Retrograde changes in metapelites from Sredna Gora Mt

Ретроградни изменения в метапелити от Средна гора

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Introduction

The metamorphic rocks from the Sredna Gora Mt have not been a subject of strong interest from the geologists. A few publications are aimed on studying the metaeclogites or granites from this area (Dimitrova, Belmustakova, 1982a, b; Mukasa et al., 2003; Velichkova et al., 2004; Peycheva, von Quadt, 2004; Carrigan et al., 2003, 2006; Gagerro et al., 2009). From these investigations is clear that the age of the protoliths of the rocks is either Neoproterozoic (616.9–595 Ma) or Ordovician (480±50 Ma) to Silurian–Devonian (406±40 Ma) (Arnaudov et al., 1989) and subsequently, they underwent a high-grade metamorphism during Late Variscan time (336.5±5.4 Ma) (Carrigan et al., 2006). The last data are in contradiction with the data for the time (398±5.2 Ma) of amphibolite facies overprint of the eclogites in the Sredna Gora area, obtained by Gaggero et al. (2009). Furthermore, relatively younger ages were obtained by Velichkova et al. (2004) using $^{40}Ar/^{39}Ar$ method (305–316 Ma). Shortly after the peak of the HT metamorphism the rocks were intruded by large granitic batholiths with nearly similar age (307–295 Ma – Carrigan et al., 2003; 305 Ma for Lesitchovo granite and 305 Ma for Medet gabbro – Peycheva, von Quadt, 2004). Regardless of existing petrological investigations, the most informative rocks (metapelites) remain beside of scope of interest of the researchers. The aim of this study is to present stages of the retrograde changes following the HP-HT metamorphism of these rocks.

Petrology

The investigated rocks crop out in the area of the "Nadezhda" mountain hut and they are part of variegated formation including migmatitic gneisses with lenses of metaeclogites and metaultramaphic rocks. Because of the high vegetation the exposures of metapelites are rare but they are adjacent with the metaeclogites. The contacts between both rock types were not observed.

The metapelites are represented by foliated two mica schists. Among them occur thin "layers" of strongly foliated rocks enriched in white mica and chlorite. The rock forming minerals are: garnet, kyanite, sillimanite, staurolite, chloritoid, chlorite, biotite, plagioclase, muscovite, plagioclase ($An_{18–22}$), epidote, rutile, apatite, zircon, tourmaline, and magnetite. They are in complicated phase relationship, i.e they were built on different stages of metamorphism at different P-T conditions.

Since the metapelites crop out nearby to the metaeclogites we can expect that they have undergone HP metamorphism, too. The relics from this event (I stage) are kyanite, garnet and rutile

Garnet occurs as small porphyroblasts and partly is replaced by chlorite. It shows typically retrogressive zonation.

Kyanite relics are rare. Commonly, it is completely replaced by sillimanite or sericite. Rutile is observed as small xenoblastic grains. The P-T conditions according to the equilibrium assemblage in the eclogites are 16–20 kbar and 650–690 °C (Machev et al., 2006).

Since the adjacent eclogites have undergone a short lived granulite facies overprint (Machev, unpublished data) we assume that the formation of sillimanite (fibrolite) replacing kyanite was a result from this event. In addition to this case sillimanite forms separate strongly elongated needle shaped crystals between the quartz grains (II stage).

Both stages have taken place under dry conditions, i.e. they were fluid absent.

The next stage (stage III) is related to the exhumation of the metapelites and metamorphism in presence of fluid phase. This circumstance has caused a formation of the micas (white mica and biotite) which form the foliation of the rocks. Both minerals are observed as relatively big flakes, in some cases perpendicular to the foliation planes. The white mica is pure muscovite (Si=3.00–3.06 a.p.f.u.) and the biotite has phlogopite-annite composition (X_{Fe}=0.50–0.60).

The P-T conditions of stage III of metamorphism are in the range 600–620 °C at 6 kbar using Bt-Ms thermometer which are in good agreement with these obtained for the amphibolitization stage in the eclogites (620–650 °C and 5–8 kbar).

During continued temperature decreasing the mineral exchanges were concentrated in the narrow zones in presence of large volume of fluid phase (mainly water). These changes are manifested by sericitization of kyanite and sillimanite, replacement of the biotite and garnet by chlorite and epidote formation in CaO enriched metapelites.

We assume that these three stages were genetically connected with the main metamorphic event during Carboniferous time.

The next metamorphic changes in the metapelites from Sredna Gora (stage IV) had been occurred after this event. They caused formation of chloritoid and staurolite. Both minerals grew under static conditions without any preferred orientation on their elongated grains and they are observed only in the sericite and fibrolite "mass" like "sticked" on it. We assume that this event has a thermal character under lithostatic pressure without any strain. This thermal overprint (147–153 Ma, Velichkova et al., 2004) can be consistent with thermal events of the same age in the Sakar zone.

Conclusions

The determined separate stages of metamorphic evolution of metapelites from Sredna Gora Mt demonstrate their complicated polymetamorphic history. The first three stages can be uniting in one polyfacies event, whereas the last stage is discrete, detached in the time. This peculiarity makes these rocks very attractive object for geological investigations and they can give answers of many questions related to the evolution of the Variscan orogeny in Bulgaria.

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