POLONAISE'97 experiments, but also with the seismic tomography experiment BOHEMA 2001/02, and numerous Czech-German projects on the geodynamics of the West Bohemia/Vogtland area that is repeatedly experiencing earthquake swarms. The projects should contribute to delineation of basement structure in regions covered by sedimentary basins, to better knowledge of crustal rheology, and deep-seated crustal inhomogeneities and will be complemented by concurrent geological/geophysical research projects focused on the shallower crustal levels. Warsaw and Prague groups with the support of NSF through University of Texas at El Paso will be responsible for the performance of the SUDETES 2003 experiment.

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Tourmaline-Bearing Leucogranites from the Třebíč Pluton in the Moldanubicum

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Peraluminous leucogranites with accessory tourmaline derived from crustal sources are widespread in mountain belts formed by continental collision (London et al., 1996). In eastern part of the Moldanubicum they are spatially associated with the Třebíč pluton, and three distinct types of leucocratic, medium- to fine-grained, biotite and muscovite-biotite granites with accessory tourmaline were distinguished.

(i) Two mica granites with tourmaline concentrated in orbicules (OTG) compose small intrusive bodies and dykes, scarcely up to 200 m thick. Quartz + tourmaline ± feldspars orbicules, up to 10 cm in diameter, or rare veins, up to 2 cm thick, are randomly distributed or concentrated in several m thick zones within bodies of leucocratic granites. Subhedral tourmaline is intersticial between euhedral grains of feldspars and quartz, and it replaces dominantly plagioclase. The accessory minerals include apatite, andalusite, cordierite, ilmenite, zircon, allanite, xenotime and monazite in granite; apatite is fairly abundant in orbicules. The tourmaline-quartz orbicules and veins seem to be a product of crystallization of evolved, B-rich medium (melt and/or fluid) during late solidus to early subsolidus stage of the granite formation.

(ii) Two mica granites with disseminated tourmaline (DTG) form relatively large intrusive bodies and dykes, up to several km^2. They do not exhibit such apparent spatial relationship to durbachite plutons as OTG. Euhedral to subhedral tourmaline grains, up to several mm long, are rather regularly distributed in the rock. The accessory minerals include apatite and zircon. In contrast to the OTG, disseminated tourmaline crystallized from granitic melt.

(iii) Biotite granites with tourmaline (MTG) typically occur in marginal zone of the Třebíč pluton. They form relatively small bodies (up to several hundred m thick) and are associated with migmatites and aplites. Euhedral tourmaline grains occur in coarse-grained pegmatoid facies, subhedral intersticial grains in rare quartz + tourmaline ± feldspars orbicules, up to 5 cm in diameter. Poikilitic garnet forms grains from 5 to 25 mm in diameter, randomly distributed in the rock, further accessory minerals include apatite, zircon and sillimanite.

All types of tourmaline granites have very similar geochemical signature corresponding to leucocratic and peraluminous (ASI = 1,0–1,3), syn- to post-collisional S-type granites: K_2O = 2.77–6.14; Fe_2O_{3tot} = 0.42–2.08; Rb = 194–234 ppm; Mg/Fe = 0.08–0.33; Rb/Sr = 1.00–5.56 in OTG, 5.24–7.34 in DTG and 0.5 in MTG; CaO = 0.49–0.87, 0.36–0.66 and 1.67, respectively. The normalized REE patterns are very similar for OTG and DTG granites; low REE concentrations ∑REE = 20.08–99.81 ppm and slight LREE enrichment (La_N/Lu_N = 1.9–6.8). The MTG indicate HREE depletion (La_N/Lu_N = 10.14) with distinct positive europium anomaly (Eu/Eu* 2.5). Similar mineral assemblages, whole rock major, minor and trace chemistry suggest that positive and negative europium anomalies (Eu/Eu* 0.5–1.6) found in both OTG and DTG rather reflect different fO_2 during crystallization. Lower CaO/Na_2O ratios (0.10–0.22) in OTG and DTG are typical for melts derived from clay-rich, plagioclase-poor pelitic rocks (Sylvester, 1998). The high CaO/Na_2O ratios (0.53) in MTG are typical for melts generated from plagioclase-rich psammitic rocks.

