VARISCAN–ALPINE EVOLUTION OF THE NORTH–VEPORIC LAYERED METAMAFIC COMPLEXES (W. CARPATHIANS)

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Abstract: Two different layered metamafic complexes have been distinguished in the Veporic basement of the central Western Carpathians. One of them, about 514 Ma old, belongs to typical leptynite-amphibolite complexes (LAC) of the European Variscides. The second (Veľký Zelený potok, VZP; remelted LAC?) one, ca. 346 Ma old is emplaced to a supracrustal complex. The LAC shows very low-T, while the VZPC a lower amphibolite facies Alpine overprint in the hanging wall of a Cretaceous thrust-fault.

Key words: layered, metamafics, evolution, W. Carpathians

Variscan structure of the metamafic complexes

The studied metamafic complexes preserve stages of pre-Alpine evolution of the Tatric and Veporic crystalline basement (Putiš and Grecula in Plašienka et al. 1997: fig. 6):

1. The older, leptynite-amphibolite complex (LAC, after Hovorka and Méres 1993) usually contains layered metamorphics of amphibolite composition that are interpreted to have formed by syn-kinematic magmatic emplacement and differentiation - layering of originally gabbro-diorite suite in tectonic environment of continental lower crust or in ancient back-arc basin crust. The zircon U-Pb upper discordia intercept age of a (meta)trondhjemite layer is 514±24 Ma (Hlošková Valley, N of central Nízke Tatry Mts., Putiš et al. 2001).

2. The northward Early Variscan continental (?) subduction at ca. 430-410 Ma (Putiš 1992; Putiš in Plašienka et al. 1997: fig. 6) is constrained by some geobarometric

data obtained from inferred retrograded eclogites (~ 10-12 kbar, Janák et al. 1996) of the LAC and the age of ca. 407 Ma of a plagio-orthogneiss (Poller et al. 2000).

3. The lower medium-temperature period of regional-metamorphic cooling during the collisional thrusting of layered metamafics (LAC) is indicated by the amphibole ^{40}Ar-^{39}Ar ages (at ca. 357 Ma, Dallmeyer et al. 1996). We interprete this age to indicate a post-obduction syn-collisional juxtaposition of a supracrustal Jarabá and a lower-crustal leptynite-amphibolite (LAC) structural complexes (Putiš et al. 2002, in press).

All the compositional layers (Hlošková Valley) are characteristic of metamorphic microstructures with mostly sharp boundaries between the layers. The magmatic minerals were replaced by metamorphic association of Hbl-Pl(25-30% An)-Grt-Ttn-Mag(Ilm)-Qtz±Bt, corresponding to the amphibolite facies. Some of them contain rutile replaced by ilmenite and titanite, or garnet replaced with a plagioclase corona.

The narrow (a few dm) zones of layer parallel shear might have been supplied by metamorphic fluids and consequently a restricted initial partial melting of mostly homogeneous amphibolites occurred. They are marked with synmetamorphic stretched intralayer folds, or separated sheared off their cores filled in by pale fine- to medium-grained (Qtz-Pl) leucosomatic seggregate with still preserved magmatic microstructure. The newest member of layered amphibolites appear to be medium- to coarse-grained pegmatitoids and Czo-Chl-Ab-Qtz veins enclosing the host folded amphibolitic structure and seem to be at least late-metamorphic.

The pre-Alpine metamorphic conditions of the LA structural complex in the Hlošková Valley achieved 630 °C at the 7-8 kbar of P (Korikovsky et al., in prep.).

4. The mafic dioritic sill or dyke intrusions of the Veľký Zelený potok complex (VZPC: dioritic orthogneisses, Putiš et al. 1996, 1997) in the northwestern Veporic area emplaced into the base of a Veporic (the Čierny Balog) supracrustal basement complex at 346±1 Ma (Putiš et al. 2001), following culmination of regional metamorphism that is coeval with ca. 348 Ma U-Pb lower discordia intercept age of that LAC metatrondhjemite.

The complex of Ky-Grt gneisses, migmatitic gneisses and normal to partially melted amphibolites (the Čierny Balog supracrustal complex=CB) was intruded by the dioritic-gabbroic more or less concordant dykes and sills (the VZPC) at the syn-metamorphic extension in the host regionally metamorphosed rocks. The whole

lithological sequence was then structurally unified during the late-metamorphic cooling and exhumation within the deep-crustal shear zone (Fig. 1).

