SOME TOPICS OF GEODYNAMIC EVOLUTION OF INNER WESTERN CARPATHIANS

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Abstract: Finding of a Variscan geosuture in the North-Gemeric zone modified former interpretations of Variscan tectonic evolution of Inner Western Carpathians. South-vergent ductile shear zone between Early Paleozoic Gelnica and Rakovec Groups of Gemericum manifested kinematics of Variscan exhumation. We suppose that thermal processes in collisional régime were sufficient for increase of thermal gradient, metamorphism and metallogenic processes.

Key words: geosuture, geodynamics, Gelnica and Rakovec Groups, Gemericum

The long-lasting research of Gemericum and surrounding units, including detail geological mapping, structural research in meso/microscales and accounting of published results of further branches of geo-sciences, brought some new topics into interpretations of geodynamic evolution of Inner Western Carpathians.

Variscan geodynamic evolution

Variscan evolution terminated with origin of *Rakovec geosuture* including lithology of Rakovec and Klátov Groups and partly Carboniferous rocks. From the Lower Paleozoic Gelnica Group it is separated with ductile shear zone of moderate northern inclination. This inclination of rock boundaries in suture zone was proved also by the results of the project SGR-Geophysics (Grecula and Kucharič, eds., 1992) as well as by the series of seismic profiles G1a/92, G1b/92 and G2/93 (Vozár et al., 1998). Microtectonic research of mylonites from the boudary zone between Gelnica and Rakovec Groups (Németh, 2001; Németh et al., 2001a) proved two principal directions of tectonic transport - in autochthonous footwall of ductile shear zone (that is in upper part of Gelnica Group) the general vergency of tectonic

transport is ESE. In allochthonous hanging wall of shear zone (tectonic mélange of Rakovec Group) the transport directions are generally to the south, locally with wider azimuthal spread. Our findings support the overall southern vergency of Variscan tectogenesis (Putiš, 1992; Putiš and Grecula in Plašienka et al., 1997). South-vergent structures are common in the Gemericum, encompassing fold structures.

The Lower Paleozoic rock sequences of Gemericum from the viewpoint of evolution can be generally divided into two large groups:

A. The rocks of Gelnica Group, representing the Lower Paleozoic cover of rigid blocks of older crystalline basement of Panafrican? provenience, were in Upper Carboniferous deformed by exhumed mélange of rocks of Rakovec Group (+ Klátov Group + part of Carboniferous sequences).

B. Rocks of Rakovec Group suffered tectonometamorphism in various depths of subduction zone. We suppose the Devonian-Westphalian age of subduction-exhumation processes. The dating of the upper boundary is based only on finding of the pressure peak of 12 kbars in a part of Westphalian sediments of Rudòany Formation (Radvanec, 1998). It suggests that also Westphalian sediments were locally recrystallized in subduction régime and subsequently exhumed. Subduction slab was inclined northwards below rocks of recent Veporicum and Tatricum. Subduction initiated the reverse displacement of rock masses in subduction slab back to surface (including sporadical mantle fragments; cf. Radvanec, 1999). When the crystalline rocks of southern basement (underlying Gelnica Group) had approached the subduction zone, the convergence decelerated and stopped.

Collision resetted the thermal régime in collided terrane and the deeply intrenched isograds neighbouring the subduction canal started to be straightened. The thermal régime during Permian was highly probable related also to the presence of prolonged thermal source below the collided terrane in the North-Gemeric zone. Position of thermal axis in North-Gemeric zone results also from reconstruction of the whole Carpathian Permian sedimentary basin and Permian magmatic trends (Vozárová and Vozár, 1987). We suppose that the increased thermal flow caused also higher temperature metamorphism of rock sequences in Gelnica Group, origin of Gemeric granites and metallogenic processes.

