HIGH-STRAIN GREENSCHIST BELT ALONG THE MARGINS OF THE CENTRAL RHODOPES

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Traditionally the Rhodopes are regarded as an area occupied by high-grade metamorphic rocks, and only along the eastern and western margin low-grade rocks are well-known (Circum-Rhodopian belt – Kockel et al. 1972). Along the northern margin of the Central Rhodopes low-grade rocks or low-grade reworked units containing abundant ultramafic bodies and metagabro are widespread (fig. 1). These rocks constitute part of a dismembered ophiolite complex. The presence of the low-grade rocks was reported by the first investigators, but the extent of the low-grade units and their position is controversial and in most cases they are not commented in large-scale tectonic models. In the present contribution an overview of these low-grade rock units is made, new field data are reported and the position of these rocks in the frame of the Rhodopian zone is discussed.

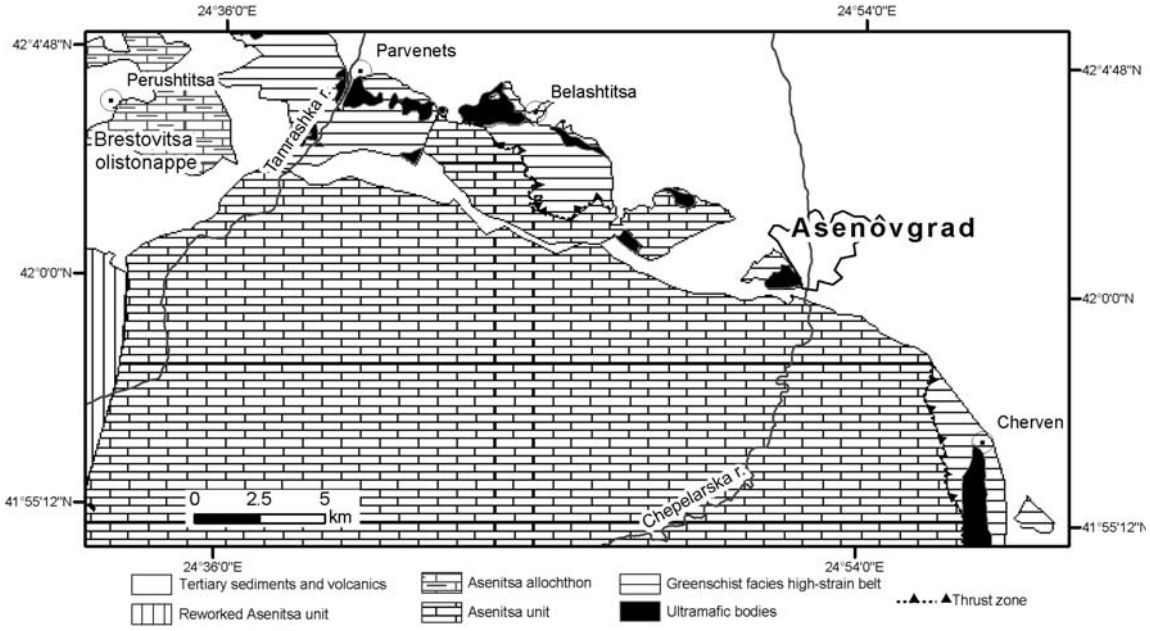

Fig. 1. Tectonic sketch of the Northern part of the Central Rhodopes (after Kozhouharov et al. 1995, Moskovski, 2002).

According to previous researchers three complexes displaying low-grade fabric could be distinguished along the northern margin of the Central Rhodopes:

(1) The uppermost part of the metamorphic section that builds the Northern Rhodopian anticline. These rocks were described as lower grade by Dimitrov (1959), Ivanov et al. (1979). Kozukharova & Ichev (1989) and Zagorchev (1994) suggested that low-grade assemblages are result of superposition of Alpine metamorphism on Precambrian metamorphics. On top of this section is the Belashtitsa Formation (Boyanov & Kozukharov, 1961; Kozukharov, 1984) that is characterized with greenschist facies mineral assemblages (Kozukharova & Kozukharov, 1962).

