

Peri-Gondwanan terranes in the pre-Early Palaeozoic basement of the region of Bulgaria

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The structure and evolution of the pre-Alpine basement of Europe have been recently subject of active research. The results of this research clarified many of the features of the peri-Gondwanan elements in this basement. Several advantages characterize the pre-Early Palaeozoic basement in the considered here region compared to that of alpine Europe. Most of these advantages are related to the lesser degree of reworking of the analysed basement during the Variscan and Alpine tectogenesis.

Both terranes treated are the basement of the Balkan terrane (Haydoutov, Yanev, 1997) and the eastern part of the Rhodope Massif.

Balkan terrane

The basement of the Balkan terrane is built up of the Cambrian Bercovitsa island arc. It is composed of two complexes — sedimentary-volcanic (Bercovitsa Group) and intrusive. The igneous rocks of both complexes show ca-alk character. Predominantly greenschist facies metamorphism is overprinted on the rocks of the Bercovitsa Group. Lower Cambrian Arhaecyathus determines the age of this Group. The island arc is built up over the Balkan-Carpathian ophiolite. Complete ophiolite section and features of a typical MORB are characteristic for this ocean crust. Its upper gabbro crystallized in the Late Neoproterozoic — 563 ± 5 Ma (Quadt et al., 1998). The island arc is transgressively and unconformably overlain by slightly metamorphosed Dalgi Dial olistostrome, which forms the lower portion of the Palaeozoic sedimentary sequence in the Balkan

terrane. The Bercovitsa island arc is obducted over the continental terrane Lainici (Kräutner, 1997) during the Lower Ordovician, when Dalgi Dial Group was formed.

East Rhodope

The Rhodopian and Prerhodopian Supergroups in the E. Rhodope are composed of high-grade metamorphics (Kozhoukharov et al., 1992). The Rhodopian Supergroup is formed by the Variegated Formations (VF). They are built up by alternating sediments and mafic igneous rocks, metamorphosed in amphibolite facies. The carried out recently research on the VF from the Avren Synform and the Bela Reka Antiform (Fig. 1) (Haydoutov et al., 2003) indicates that they were formed in the conditions of a primitive island arc. The VF associate with highly dismembered ophiolite bodies of different composition, with traces of HP metamorphism. They usually form the base of the VF (Kozhoukharova, 1996). The sedimentary components of the VF show flysch character. Metamafic volcanics and metagabbro form the igneous components of the Formations. They alternate with the metasediments (in the synform), or intersect the ophiolites (mainly in the antiform). The geochemical features of the igneous components characterise them as boninites or ca-alk magmatites.

The Prerhodopian Supergroup in the E. Rhodope, forming the cores of the Bela Reka and Kesebir Antiforms (Fig. 1), is composed by metagranite, orthogneiss and gneiss-schists (Kozhoukharova et al., 1988; Macheva, Kol-