Later Permian evolution in the Inner Western Carpathians is characterized with northward dispacement of lithospheric plates with collisional terrane. The position of the axis of conductive heat was therefore gradually shifted towards the southernmore Gemeric zones. This is proven also by still younger ages of Gemeric granite from the north southward:

[Hnilec - 290 Ma (Kovach et al., 1986) and 282 Ma (Cambel et al., 1989); Betliar 272 Ma; Humel 270 and 246 Ma; Zlatá Idka 251 and 223 Ma (Kovach et al., 1986)]. Similar effect is exhibitted also by the presence of best developed siderite-sulphidic veins directly in North-Gemeric zone. These veins penetrate from the Gelnica Group through the suture zone. Southward the veins parameters become worse. Conductive overheating of Lower Paleozoic rocks of the Gelnica Group was most intensive in its lowermost horizons, built with black schists, lydites, carbonates and the variegated volcanic horizon (Betliar Fm., Holec Beds and lower parts of Smolník Fm.). Rocks served as a source of metals for fluids entering into fractures in overlying rock sequences (cf. Grecula et al., 1991). Position of mentioned rocks on rigid crystalline basement and below soft cover of overlying rocks of Gelnica Group protected them against tectonization during preceeding south-vergent exhumation of rocks of the Rakovec Group. Pre-Permian tectogenesis was accommodated by overlying rocks of Smolník and Hnilec Fms. (Fig. 1).

Alpine geodynamic evolution

The effects of Permian extension in Gemeric terrane, owing to displacement of lithosphere above the axis of convectional heat, were shifted southwards. The continental crust in South-Gemeric zone was gradually disintegrated and the prolonged Meliata-Hallstatt basin originated. Later Alpine evolution after Upper Jurassic? convergence has been divided into four deformation stages:

Deformation stage AD_1 is tightly related to the closure of Meliata-Hallstatt basin with following succession of events: Closure of the basin and transport of the Bôrka nappe on Gemericum. Ongoing convergence caused not only the north-vergent imbrication of Lower Paleozoic rocks of former Variscan collisional terrane, but the Lower Cretaceous displacement of several kilometers thick rock pile of Gemericum northward on Veporicum. This process of detachment was allowed by the rheologically contrast horizon of the black schists of Betliar Fm., dividing rigid crystalline basement from relatively softer rocks of Gelnica Group. We suppose that a part of former Betliar Formation remained in its homeland. The north-vergent imbrication in low-temperature brittle-ductile and brittle regime caused multiple repeating the Early Paleozoic lithology of Gemericum in recent picture. Thrusts destructed also courses of Late-Variscan ore veins (cf. numerous examples in Grecula et al., 1995).

The Lower Cretaceous Gemeric nappe displacement during AD_1 caused:

1. Truncation of northern depth continuation of Rakovec geosuture, and "retraction" of its lower parts below Gemericum.

2. Thrusting of North-Gemeric zone on "Veporic ramp" caused uplift of frontal parts of the nappe, its disintegration and later erosive removal of cover carbonates of the Stratená Group.

Thickening of continental crust caused the Middle Cretaceous unroofing of Veporic "core" during AD_2. The younger conjugate systems of brittle-ductile and brittle shear zones of NW-SE and NE-SW trends (AD_3; cf. Grecula et al., 1990; Németh et al., 2001b) formed arc bending of Gemericum, and *sensu lato* of the whole Western Carpathians.

The orogen parallel extension in east-west direction during AD_4, documented preferably in the North-Gemeric zone, was caused by crustal indentor directed to the north to the Gemeric zone.