(2) The Parvenets complex (Ivanov et al. 1984). Several features are specific for this complex: (a) Abundance of variously deformed pegmatitic veins. Kozukharova & Kozukharov (1962) regard them as a result of Paleozoic magmatism into Precambrian basement. (b) Intensive greenschist facies reworking. This key feature of Parvenets complex was for the first time documented by Ivanov et al. (1984). According to Kozukharov et al. (1992) the low-grade reworking is a result of movements along the Maritsa fault zone. (c) Abundance of ultramafic rocks and amphibolites. Ivanov et al. (1984) included all ultramafic rocks from the Northern slopes of the Central Rhodopes into the Parvents complex.

(3) Phyllitoid complex. With this name a rock assemblage that includes limestones, marls, siltstones and various magmatic rocks is designated. The first and only detailed description of these rocks was made by Ivanov & Todorova (1962). Some authors assume Pre-Cretaceous age for these rocks and compare them with the metamorphics from Sakar unit (Ivanov et al. 1979; Moskovski & Ivanov, 1986). According to

Kozukharov et al. (1992) the magmatic rocks from this complex are devoid of metamorphic alterations and belong to the Upper Cretaceous magmatic complex.

On the basis of field and microstructural data, a new interpretation of the structure of the Northern margin of the Rhodopes is emerging. The new data concern mainly the constituent rock types of the rocks complexes, the relations between the rock types, the spatial distribution of the rock complexes and the synmetamorphic fabric.

Along the entire northern and northeastern margin of the Central Rhodopes a large number of ultramafic bodies are cropping out. Contrasting interpretations about their relations with the host rocks were proposed: the ultramafic rocks are a result of magma emplacement into the metamorphic basement (Ivanov & Zagorchev, 1961; Trashliev & Stanisheva, 1963), forming bodies conformable to the foliation in the host rocks (Ivanov et al. 1984) or representing fault-bounded tectonic blocks (Kozhoukharova, 1984). Field data from the Parvenets complex (SW of the village of Parvents and along the Bardashka river) support the interpretation of Ivanov et al. (1984). In these localities ultramafics form lens-like bodies that display low-grade foliation parallel to the mylonitic foliation in the host gneisses and orhtoamphibolites. However, this type of relations is not restricted to the occurrences of the gneisses from Parvents complex between the villages of Markovo and Brestovitsa.

The large ultramafic body from the vicinities of the villages of Cherven and Gornoslav displays similar contact relations with the rocks from the Belashtitsa Formation. In a number of places inside the ultramafic body, a foliation steeply dipping to the east is observed. This foliation is conformable to the contacts of the body, as well as to the foliation in the host rocks. Immediately below the ultramafic body, a thin sliver consisting of mylonitic orhtoamphibolites and biotite gneisses is observed. The orientation of the foliation in these rocks is parallel to the foliation in the underlaying schists and marbles from Belashtitsa Formation. Similar conformable relations between the ultramafic rocks, thin slivers of biotite gneisses, amphibolites and weakly metamorphosed sediments and volcanics have been observed west from the village of Belashtitsa. All these field data indicate that: (1) at least during the final stages of the synmetamorphic evolution these rocks were part of the same unit; and (2) the distribution of the Parvenets-type gneisses and orhtoamphibolites is not restricted to the area between the villages of Markovo and Brestovitsa, but these rock types are common along the contacts of the ultramafic bodies (a feature mentioned by Ivanov et al. (1979) but not commented later). The mylonitic augen schists that crop out SW from the village of Dolnoslav are also probably part of the Parvenets complex.