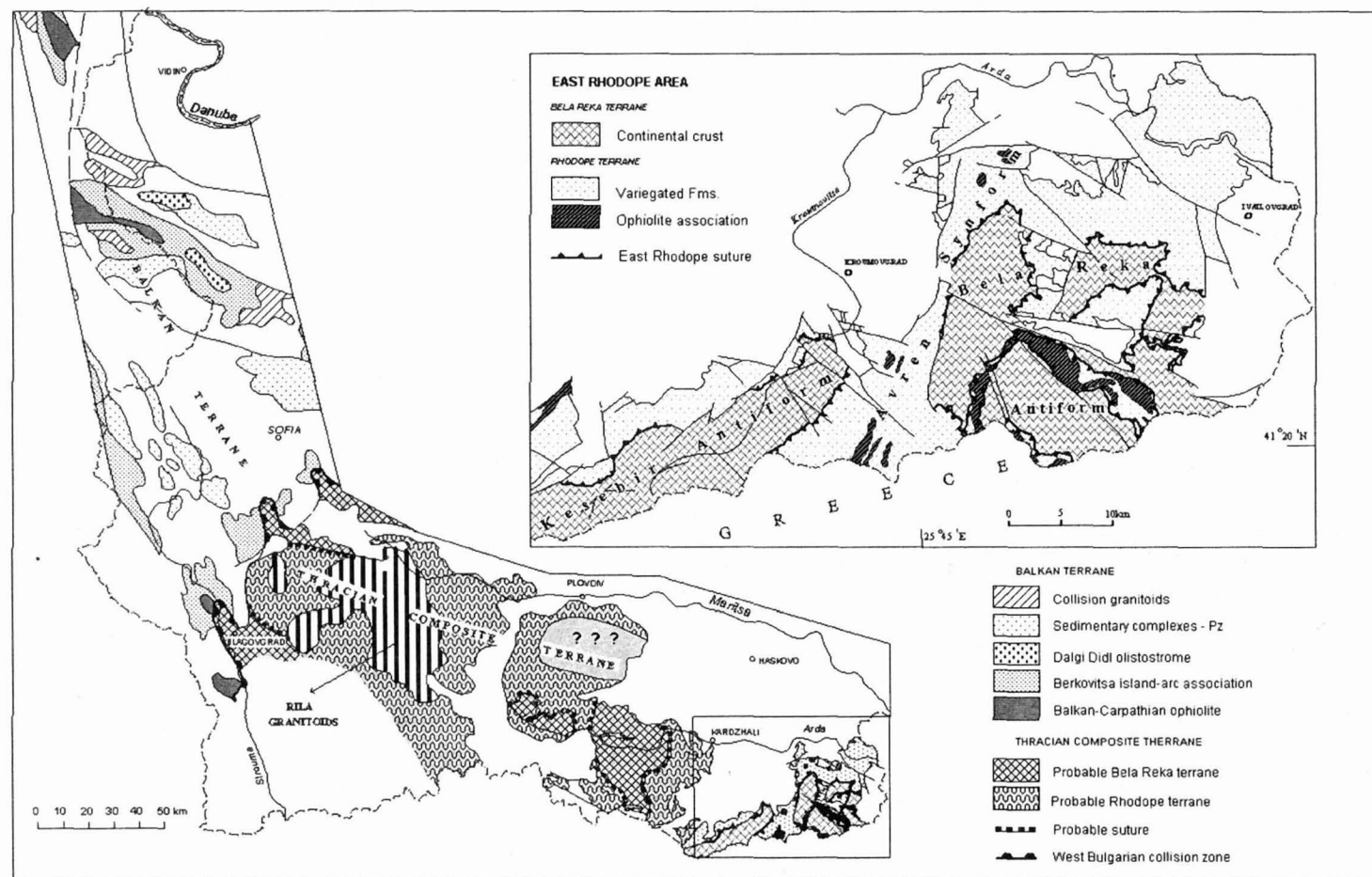


Fig. 1. Relations of Balkan terrane and Thracian composite terrane (including also Bela Reka and Rhodope terranes)

cheva, 1992) — typical of continental crust. U-Pb zircon data (Peytcheva, Quadt, 1992) indicate its Variscan age. The synforms are built up by a double-layered structure. The lower layer consists of fragments of ocean crust overlain by a layer composed of the VF. The new U-Pb zircon dating (Carrigan et al., 2003) indicates that the metaigneous rocks of the VF crystallized in the Late Neoproterozoic. The double-layered assemblage is situated over the continental crust tectonically. Tectonic imbrication is typical for this contact, which divides two different types crust. This is the East Rhodope suture (Haydoutov et al., 2003). Both types crust form two different terranes: Rhodope (the island-arc one) and Bela Reka (the continental). The properties of the suture, after realization of the necessary correlations, could be of significance for clarifying the structure of the whole Rhodope Massif. These correlations should take into account the fact that the VF is exposed as well in the Central and Western parts of the massif, and also the continental crust — e.g., in the Madan-Davidkovo and Shiroka Luka Antiforms.

The comparison of both described terranes indicates that they are different structures. The main differences being: more primitive character and older age of the Rhodope terrane as well as its more complex evolution in alpine time. The space relation between both terranes is an important issue, however, since the mentioned correlation between the East and the rest parts of the massif has not been performed yet, it is not properly clarified. At present the contact of the Balkan terrane in West Bulgaria is with the Thracian composite terrane, which includes also the Rhodope and the Bela Reka terranes. This contact bears features of a typical collision zone — the West Bulgarian collision zone (Fig. 1).

Significant is the comparison with the closest peri-Gondwanan terranes. The Balkan terrane shows close resemblance with the basement of the Istanbul zone — the Bolu massif (Yigitbas et al., 2001), while the terranes of East Rhodope — with Menderes and particularly with the Bitlis one (Göncüoğlu, Turhan, 1997). A tendency of youngening of the island-arc terranes from S to N is observed in the Arabian Shield (Stoeser, Camp, 1985). Also along the Hijas shear zone the NW part of the Shield is transported to NW — almost to the neighbourhood of our region. Direct comparison cannot be done, but the tendency of youngening from S to N is also established for the considered here terranes. The comparison with the Bohemian massif (Dörr et

al., 2002) is also very informative. The presence of the Late Neoproterozoic ophiolites in the Teplá-Barrandien terrane, covered by non-metamorphic Paleozoic, the composition of the Moldanubian terrane (high-grade metamorphics and eclogites), and the Moldanubian shear zone, dividing these terranes, are all features resembling the analysed here terranes.