The mafic (meta)magmatites are compositionally layered into a cumulate-like hornblendite, gabbro-diorite, tonalite to trondhjemite. Magmatic layering transformed to subsolidus high-temperature layering along the extensional meso-shear bands filled in by leucotonalitic melt seggregates crosscutting former magmatic structures at the acute to medium angles. A new ductile strain localization enhanced mechanical differentiation of dark and pale minerals into often isoclinally folded layers, with the CPO fabrics of amphibole, plagioclase and quartz.

The relic undeformed (unmylonitic) domains in metadiorites possess well preserved mesostructures of inferred magmatic origin. They comprise still observable magmatic foliation and lineation defined by subparallel oriented inherited lath-shaped magmatic forms of porphyric (often hypidiomorphic) plagioclase (1-1.5 cm of size) with biotite and amphibole in metadiorites. Compositional alternation of the differentiated magmatic members within larger diorite bodies, amphibolite xenoliths and the mentioned fabrics are interpretable to have formed by melting of the underlying LAC.

The VZP structural complex underwent a pre-Alpine metamorphism at estimated temperature of ca. 610 °C and 6-7 kbar of pressure (Filová 1997).

5. The muscovite ^{40}Ar-^{39}Ar ages at ca. 332 Ma from the Nízke Tatry (Bystrá Valley) early-Variscan orthogneiss (381±6 Ma, Putiš et al. 2002) reflect the late-Variscan cooling of the Tatric basement, including the LAC, below 400 °C (Dallmeyer et al. 1996).

In general, the Upper Variscan (Tatra) Nappe high-grade metamorphic complex (paragneisses, migmatites, amphibolites of the Jarabá complex, with the emplaced 360-300 Ma old granitoid plutons) including its lower-crustal sole predominantly composed of metamafic rocks (amphibolites, inferred retrograded eclogites, serpentinites and metagabbros, of the LAC) overlies a medium-grade supracrustal complex (micaschists to gneisses, sporadic amphibolites, without granitoids) of the Middle Variscan (Hron) Nappe (Putiš 1992; Bezák 1994) (Fig. 1). Then the VZP metamafic complex in the hanging wall of the Čierny Balog structural complex has a structural position equivalent to the base of the Jarabá supracrustal complex (while the LAC is an individual lower-crustal structural complex in the footwall of the supracrustal complexes).

Alpine overprint of metamafic rocks

1. The LAC in the north-Veporic area (the Hlošková Valley) shows only anchimetamorphic overprint that is compatible with the prograde Cretaceous metamorphism of tonalites and Permo-Scythian sandstones of the overlying south-Veporic Vápenica nappe (Putiš 1989; Korikovsky et al. 1992).

2. The Alpine overprint of the VZP complex is essentially higher – in lower amphibolite facies conditions (Putiš et al. 1996, 1997; Filová 1997; Filová et al. 2000).

The special feature is the breakdown of plagioclase that is directly replaced by grossular-enriched garnet. The skeleton garnet cores still contain irregular relics of plagioclase and they are overgrown by idiomorphic grossular-rich rims. Some plagioclase grains are infilled by tiny grains of idiomorphic grossular-rich garnet, epidote-clinozoisite and albite. The garnet grains gradually unite into larger "mosaical" porphyroblasts remaining original grains boundaries.

Variscan amphiboles of Mg-hornblend to tschermakite-hornblend composition are replaced by minor blue-green tschermakite grains in equilibrium with newly-formed garnets in mylonitic to ultramylonitic layers. Here the metamafics also contain newly-formed phengite, chlorite and biotite, sporadically chloritoid that is undoubtedly Alpine mineral assemblage. The used Grt-Hbl thermometers (Powell 1985; Graham and Powell 1984) indicate the temperatures of Cretaceous metamorphism of 513 ºC (Powell 1985) - 537 ºC (Graham and Powell 1984) (Filová 1997; Filová in Putiš et al. 1997) at medium pressures 8-9 kbar. The latest stage of Cretaceous exhumation and cooling is actinolitization of tschermakite, the growth of actinolite needles, biotite and chlorite.

