New isotopic data on the Cadomian age of the Frolosh metamorphic complex and the Struma diorite complex

Нови изотопни данни за кадомската възраст на Фролошкия метаморфен комплекс и Струмския диоритов комплекс

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The Ediacaran – Cambrian? (Cadamian) diabase-phyllitoid Frolosh complex (Frolosh Formation – Zagorčev, 1987) consists of metadolerites, green rocks, actinolite-chlorite and chlorite schists, calcareous schists, phyllites and metasandstones. They contain rootless lensoid bodies of metalherzolite and metabasics. The whole complex underwent green-schist-facies metamorphism, and was intruded by gabbroids, diorites and granites (Struma diorite formation – Stefanov, Dimitrov, 1936) of a supposed arc origin (Graf, 2001). Geologically, the age of the Struma diorites is constricted between the greenschist-facies metamorphism of the Frolosh complex, and the covering Permian Skrino Formation that contains pebbles from the Frolosh and Struma rocks.

The Frolosh complex covers with a sharp contact the amphibolite-facies Ograzhdenian complex (variable gneisses and amphibolites with different degree of migmatization). The Ograzhdenian gneisses near the contact are affected by superimposed intense deformations and retrograde greenschist metamorphism (diaphthoresis) (Zagorčev, 1974, 1975). The Frolosh schists contain rootless bodies (inliers) of diaphthorized and refolded Ograzhdenian gneisses concentrated in a band situated at about one kilometer from the contact. The latter is strongly tectonized but bears no traces of striae or other type of lineation. The character of the contact has been subject of different interpretations: Zagorčev (1974, 1975, 1987) argued for a primary depositional unconformity strongly tectonized during consequent folding whereas Bonev et al. (1995) suggested an Alpine low-angle Gabrovodol detachment fault that separated a Mesozoic greenschist-facies (Frolosh) complex from a “Rhodope metamorphic core complex” with Alpine metamorphism of Palaeozoic to Mesozoic protoliths. Haydoutov (1989) and Haydoutov et al. (2010) consider the ultrabasic and basic rocks of the Frolosh complex as oceanic-crust ophiolites included as several huge blocks in the schistose matrix, whereas the Struma diorites belonged to an ensimatic arc.

Although the opinion about a Mesozoic age of both the Frolosh and the Struma complex (Bonev, 1996; Ricou et al., 1998) has not been based on any facts, conclusive evidence about the Cadomian age of the basic rocks affiliated to the Struma diorites has been obtained by the theses of Graf (2001) who quoted a U-Pb zircon age of 557±3.5 Ma for the Razhdavitsa gabbro, and by Kounov (2002) who quoted an age of 569±11 Ma for a coarse-grained Struma diorite. We made a systematic sampling in the type area of the Frolosh and Struma complexes, along the road in the valley of the river Kopriven between the villages of Frolosh and Dragodan. The samples were processed at the laboratories of the University Babeş-Bolyai. The LA-ICP-MS measurements were performed by C. Balica at the LaserChron facility, Department of Geosciences, University of Arizona using an ISOPROBE MC-ICP-MS equipped with a New Wave DUV193 nm Excimer.

The U-Pb study on zircons from the Frolosh and Struma complexes yielded age ranges constricted between 578.6±1.8 and 516.2±2.1 Ma. In some cases the ages show a bimodal repartition, the U-content increasing toward younger ages. In other cases the cores are a little older than the rims. The data con-
firm previous considerations (s. Zagorčev, 1987; Graf, 2001; Kounov, 2002; Haydoutov et al., 2010) about the Cadomian age both of the Frolosh and Struma complexes, and definitely reject conjectural speculations about a Mesozoic age and Tethyan origin. A very important result from our studies is that all four rock types yielded only Cadomian zircons. This implies that the rocks have been formed by non-contaminated juvenile magmas, and that after solidification they have never been in conditions favorable for zircon crystallization. However, some inconsistencies between U-Pb dating on zircons and the geological evidence on the sequence of igneous and metamorphic events are apparent: the oldest dates (552.5±1.5 Ma) were obtained for the geologically youngest K-fs granites and for the basic enclaves (552.3±1.3 – 578.6±1.8) in the diorites whereas the metadolerites of the Frolosh Formation (host rocks for both basic rocks, diorite and granite) yielded the youngest age (516.3±2.1 – 532.1±1.5 Ma) almost identical to that (519.3±1.4) of the postmetamorphic Struma diorite. The reason for such inconsistencies should be further explored.

References


