Two contrasting U-Pb zircon age determinations of metamorphic rocks in the western part of the Rhodope metamorphic complex

Две контрастиращи U-Pb възрасти на цирконии в метаморфни скали от западната част на Родопския метаморфен комплекс

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Introduction

The Rhodope metamorphic complex was long time considered Precambrian because of interpretations originated in the pre-plate tectonics concepts (Kozhoukharov, 1984, and many others). When results of U-Pb zircon and other precise dating of metamorphic and magmatic rocks of the Rhodope metamorphic complex were obtained, they confirmed the Alpine tectonic and metamorphic overprint on rocks of mainly Mesozoic and Paleozoic to Neoproterozoic protolithic age. By now there are still many questions about age relationships between the different metamorphic units there. Their protoliths are likely to be of very different origin that in particularly reflected on the zircon morphology and age of the central and peripheral parts of the crystals. Here we present contrasting U-Pb zircon dating results of two lithological units in the western part of the Rhodope metamorphic complex.

Geological setting

Augen quartz-biotite gneisses were sampled in the vicinity of village Pastra (sample 73-92) and metagranites were taken from Strashnoto ezero in the vicinity of Malyovitsa chalet (sample P-11). The gneisses belong to the Kerdilion unit (Georgiev et al., 2010). The metagranites belong to the Prekorechka lithostratigraphic unit (Dimov, Damianova, 1996).

Analytical techniques

Zircon grains were extracted and concentrated by rock crushing, Wilfley table and heavy liquid treating. Zircon morphology was revealed by cathode luminescence (CL) and backscattered electron imaging at the University of Belgrade on JEOL JMS-6610 LV SEM-EDS. Zircon U-Pb dating was performed by the New Wave excimer laser coupled to ELAN DRC-e ICP MS at the Geological Institute of BAS. Laser ablation analyses were performed on rim (r) and/or core (c) spots of the zircon crystals depending on the zircon internal peculiarities. Analytical error ranges from 1 to 3%. Data-point error ellipses of estimated zircon ages are 68.3% confidence level.

Results and discussion

The zircon crystals of the augen quartz-biotite gneisses display a relative diversity of textures, represented by magmatic oscillatory zoning (grains 7r, 8r1, 8r2, 21r, 24r, 24c) to chaotic textures (5r, 5c). Transitions between these two distinctive textures are available: 1) oscillatory zoning (1c) cut off by area of local re-crystallization (1r) or by chaotic re-crystallization zoning (11r) or by homogenized zoning (12 r); 2) irregular oscillatory zoning (3r, 4r); 3) xenocrystic core with oscillatory zoned mantle (14r); 4) subrounded cores enclosed in oscillatory zoning mantle (29r); 5) obscure core texture with oscillatory zoned mantle (31r); 6) repeatedly grown oscillatory zoning (38r). The oscillatory zoning textures of zircon crystals indicates magmatic origin while metamorphic textures refer to recrystallization at crystal terminations and within crystal interior (Corfu et al., 2003), and suggest overprint under high-grade metamorphic conditions.

The zircon crystals of the metagranites display textures such as: 1) oscillatory zoning core (1c) cut by oscillatory zoning mantle (1r); 2) convolute zoning core with oscillatory zoning mantle (4r, 11r); 3) obscure core texture with oscillatory zoned mantle (6r, 6r/c, 17r). Here the cores probably have undergone significant changes under metamorphism.

Zircon ages of the augen quartz-biotite gneisses taken in the vicinity of village Pastra (Fig. 1A) reveal very wide range of ages: from 539.0 to 287.9 Ma (Lower Cambrian – Lower Permian; International Chronostratigraphic Chart). It is an obvious indication of zircons belonging to protoliths that differ strongly in age. This fact may indicate a sedimentary origin and define the rocks as paragneisses. An alternative interpretation infers magmatic origin of Kimmerian protoliths, which suffered Variscan metamorphism, and