Conclusions

Using the field, petrological and petrotectonic methods, we have distinguished two metamafic complexes of different age, structural position and evolution (Fig. 1):

1. The metamafics of the eastern part of the Nízke Tatry Mts. represent the group of leptynite-amphibolite complexes (LAC, Hovorka and Méres 1993), with the oldest isotope ages of their magmatic protoliths (514±24 Ma, Putiš et al. 2001).

2. The metamafics of the Veľký Zelený potok (VZP) Valley complex are younger (346±1 Ma, Putiš et al. 2001) and emplaced into the base of a supracrustal (Čierny Balog) structural omplex. They are interpreted as product of remelting of the LAC.

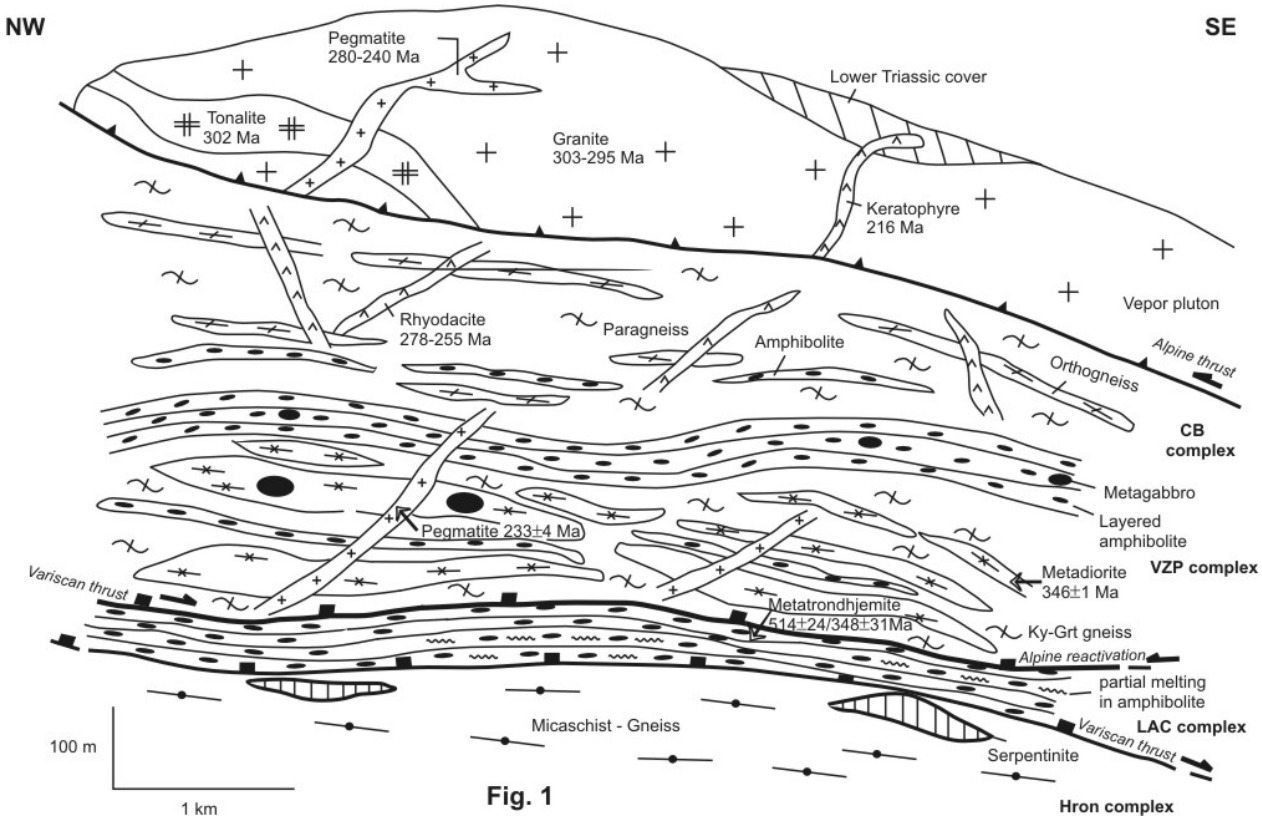

Fig. 1

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