Voluminous granitoid magmatism along a major Variscan tectonic zone in Central Balkanides

Обилен гранитоиден магматизъм по главна Херцинска тектонска зона в Централните Балканиди

Ianko Gerdjikov[1], Anna Lazarova[2], Eleonora Balkanska[1], Dimo Dimov[1]
Янко Герджиков[1], Анна Лазарова[2], Елеонора Балканска[2], Димо Димов[1]

[1] Sofia University, Dept. of Geology and Paleontology; E-mail: janko@gea.uni-sofia.bg
[2] Geological Institute, BAS

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The differences between the metamorphic basement of Stara planina and Central Srednogorie are obvious and well known from years (e.g. Dimitrov, 1939). Recently they were used as a base to propose the existence of two distinct Variscan tectonic plates (Haydoutov, 1991) or terranes (Haydoutov, Yanev, 1997). Numerous papers deal with the details of stratigraphy, petrology, geochemistry and geochronology of these metamorphic rocks as well as associated granitoids. On the other hand little is known about the terranes' boundary and the timing of convergence-related deformation. Most often it is stated (e.g. Carrigan et al., 2005) that this important boundary reflects terrane accretion during Variscan orogeny and subsequently was reactivated as Alpine fault. Last year we reported (Gerdjikov et al., 2007) the existence of Stargel-Boluvania tectonic zone (SBTZ) that emplaces the Central Srednogorie High-Grade Metamorphic Complex (CSHGMC) on to Diabase-Phyllitoid Complex (DFC). The field relations in the Vezhen massif area and available geochronological data indicate that the shearing along SBTZ took place in the interval 336–314 Ma, i.e. after the high-grade metamorphism of CSHGMC but before the emplacement of Vezhen pluton. The continuation to the east of this major Variscan tectonic zone is problematic. In the area of Troyanska and Kalofers-ka Stara planina there is no direct contact between the metamorphic rocks of DFC and CSHGMC. And indeed, there the structure of the Variscan orogen is obscured by Late Alpine thrusting.

Important insights into this problem outcome from the studies carried out on the southern slopes of Stara Planina between the village of Hristo Danovo and Kalofer as well as from the western part of the Botev Vrah allochthone. Here, within the pre-Permian basement we have distinguished three major rock assemblages: i) Low-grade rocks of DFC and associated metamorphosed leucogranites; ii) High-grade rocks of CSHGMC; and iii) Foliated and unfoliated granitoids. A key feature in our model is that within all of these contrastly differing rock associations the dominant (main-phase) foliations are sub-parallel and are dipping to the south. As main phase foliation we designated latest penetrative tectonic fabric that often re-works and transposes an earlier foliation/s. The associated lineations show significant variations from down-dip to strike-parallel orientations but no lithological control on these variations have been observed.

Here, DFC is built up almost by quartz-sericite-chlorite, biotite or two-mica schists, but quartzites and amphibolites are presented as well. A most striking feature of the unit is its higher-grade fabric compared to the rock varieties from the same unit in Zlatishka Stara Planina. The presence of biotite in schists as well as the complete recrystallization and mylonitization of metasandstones indicate metamorphic temperatures close and above 400° C. In general within the studied area, the rocks of DFC are intensively deformed as in the vicinities of the foliated granitoids display transposition of foliation. Associated with DFC are fine-grained leucogranites often intensively mylonitized and transformed into quartz-sericite schists in high-strain domains. Their structural features and low-grade fabric point to pre-tectonic emplacement in relation to the main-phase of foliation within the DFC. These metamorphosed granitoids are common in the western part of the Botev Vrah allochthone and are also found as relatively small bodies along the foot of the mountain.

High-grade metamorphic rocks of CSHGMC build up a comparatively large tract west and north of Kalofer and are also found as decameter-scale xenoliths included in granitoids west of Botev peak. In these outcrops the complex consists of migmatitic gneisses, coarse-grained mica schists, amphibolites and scarce quartzitic levels. Two structural domains can be distinguished. The first one is built up by metatexites often with extremely folded migmatitic layering, the second one consists of mica-rich rocks and augen gneisses both containing boudinaged leucosomes and granitoid dykes. This more strained part of the metamorphic pile displays constantly dipping to the south foliation that often bears down-dip lineation defined by mica flakes and stretched quartz grains. Sense-of-shear criteria (shear bands and asymmetric S-shaped augens) indicate top-to-north shearing.

In these parts of Stara Planina, DFC and CSHGMC host a variety of granitoid rocks ranging in composition from diorite to leucogranite. Most of them display a solid-state fabric as only some medium- to fine-grained varieties are completely devoid of solid-state overprint. Typically concordance between the granitoids' contacts, main-phase foliation and solid-state fabric has been observed. Large bodies of K-feldspar porphyritic granites and leucogranites exhibit a steady south-dipping foliation, as in some cases even display gneissic fabric and used to be regarded as metamorphic rocks (Stara planina high-grade metamorphic series; Kuikin et al., 1971) or as pre-Variscan granites (Milanov et al., 1971). Mylonitic dykes are common in the immediate host rocks, a feature indicating strong basement reworking during magma emplacement. Unlike the monotonously dipping to the south foliation, the linear fabric within the granitoids has more complex geometry. The varieties from the southern slope of the mountain display almost strike-parallel lineation and in some cases lineation is more pronounced than foliation (L>S fabric type). East-west trending lineations are observed in the area of Kupena peak and Krastsite within the Botev Vrah allochtone. On the other hand N-S trending lineations are also common. For example within the southern part of the allochthone (south of Botev Vruh peak) the N-S lineations are associated with pronounced flat-laying solid-state gneissosity. Such lineations are also developed within narrow sericite- and chlorite-rich mylonitic and phyllonitic shear belts. The low-grade tectonites contain abundant shear-sense indicators for top-to-the north shearing. All these data point to the existence of a complex transpressional system that accommodated huge amounts of granitic melts.

Both stratigraphic evidences as well as geochronological data constrain the timing of the transpressional deformation and voluminous magmatism. To the west of the Kozya Stena peak mylonitic leucogranites and almost unfoliated granites are covered by Permian-Triassic sediments. One of the weakly foliated to unfoliated granitoid bodies was recently dated at 303.5±3.3 Ma (Hisara granite – Carrigan et al., 2005). The presence of xenoliths from CSHGMC within the granite suggests emplacement after the thermal peak of metamorphism that was recently dated at 336.5±3.3 Ma (Carrigan et al., 2006). These age constraints suggest massive and extended magmatism in an interval after 336.5 Ma but before 303.5 Ma – a period of intensive Variscan tectonics (for details see Gerdjikov et al., 2007).

Conclusions

The two contrasting metamorphic complexes – DFC and CSHGMC – display co-planar tectonic fabric. In contrast to Zlatishka Stara Planina, here the contact is masked by the intrusion of foliated and unfoliated granitoids. The solid-state fabric of granitoides is co-planar to the orientation of the main-phase foliation in host rocks. It is unlikely that the attitudes of the ductile fabrics have been significantly influenced by Late Alpine faulting and furthermore – the orientation of the main-phase foliation is similar to the one in the zone of SBTZ. These data as well as the results of the kinematic analysis indicate Late Variscan crustal-scale rock flow in a transpressional/compressional setting.

One of the salient features of the studied area is the presence of large granitoid bodies. Their emplacement can be regarded as slow accretion of separate magma batches synchronously and following pronounced episode of Variscan oblique convergence.

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