Late Jurassic metamorphism of high-grade metamorphic rocks from Krumovitza/Kimi unit, East Rhodope, Bulgaria – SHRIMP U-Pb dating of zircons

Късноюрски метаморфизъм на високостепенни метаморфити от единицата Крумовица/Кими, Източни Родопи, България – SHRIMP U-Pb датиране на циркони

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Introduction and geological setting

The Alpine evolution of the Rhodope region includes at least 4 magmatic and metamorphic evens (see Liati et al., 2011). Perraki et al. (2006) first described UHP metamorphism in the Rhodope massif, based on the study of metapelites from the Variegated metamorphic complex, known as Krumovitza or Kimi unit, and opened the question about its time and duration. The geochronological and petrological data for metamorphic rocks in the Greek Rhodope related the UHP event and granulite facies overprint to Mesozoic time (Bauer et al., 2007; Liati et al., 2011; Wawrzenitz, Mposkos, 1997). Evidence for Mesozoic HP/HT metamorphic event was reported for the Central Rhodope metamorphic rocks (Cherneva et al., 2014; Didier et al., 2014 and references therein), however a few data are available yet for the Bulgarian part of the Eastern Rhodope massif.

Analytical methods

U-Pb SHRIMP analyses and CL images of separated zircons from metapelite and retrogressed eclogite were performed at IBERSIMS laboratory, University of Granada, Spain. The spot’s diameter was 20 μm with Temora standard.

Petrography

The samples studied are two-mica garnet-bearing metapelite and retrogressed eclogite, collected near Devesilovo and Avren villages. In metapelite, the garnet porphyroblasts are fractured and biotitized, often fragmented. Big muscovite flakes form the matrix foliation and partly replace the biotite. Dispersed plagioclase and quartz grains occur in the matrix also. Thick quartz bands with included and foliated minerals from the matrix are common. Accessories are presented by abundant zircon, and big rutiles replaced by opaques and some monazite grains. Retrogressed eclogite is mainly composed of amphibole, associated with smaller rounded and irregularly shaped garnets with abundant inclusions. Plagioclase and quartz form small pockets or symplectite-like intergrows with amphibole. Epidote grains are elongated and associate with plagioclase, quartz, and scarce chloritized biotite. The main accessory minerals are abundant rutile and zircon, opaques, and apatite.

Geochronological data

The separated zircons (>115 μm) in metapelite sample are abundant, transparent, with rounded or multifaceted shape (Fig. 1a). On CL images they display sector zoning, typical for granulite facies (Harley et al., 2007) or UHP metamorphism (Rubatto, Hermann, 2007). Small (rarely bigger than 20 μm), dark or light cores with square or irregular outlines take up about 25% of the grains. A few zircons have well developed darker rim. For this sample 29 analyses in 16 zircon grains were performed, with 18 ages of discordance <10%. The inherited cores have discordant ages that spread from 179 to 386 Ma (Fig. 1b) and up to 1469 Ma. Wide metamorphic zones with sector pattern on CL images yield ages from 153.7 to 158.4 Ma (Fig. 1b), having an average value of 155.57±0.71 Ma. Single analysis in darker outer rim shows the same age (155.5 Ma). Th/U ratio varies significantly from 0.00 to 0.59 for the last group of zircons, due to higher variation of Th content.

In retrogressed eclogite, the separated zircons (63–125 μm) have rounded short-prismatic or irregular shape (Fig. 1c). On CL images they do not display zon-

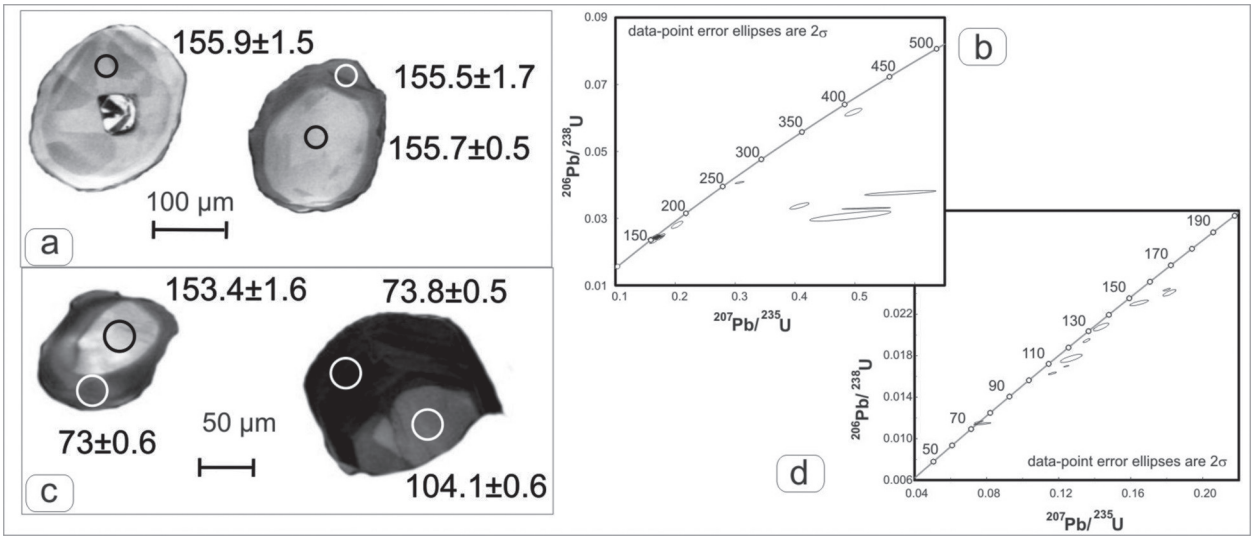

Fig. 1. *a*, CL images of zircons from metapelite sample with analytical points and calculated age; *b*, U-Pb concordia diagram for metapelite; *c*, CL images of zircons from retrogressed eclogite with analytical points and calculated age; *d*, U-Pb concordia diagram for eclogite for metamorphic ages discussed in the text

ing or older cores, but more grains have outer darker rim (up to 40 μm thick) (Fig. 1c). Many zircons have rather big mineral inclusions of probably rock-forming and accessory minerals. The results of 20 analyses in 11 zircons from the retrogressed eclogite yield 10 concordant ages only (Fig. 1d). They cluster in three groups: 147–155 Ma for the lighter central parts on CL images (in accordance with the age of the metapelite sample); 104–132 Ma for the grey or darker parts/rims and younger ages 73.0 to 74.6 Ma, for the darker outer rim. The latter has very low Th/U ratio 0.01–0.02, compared to the first two groups (0.10–0.20), and this implies growth at different conditions or crystallization during late metamorphic event. Results of discordant ages (114–207 Ma) in eclogite and a few discordant ages in metapelite sample show intensive Th loss.

Discussion

Geodynamic interpretations of geochronological data in the Rhodope massif include several successive metamorphic events and overprints, as well as isolated magmatism. Both of the samples studied herein have petrographic features of retrogression, but surprisingly only one dominant metamorphic age in the metapelite (155 Ma) was detected, and it should be related to the UHP/HT event in the area, although more petrographic data are needed to support that assumption. Three groups of ages in retrogressed eclogite record a Late Jurassic metamorphism, continuous Cretaceous thermo-metamorphic event, and distinct amphibolite facies metamorphism at ~73 Ma, as discussed by Bauer et al. (2007) and Liati et al. (2011). The contribution of this study to the geodynamic interpretations for Krumovitza/Kimi unit is providing the precise age of the Jurassic metamorphism and the evidences of its intensity, confirming the geochronological data already published for the area.

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