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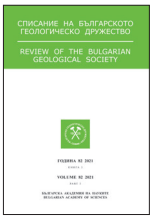

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Eclogite-like rocks from Southern Pirin Mountains – preliminary results about petrology and time of formation

Еклогитоподобни скали от Южен Пирин – предварителни резултати за петрологията и времето на образуването им

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Abstract. North-northeast of the village of Ilinden (Southern Pirin Mts) three eclogite boudins were separated on the geological map in scale 1:50 000 (Sarov, 2010). The rocks belong to the Slasten lithotectonic unit. The mineral assemblage and mineral chemistry do not allow these rocks to be classified as eclogites. They can be considered as eclogite-like ones, formed by postmagmatic-metasomatic alteration of the host rocks. Based on LA-ICP-MS sphene U-Pb dating, eclogite-like rocks yield a Late Jurassic age (160±19 Ma).

Keywords: eclogite-like rocks, South Pirin Mts, sphene.

Geological setting

The eclogites carry important information about the reconstruction of the P-T path of high-grade metamorphic rocks. Very often equilibrium mineral assemblages in eclogites are the only source keeping information about peak pressure conditions of metamorphism of rock units.

During the geological mapping of Bulgaria in scale 1:50 000, in the vicinity of the village of Ilinden (Southern Pirin Mts) three eclogitic bodies were separated (Sarov, 2010). Their host rocks belong to the Slashten lithotectonic unit, which is situated between the underlying lower metamorphic Mesta unit and the upperlying Sarnitsa lithotectonic unit, bounded by the syn-metamorphic thrusts of the Mesta and Dolen shear zones, respectively. The exposures of the rocks of the Slashten lithotectonic unit are observed in two strips. The northern stripe traces at the villages of Satovcha, Pletena, Oreshe, Krushevo, and Dabnitsa, while the southern one, in which the described eclogite bodies are situated, reveals in the Mesta River Valley, south of the villages of Koprivlen, Petrelik, Beslen, Teplen, and Ilinden. At the base of the unit, bodies of serpentinized ultrabasites, metagabbros and eclogites are presented, included among kyanite- and garnet-bearing two-mica schists. Upwards in the section, follow biotite gneiss-schists, marbles, and calcschists, as well as migmatized para- and orthogneisses, hosting bodies of orthoamphibolites (metagabbros), etc.

Petrology

The discovered by the geological mapping (Sarov, 2010) eclogite bodies crop out within the southern strip of the unit and form elongated in S-N direction small lenses (up to several meters), parallel to the foliation of the country rocks. The latter are represented mainly by strongly elongated bands of foliated amphibolites probably of an ortho-origin (metagabbros) hosted in turn within biotite gneisses, gneiss-schists and marbles. Equilibrium mineral assemblage of amphibolites is pre-

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sented by green amphibole+plagioclase+epidote+quartz+sphene. This allows us to classify these rocks as epidote-bearing amphibolites formed under low temperature amphibolite facies conditions.

Our petrological investigations show that the rocks described as eclogites show some features which do not allow considering them as classical eclogites formed under HP metamorphic conditions. They are similar in mineral composition to the defined by Dobretsov et al. (2020) "eclogite-like rocks", for which it is thought to be formed under P-T conditions typical for amphibolite facies with influence of postmagmatic fluids. The main differences between both rock types (eclogites and eclogite-like rocks) are the compositions of garnet and pyroxene – omphacite+garnet (Alm-Pyr) in eclogites and diopside+garnet (Alm-Gross) in eclogite-like rocks, respectively.

The studied eclogite-like rocks are coarse-grained with massive structure and without any internal foliation. They are built up of garnet (>70%), pyroxene, sphene, plagioclase, quartz, calcite, and epidote. Garnet is brown in color and forms large porphyroblasts up to 5 cm in diameter, containing numerous inclusions of quartz, epidote, and sphene. The composition of garnet is unusual for eclogites and varies in a narrow range – Alm 11.66–17.45%; And 7.67–9.41%; Gross 73.52–81.13%; Pyr 0.57–1.46%), i.e. it refers to the almandine-grossular type and differs significantly from the typical skarn garnets that are grossular-andradite in composition and from the eclogite garnets that are pyrope-rich. The REE distribution pattern in garnet is characterized by a strong Ce depletion, rapid increasing of LREE up to Sm and plateau-like distribution of the HREE.