The described terranes, on the base of the principles of the terrane analysis, are characterized as fragments of ensimatic island arcs. The composition of the sedimentary and igneous components, reflecting the geodynamic conditions of their formation, the age of the associations composing them and the carried out correlation clearly indicate that they are peri-Gondwanan blocks.

References

- Carrigan, Ch., Mukasa, S., Haydoutov, I. and Kolcheva, K. 2003. Ion microprobe U-Pb zircon ages of pre-Alpine rocks in the Balkan, Sredna Gora, and Rhodope terranes of Bulgaria: Constraints on Neoproterozoic and Variscan tectonic evolution. — *Journal of the Czech Geological Soc. Abstracts. International conference "Geology without frontiers: magmatic and metamorphic evolution of Central European Variscides"*, 48 (1-2): 32-33.
- Dörr, W., Zulauf, G., Fiala, J., Franke, W., Vejnar, Z. 2002. Neoproterozoic to Early Cambrian history of an active plate margin in the Teplá-Barrandien unit — a correlation of U-Pb isotopic dilution TIMS ages (Bohemia, Czech Republic). — *Tectonophysics*, 352, 1-2; 65-86.
- Göncüoğlu, M., Turhan, N. 1997. Rock units and metamorphism of the basement and Lower Paleozoic cover of the Bitlis massif, SE Turkey. — *Turkish Assoc. of Petrol. Geologists, Sp. Publ.*, 3; 75-81.
- Haydoutov, I., Yanev, S. 1997. The Protomoesian microcontinent of the Balkan Peninsula — a peri-Gondwanaland piece. — *Tectonophysics*, 272; 303-313.
- Haydoutov, I., Kolcheva, K., Daieva, L., Savov, I., Carrigan, Ch. 2003. Island arc origin of the Variegated Formations from the East Rodopes, Bulgaria: implications for the evolution of the Rhodope Massif. — *Ophioliti* (in press).
- Kozhoukharov, D., Boianov, I., Goranov, A., Kozhoukharova, E. 1992. Geological map of Bulgaria 1:100 000, Sheet Krumovgrad and Sape, Committee of Geology and Mineral Resources, Sofia.
- Kozhoukharova, E. 1996. New data for the geological position of the Precambrian ophiolitic association in the Rhodope Massif. — *C.R. Acad. bulg. Sci.*, 49, 1; 57-60.
- Kozhoukharova, E., Kozhoukharov, D., Zagorcev, I., Boyanov, I. 1988. Gneiss-granites in the East Rhodopes. — *Rev. Bulg. Geol. Soc.*, 59; 53 — 65.
- Kräutner, H. 1997. Alpine and pre-alpine terranes in the Romanian Carpathians and Apuseni mts. — *Annales geol. des pays Helléniques*, 37; 331-400.
- Macheva, L., Kolcheva, K. 1992. Metagranitoids from East Rhodopes — occurrences and main features — *C.R. Acad. bulg. Sci.*, 45 (6); 63- 67.

- Peytcheva, I., Quadt, A. 1995. U-Pb zircon dating of metagranites from Bela Reka region in the East Rhodopes, Bulgaria. — *Sp. Publ. of the Geol. Society of Greece, XV Congress of the Carpatho-Balkan Geol. Assoc.*, 4/2; 637-642.
- Quadt, A., Peytcheva, I., Haydoutov, I. 1998. U-Pb zircon dating of Tcherny Vrah metagabbro, the West Balkan, Bulgaria. — *C. R. Acad. bulg. Sci.* 51, 1-2; 81-84.
- Stoeser, D., Camp, V. 1985. Pan-African microplate accretion of the Arabian shield. — *Geol. Soc. Am. Bull.*, 96; 817-826.
- Yigitbaş, E., Kerrich, R., Yilmaz, Y., Xia, Q., Elmas, A. 2001. A Pre-Cambrian ophiolitic belt and an ensimatic island arc association in the basement of the Istanbul-Zonguldak Unit (NW Turkey) and its significance. — *Abstracts, Europrobe meeting, Ankara*, 95.