Another set of observations, concerning constituent lithologies and synmetamorphic fabric, allow to better constrain the relations between these rock complexes: (1) In the WNW periphery of the village of Hrabrino, Ivanov (1989) described thrusting of Parvenets complex over marbles and calc-silicates. Field relations in this area are more consistent with interpreting these metasediments as a part of the Parvenets complex. Moskovski (2002) also reported the presence of marbles and calc-silicates in the Parvenets complex. It is worth noting that the Parvenets complex is covered by Tertiary sediments in this area and no direct relations with the marbles from Brestovitsa olistonappe (Moskovski, 2002) could be observed. (2) Orthoamphibolites are widespread in the Parvenets complex (Ivanov et al. 1984; Ichev & Pristavova, 2004). A great number of them represent highly reworked gabbros. In the uppermost part of the Belashtitsa Formation (e.g. SW from the village of Brestnik) an abundance of metabasic rocks, including coarse-grained recrystallized gabbros is also observed. (3) Our data also show that metamorphism in Belashtitsa Formation has not surpassed garnet grade and on an outcrop-scale the synmetamorphic fabric is characterized with single, often mylonitic foliation or more often S/L fabric. In the area of Belashtitsa and Brestnik, the lineation plunges gently to NW or SE and is defined by aligned micas, actinolite and stretched quartz aggregates. Shear-sense criteria indicate top-to-the NW shear deformation. On the contrary, the gneisses from the Parvenets complex display obvious evidence for more complicated structural and deformational history. At least two successive metamorphic events could be distinguished in Parvenets complex: (a) a high-grade amphibolite facies event during which these rocks were partially melted; (b) a retrograde greenschist facies event that strongly affected a great part of this unit. The retrograde reworking is associated with intensive mylonitization, but in a number of places low-strain domains allow to study the precursor high-grade fabric. The mylonitic lineation, defined by alignment of micas and stretched quartz, is almost horizontal and strikes NW-SE. In the well-exposed sections SW of Parvenets and along the Bardashka river, porphyroclast systems and shear bands indicate a consistent top-to-the NW shear sense during greenschist facies metamorphism.

On the basis of: (1) close spatial occurrences, (2) similar orientation of lineation and same shear sense; (3) lack of structural breaks; (4) abundance of metabasic and ultramafic rocks; (5) low-grade metamorphic reworking it could be suggested that the Parvenets complex and Belashtitsa Formation are representing single tectonic unit situated on top of the Rhodopian metamorphic rocks. Two models could be proposed to explain the initial high-grade metamorphism in the Parvenets complex: (1) Parvenets complex is a slice of the pre-Alpine basement of the Balkanides (as Ivanov (1989) suggested); (2) Parvenets complex is a highly reworked metamorphic sole of a dismembered ophiolite complex. In any case, the position of these rocks over Dobrostan carbonate platform (about 1 500 m thick) undoubtedly indicate compressional tectonics that at some places has been reworked during the formation of the Tertiary basins and the contemporary relief.

Most probably the Phyllitoid complex is also part of this greenschist belt along the northern rim of the Central Rhodopes. At this moment this is the most enigmatic rock complex, but it is clear that these rocks are also metamorphosed at low grade. The Pyllitoid complex represents a complicated mixture of metasedimentary-metavolcanic rocks highly reminiscent of mйlange complex. These rocks also display rather complicated and perhaps interfingering relations with the metamorphics from Belashtitsa Formation in the area

SW of Brestnik.

At the scale of the Rhodopian zone, the described low-grade high-strain belt could include part of the Kardzali unit (Sarov et al. 2004), low-grade mylonites hosting ultramafic lenses and eclogites from the Drangovo horst, as well as similar rocks from the vicinities of the villages of Satre and Temenos (Northern Greece). Similarly to the northern margin of the Central Rhodopes these metamorphic tectonites most often display NW-SE trending lineation and the mylonitic fabric indicates top-to-the NW shear sense (cf. Burg et al. 1996). If an Early Alpine age of the synmetamorphic fabric is assumed (Ivanov, 1989; Burg et al. 1996) the vergency of the Early Alpine orogeny in the internal part of the Balkanides has to be re-evaluated.

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