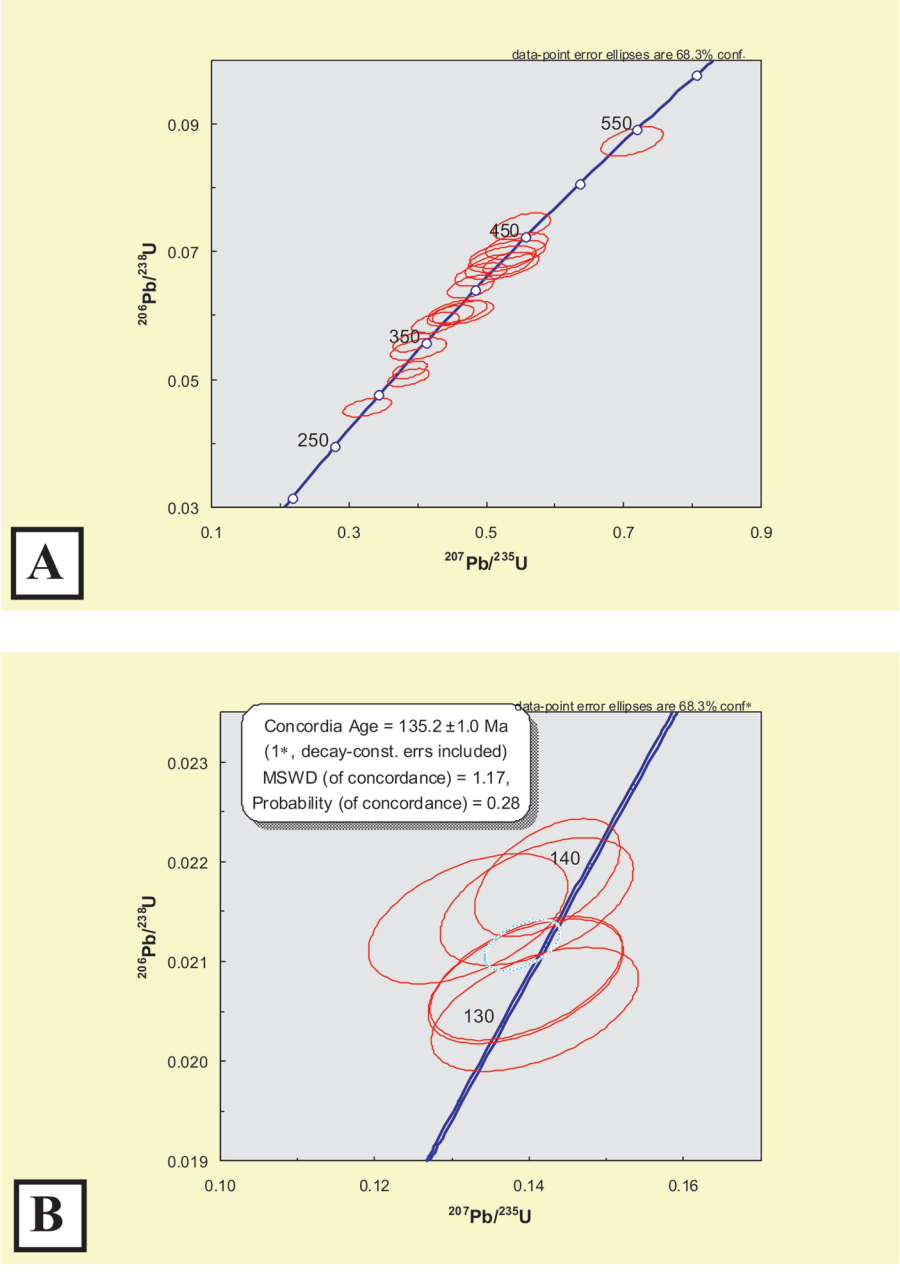

Fig. 1. *A,* Zircon ages of the augen quartz-biotite gneisses of sample 73-92; *B,* Zircon concordia age of the metagranites of sample P-11

then this Variscan basement complex was slightly overprinted by younger (Alpine?) tectono-metamorphic event.

In contrast, the zircons in the metagranites taken in the vicinity of Malyovitsa chalet (Fig. 1B) show a concordia age of 135.2 ± 1.0 Ma defining its Valanginian Stage age of Lower Cretaceous (International Chronostratigraphic Chart) for the granitic protoliths.

References

Corfu, F., J. M. Hanchar, P. W. O. Hoskin, P. Kinny. 2003. Atlas of Zircon Textures. – In: *Zircon. Reviews in Mineral. Geochem*., *53*, 16, 469–500.

Dimov, D., K. Damianova. 1996. Synmetamorphic tectonic units in Northwest Rila. – *Rev. Bulg. Geol. Soc*., *57*, 2, 25–30 (in Bulgarian with English abstract).

Georgiev, N., J. Pleuger, N. Froitzheim, S. Sarov, S. Jahn-Awe, T. J. Nagel. 2010. Separate Eocene-Early Oligocene and Miocene stages of extension and core complex formation in the Western Rhodopes, Mesta Basin, and Pirin Mountains (Bulgaria) – *Tectonophysics*, *487*, 59–84.

International Chronostratigraphic Chart. International Commission on Stratigraphy, August, 2012. http://www.stratigraphy.org/column.php?id=Chart/Time Scale

Kozhoukharov, D. 1984. Lithostratigraphy of the Precambrian metamorphic rocks from Rhodope supergroup in the Central Rhodopes. – *Geologica Balc*., *14*, 1, 43–88 (in Russian with English abstract).