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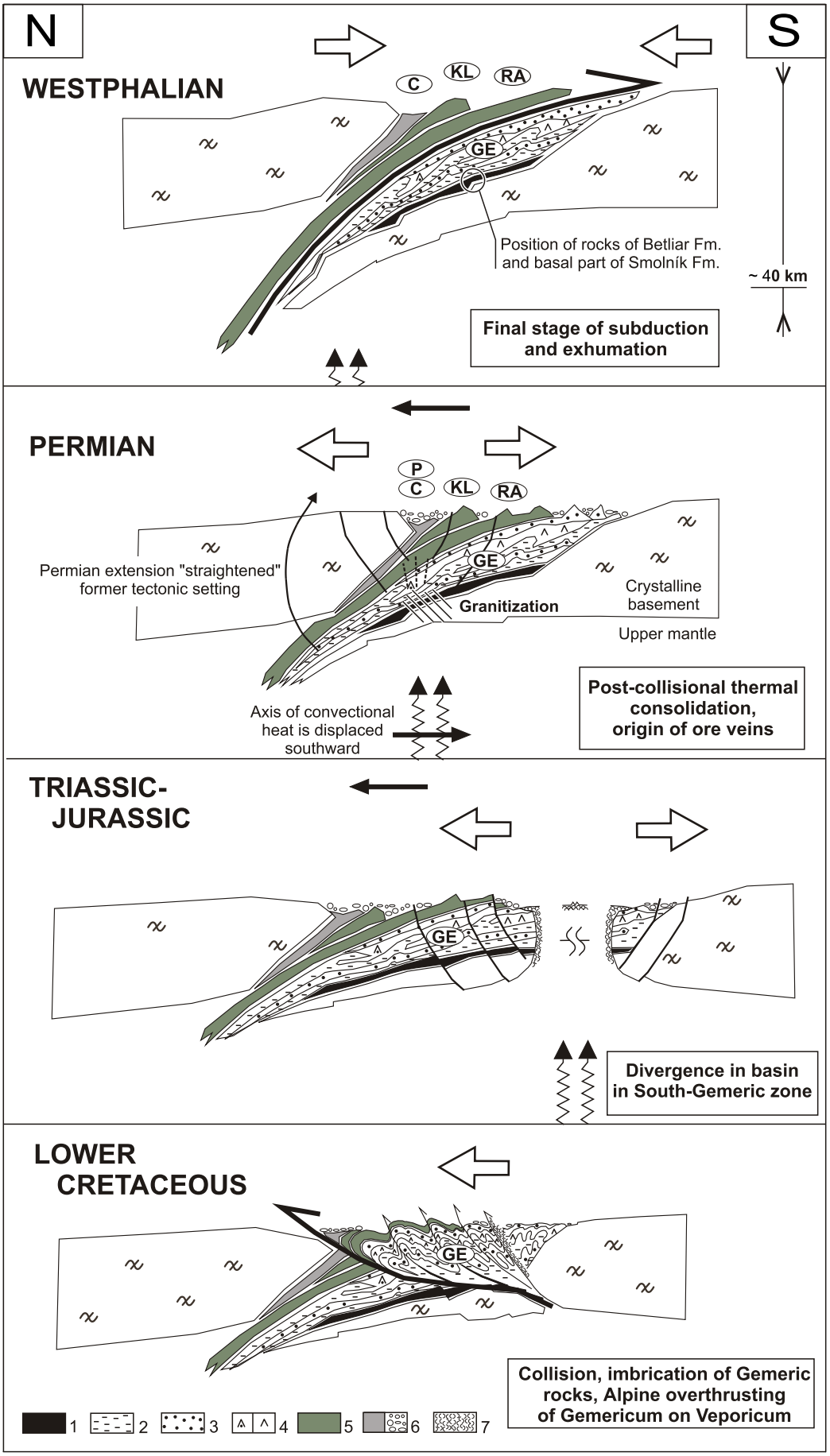
Fig. 1. Interpretation of the geodynamics of Inner Western Carpathians. GE - Gelnica Group, RA - Rakovec Group, KL - Klátov Group, C - Carboniferous rocks, P - Permian rocks. White arrows - direction of convergence, resp. divergence, black undulating arrows - axis of convective heat, black straight arrows - relative migration of collided terrane with respect of axis of convective heat. 1 - black schists of Betliar Fm. (Ordovician-Silurian), 2 - green schists of Smolník Fm. (S-D), 3 - flysch - lower bed - in Smolník Fm. (S-D), upper bed - the supreme parts of Hnilec Fm. (D-C_1?), 4 - intermediate and acid volcaniclastics of Hnilec Fm. (D), 5 - effusive and extrusive products of basalt volcanism, locally with accompanying rocks (D), 6 - clastics of Rudňany Fm. (C) and further Carboniferous and Permian clastics, 7 - effusive and extrusive products of basalt volcanism of Mesozoic evolution, locally with accompanying rocks.


N
S
WESTPHALIAN
C
KL
RA
GE
Position of rocks of Betliar Fm.
and basal part of Smolník Fm.
~ 40 km
Final stage of subduction
and exhumation
PERMIAN
P
C
KL
RA
GE
Permian extension "straightened"
former tectonic setting
Granitization
Crystalline
basement
Upper mantle
Axis of convectional
heat is displaced
southward
Post-collisional thermal
consolidation,
origin of ore veins
TRIASSIC-
JURASSIC
GE
Divergence in basin
in South-Gemeric zone
LOWER
CRETACEOUS
GE
Collision, imbrication of Gemeric
rocks, Alpine overthrusting
of Gemericum on Veporicum
1
2
3
4
5
6
7