PERMIAN TO TRIASSIC GRANITIC AND RHYOLITIC MAGMATISM IN THE WESTERN CARPATHIANS: COMPOSITION, EVOLUTION AND ORIGIN

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Abstract: Granitic and rhyolitic Permian to Triassic magmatism played an important role in the Western Carpathians also after main Variscan orogenic stages when the tectonic regime gradually changed from collisional to extensional post-orogenic conditions. The magmatism is represented by (1) Post-Variscan, Permian (~280-250 Ma) rare-element S-type leucogranites and mainly A-type granites, porphyries, rhyolites to rhyodacites, and (2) Early-Alpine, Triassic (~250-235 Ma) A-type leucogranites and rhyolites.

Key words: Western Carpathians, granites, rhyolites, Permian, Triassic.

Introduction

The West-Carpathian pre-Alpine basement shows a wide variety of acid magmatic, mainly granitic rocks; their compositional evolution from Devonian to Triassic clearly indicate a main tectonic stages from early- to middle-Variscan collision through late-Variscan transtension up to post-Variscan and early-Alpine extension (Uher & Broska, 2000, Petrík et al., 2001). After main production of Devonian to Carboniferous, calc-alkaline, orogen-related S- and I-type granitic suites in the Tatricum and Veporicum Superunits, small intrusions of leucocratic, more alkaline-enriched S- and A-type magmatic rocks occur in relationship with a gradual change of tectonic regime from collisional to extensional regime.

Permian post-Variscan stage

Post-Variscan (Permian, ~280-250 Ma) rare-element S-type leucogranites and granite porphyries and mainly A-type granites, granite porphyries and rhyolites-rhyodacites represent small intrusions, dykes and lava flows which occur through whole West-Carpathian area (Tatricum, Veporicum, Gemericum and Zemplinicum Superunits).

Rare-element Sn-bearing specialized leucogranites to granite porphyries of the Spiš-Gemer type show peraluminous trend with elevated Si, Al, K, Na, P, Rb, Cs, B, Sn, Nb, Ta,

F and strongly depleted in Ca, Mg, REE`s and Zr (Uher & Broska, 1996, Broska and Uher, 2001). These tourmaline-bearing granites with Li-rich micas, cassiterite, topaz and Nb-Ta-W-phases in greisen- and albitite-bearing cupolas (Dlhá Valley, Hnilec) originated from matured crustal protolith (I_{sr}>0.710) by evolved fractional crystallization at low temperature and fO_2 conditions. U-Th-Pb EMPA monazite as well as U-Pb single zircon dating clearly evidence their Permian age (~275 to 250 Ma, Finger & Broska, 1999; Poller et al., 2002).

A-type magmatites are represented by peraluminous biotite (annite-rich) leucogranites to granite porphyries enriched in Si, K, Rb, Ga, Zr, REE`s and Nb; they are hypersolvus-transsolvus (Turčok, Upohlav) to subsolvus (Velence); allanite-(Ce) or monazite-(Ce), magnetite and/or ilmenite and zircon (I.T=800-400) show a broad temperature and fO_2 variability of the group (Uher & Broska, 1996). Volcanic members reveal transitional calc-alkaline (Harnobis rhyodacites) to alkaline trend (e.g. Malé Karpaty Mts. and Gemericum rhyolites) documented by zircon typology (Broska et al., 1993). Lower Permian age (~280 Ma) of the Upohlav-type granites is documented by U-Pb zircon isotope dating (Uher & Pushkarev, 1994). Preliminary U-Pb zircon results of the Turčok granites show their age on the Permian – Triassic boundary (~250 Ma; Poller & Uher, in prep.)

Early-Alpine Triassic age

Early-Alpine (Early to Middle Triassic, ~250-235 Ma) A-type leucogranites and K-rich rhyolites were recognised only recently (Putiš et al., 2000; Uher et al., in press), however small occurrences of ”quartz porphyries” in Triassic carbonate sequences were known before (e.g. Zorkovský, 1959; Slavkay, 1965). The group represents Hrončok granite in the Veporicum Superunit (suggested formerly as Permian intrusion, Petrík et al., 1995) and rhyolites in the Silicicum Superunit (Drienka, Telgárt, Veľká Složka). Composition and accessory phases (monazite-(Ce), zircon: I.A~700, I.T<300) indicate alkaline, lower temperature conditions for the Hrončok granite (Petrík et al., 1995; Uher & Broska, 1996), whereas K-rich rhyolites solidified from hot and dry alkaline magma (zircon: I.A~700, I.T=700-800 Uher et al., in press). Middle Triassic age of the Hrončok granite was detected by U-Pb zircon isotope dating (~240 Ma, Putiš et al., 2000). The rhyolites and rhyolite pyroclastics of the Silicicum Superunit are distinctly enriched in K_2O (5-9 wt.%) and depleted in Na_2O (up to 2 wt.%), probably due to the late-or post-magmatic alteration (Uher et al., in press).

Concluding remarks

A-type granites and rhyolites and probably also rare-element S-type Spiš-Gemer granites originated under transtensional or extensional regime (Petrík et al., 1995, Uher & Broska, 1996) during Post-Variscan (Permian to Triassic) stages, connected with the devolatization of granites without pegmatite production as well as the formation of the hypoabyssal granite porphyries and volcanic products. The change of geochemical trend due to changes of tectonic regime through orogenic cycle from collision-related calc-alkaline to post-orogenic and anorogenic alkaline magmatic suites is clearly documented whole Variscan Europe and other regions worldwide (Bonin, 1990). The presence of Permian to Triassic granitic and rhyolitic magmatism in the West-Carpathian area shows their similarity with West-Mediterranean magmatic province (cf. Bonin, 1990) and possible paleogeographic position in “southern” branch of the Variscan and post-Variscan Europe, together with recent Alpine and Dinaride terrains. The differencies of protolith are resulted in final geochemical tendency of West-Carpathian Permian to Triassic acid magmatic members: the rare-element S-type granites were originated from matured metapelitic, Si, K and B-rich source, whereas A-type granites and rhyolites were formed probably from older (meta)granitic rocks. In the both geochemical groups, fractional crystallization played an important role during their emplacement and solidification. Consequently, the compositional changes of West-Carpathian silicic magmatism through Variscan orogeny to Early-Alpine platform stages, from orogenic S- and I-type to post-orogenic mainly A-type magmatites, impressively reflected tectonic evolution of the region from Devonian to Carboniferous transpression period followed by Permian to Triassic transtension to extension regime.

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