



Deciphering the Variscan orogeny record in Bulgaria

Дешифриране на херцинския ороген на територията на България

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Variscan units

A large part of SW and Central Bulgaria is built up of high-grade metamorphic rocks, traditionally regarded as a Precambrian basement. In fact an assumption of Precambrian age was highly speculative. The recently obtained ages have shown that the basement consists of Lower Paleozoic magmatic and sedimentary rocks as well as Ediacaran–Early Cambrian magmatics, all metamorphosed at MP/HT conditions during Late Variscan time. An earlier HP metamorphic stage is evidenced by the presence of scattered, variously retrogressed, eclogite lenses. Accordingly, a typical collisional P-T path can be suggested for these basement units. We collectively designate them as Lower Plate or Thracian composite terrane (Table 1).

In contrast, the Upper plate units (Table 1) do not present any record of an HP events and witness (if any) only LT metamorphism. Thus, a supracrustal position for these units could be supposed during the Variscan orogeny. Within both the Upper and the Lower plate units several tectonic elements (Table 1) are distinguished, on the basis of their protolithic age, lithology, structural and metamorphic record, etc.

Variscan fabric

Despite occasionally penetrative Alpine overprint, the Variscan fabric is relatively well preserved. We are distinguishing regional and shear-zone related fabrics (Table 2). The first type of fabric is restricted to the elements of either Lower or Upper plate only, whereas the shear-zone fabric is developed often along the boundaries of the plates.

However, our knowledge of the Variscan fabric is rather limited and some age constraints (⁴⁰Ar/³⁹Ar data – Gerdjikov et al., 2010) are available only for Dm fabric. Additionally, as an indicator for the upper age limit of Dk fabric is used the ⁴⁰Ar/³⁹Ar age from the post-kinematic plutons (~339 Ma – Buzzi et al., 2010). The geodynamic significance of the Variscan fabrics is also poorly determined. Some attempts in resolving this are presented in Table 2. The arguments to attribute Dk fabric to a N-vergent compression are not based on analysis of the high-strain zones, but instead to the dominant fold vergence in the Lower Paleozoic rocks.

Two shear zones – Stargel-Boluvania (or Stargel-Boluvania Tectonic Zone/SBTZ) and Gabrov dol

Table 1. The major constituents of the Variscan orogen in Bulgaria

Lower Plate		Upper Plate	
Central Srednogorie High-Grade metamorphic complex (CSHGMC)	Strandzha High-Grade metamorphic complex	Cadomian Fragments (Vukan, Gologlavtsi, Lazovo Complex, etc.)	Lower Paleozoic (meta) sediments: Lyubash Domain, Svoje Domain, Shipka Domain
Ograzhden-Vertiskos complex (OVC)	Proto-Rhodope complex	Units in Alpine allochtones: Morava and Strandzha	Karlovo-Ribaritsa Domain

Table 2. Different types Variscan fabric

Index	Unit/area	Aproximate Age	Structural trends/geodynamic significance	Extent
Dk	Upper plate (Svoje domain}	Pre-339 Ma	~E-W/N-vergent compression	Regional
Dl	Ograzhden-Vertiskos, SHGMC	~335 Ma	NNW to NW-SE/ unknown	Regional
Dm	CSHGMC, Svoje domain	~333 Ma	E-W/north-vergent transpression	Crustal-scale shear zone – SBTZ
Dn	OV, CSHGMC, lower part of Upper plate or Frolosh and Topolnitsa arc	Post 330 Ma	Complex, modified during Alpine times (?)/extension	Crustal-scale shear zone – GDSZ

(GDSZ) are the most prominent Variscan structures. Considering the evolution of the Variscan orogen, both zones are relatively late features and are related to a strong retrogression of the high-grade fabric of the Lower Plate. The SBTZ is probably the main Variscan suture in the Balkan sector of the Variscides, yet the shearing along the zone is toward the foreland of the overriding plate (e.g. it is a part of the retro-wedge of the orogen).

Without completely discount a possibility of strong Alpine overprint along the GDSZ, some arguments indicate that the zone is related to a Late Variscan extension. Such argument is for example the fast exhumation of high-grade rocks from CSHGMC east of Sofia (Velichkova et al., 2004). The $^{40}\text{Ar}/^{39}\text{Ar}$ data of Velichkova et al. (2004) indicate fast cooling of the Lower plate's rocks at 315 Ma. Moreover the strongly retrogressed basement clasts are abundant in the Stephanian (~304–299 Ma) coarse-grained sediments.

Conceptual model for the Variscan geodynamic evolution

Concerning the evolution of the major units of the Variscan orogen in Bulgaria the following statements could be made with some certainty: 1) OVC unit represented a magmatic arc during the Ordovician whereas CSHGMC unit has occupied most probably more hinterland-ward position as few Ordovician magmatites were recognised along this unit. 2) Lower plate

was subducted below Upper plate during the Variscan cycle. The lack of subduction-related magmatism in the Upper plate can be due either to the short duration of the subduction or to strike-slip dominated closure of the intervening basin. 3) As in the well-studied western European part of the Variscan orogen the Balkan sector was probably doubly-vergent with main tectonic transport direction toward Lower Plate (to the SW). Accordingly, we interpreted the Variscan fabric in Svoje domain (Dk) as formed in a retro-wedge of the collisional orogen. 4) SBTZ is a late-orogenic feature, resulting of the indentation of the CSHGMC (interpreted as a Gondwana continental promontory during this stage) to the north into Upper plate; 5) GDSZ is a post-convergence extensional zone along which contrasting units were juxtaposed.

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