffusion zoning in the small garnets. Because the HWMR overlie the PMMR, the pressure of the retrograde metamorphism was lower (in the stability field of andalusite). If this assumption is true then the HWMR may be interpreted as polymetamorphic units.

The obtained results show that parts of the rocks east of the town of Sandanski have not been a part of the Rhodope massif. They have undergone different P-T evolution and we agree with the opinion of Ivanov, (1998, unpublished), that the rocks from the hanging wall of the Strymon detachment fault (Serbo-Macedonian massif or Upper terrain after Burg et al., 1996) are part from the Sredna Gora metamorphic rocks (Paleozoic age of main metamorphism and Alpine overprint).

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