Pyroxene and epidote are observed as single grains between garnet porphyroblasts or form small lens-like accumulations. The oP-Tical properties of pyroxene (color, extinction angle, character of pleochroism, etc.) allow classifying this mineral as diopside.

Sphene forms large idiomorphic grains probably of magmatic origin. There is no evidence for replacement nature of sphene at the expense of rutile. The REE distribution in mineral shows bell-shape pattern from La to Eu and smoothly depletion of the HREE to Lu.

Studied eclogite-like rocks show variations of SiO_2 content in a narrow range (44–45%) and K_2O+Na_2O=1.0–1.3 %. On the TAS diagram (after Le Maitre, 2002) these rocks plot in the field of picrobasalts. According to the proposed by Dobretsov et al. (2020) mechanism for the formation of eclogite-like rocks, we can assume that the primary chemical composition was changed during their formation.

Discussion and conclusions

The established mineral association in studied rocks – almandine-grossular garnet+diopside is similar to those described by Dobretsov et al. (2020) in metagabbros from Olkhon terrain, West Baikal area, for which formation by postmagmatic-metasomatic alteration of basic rocks with participation of neighboring carbonate material is supposed. We propose such a mechanism of formation for the eclogite-like rocks from Southern Pirin Mts soon after their crystallization. The main factor of transformation should be postmagmatic fluid enriched in CaO probably under influence of the carbonate rocks, cropping spatially close to the amphibolite bands in the area. The subsequent metamorphism has turned the gabbro into strongly foliated amphibolites (am phibole+plagioclase+quartz+sphene) and the metasomatically altered parts as rheological stronger rocks were preserved as boudins.

The P-T conditions of metamorphism of the rocks from the southern part of the Slashten unit obtained by Cherneva et al. (2011) are in the range 691–724 °C and 7.4–8.6 kbar, conditions rather high temperature then the equilibrium assemblage in the amphibolites (epidote-bearing), enclosing eclogite-like rocks.

To determine the time of formation of the eclogite-like rocks we focus on U-Pb dating on garnet and sphene. Unfortunately, garnets are uranium poor and thus useless for this purpose. LA-ICP-MS analyses of sphene yield a Late Jurassic age of 160±19 Ma (Fig. 1). Indeed, these results are in good agreement with a number of previous data produced from both northern and southern stripe of the Slashten Unit: 158.1±3.0 Ma zircon U-Pb age for orthoamphibolites of the Satovcha metaophiolite fragment near the village of Pletena (Marinova, Stankova, 2012)

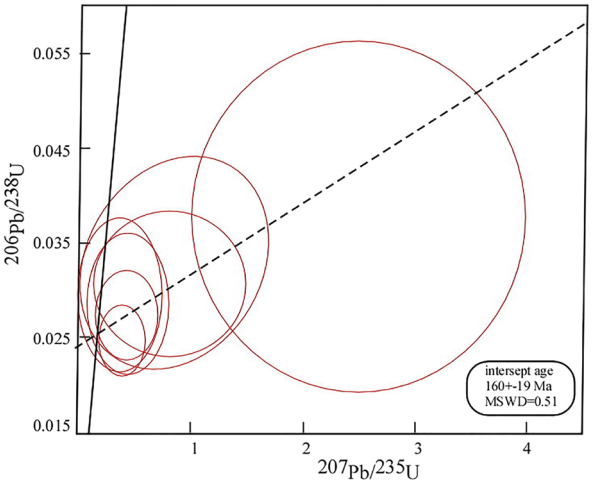

Fig. 1. Concordia diagram of U-Pb LA-ICP-MS sphene analyses of the eclogite-like rock

and 160±1 Ma for plagiogranites and metabasites from the same locality (Froitzheim et al., 2014). These results confirm the widespread manifestation of Jurassic magmatic and metasomatic events in the upper lithotectonic units of the Rhodope metamorphic terrain. Cherneva et al. (2011) dated leucosome zircons and zircon rims in gneisses from the Slashten unit in the range 74.1±3.9–65.6±5.7 Ma, i.e. relatively older compared to data for the same event in the Eastern and Central Rhodope lithotectonic units. Based on the ages obtained from zircon rims 147–165 Ma von Quadt et al. (2008) consider this age as time of migmatization of the rocks from the Slashten unit. To shed more light on all mentioned discrepancies concerning metamorphic conditions and the age of metamorphic events additional more precise investigations are necessary.

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