The zircon saturation temperatures 784–725 °C obtained for durbachitic rocks in Třebíč pluton (Watson and Harrison 1983) are similar to those the MTG (778 °C); DTG and OTG provided 660–713 °C, and 660–746 °C respectively.

The geochemical signatures suggest relatively primitive character of all granite types. The OTG and DTG had similar protoliths (metapelites) and conditions of melting (probably muscovite dehydration melting). Geochemical and mineralogical signatures of MTG exhibit less primitive character and higher temperature of melting (probably biotite dehydration melting).

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Tectonic Environment and Magnetic Susceptibility of the West Carpathian Granites

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In the West Carpathians, there are two principal groups of granitic rocks that originated during the peak stadium of the Variscan collision processes and/or after the slab breakoff (or delamination). The older one is pretty peraluminous (ASI = 1.1 – 1.5) dominated by two-mica granites and granodiorites, whereas biotite granodiorites to tonalites being less common. Accessory mineral association comprising monazite and ilmenite and presence of host (metamorphic) rock xenoliths are typical of these rocks. From geochemical point of view, Ba, Sr and Rb range widely (up to 2000, 1000, and 200 ppm, respectively) with Rb/Sr generally <1. The REEs are moderate with fractionated pattern and small negative Eu anomaly. Initial Sr 0.706 – 0.708, $\varepsilon\ Nd_{(350)} = -0.62$ to -4.24, the $^{206}Pb/^{204}Pb$ ratios of the whole rock samples range from 18.39 to 19.28 and the $^{207}Pb/^{204}Pb$ ratios from 15.59 to 15.74, stable isotopes (O and S) with values $\delta\ ^{18}O_{(SMOW)} = 8.8 – 11.3‰$ and $\delta\ ^{34}S_{(CDT)}$ from −0.9 to +5.7‰. Magmatic intrusion age of these granites is between 350–330 Ma with majority around 340 Ma. These granitic rocks resemble in classical alphabetic nomenclature common S-type and/or Ilmenite Series granites.

The younger group of granites is rather metaluminous to subaluminous (ASI = 0.8 – 1.1) dominated by biotite tonalite to granodiorite with scarce hornblende. Muscovite-biotite granodiorite to granite are in less extent. Accessory mineral association of magnetite + allanite and occurrence of mafic microgranular enclaves (MME) are characteristic of this group. Lower SiO_2 concentrations are compatible with higher trace elements Zr, Ba, Sr, LREE and Fe group element contents. REE patterns are typically steeper with higher LREE and without Eu anomaly. The initial Sr = 0.704 – 0.707 with Rb/Sr = 0.05 – 0.7 which are consistent with Rb-poor crustal source and/or mixed lower crustal or mantle component. Few Nd data fall within the S-type group – $\varepsilon Nd_{(i)} = -1.7$ to -3.5 although mafic dioritic enclaves with $\varepsilon\ Nd_{(i)} = 1.8 – 0.5$ clearly indicate interaction with a basic or intermediate, dioritic lower crustal melt. The $^{206}Pb/^{204}Pb$ ratios of the whole rock samples range from 17.99 to 18.85 and the $^{207}Pb/^{204}Pb$ ratios from 15.53 to 15.70. Stable isotopes (O and S) with values $\delta\ ^{18}O_{(SMOW)} = 7.8 – 9.9‰$ and $\delta\ ^{34}S_{(CDT)}$ from −2.9 to +2.3‰ also support melting of more basic lower crustal protolith. Magmatic intrusion ages of these granites vary between 310 – 300 Ma and these granitic rocks can be compared to I-type and/or Magnetite Series granites.

Generally we suppose that collisional processes that result in the formation of crustal-scale nappe structures and generation of collision-related felsic "S-type" granite magmatism characterize the main Meso-Variscan collisional period. Neo-Variscan stage is connected with collapse of the collisionally thickened crust. The final collisional shortening was followed by the gravitational instability of thickened lithosphere, which resulted in the process of thinning of lithosphere (lithospheric delamination, detachment of lithospheric root from the light continental lithosphere, or slab breakoff). As a result of the slab-breakoff, the asthenosphere upwelled and thermal perturbation led to melting of the metasomatised lithospheric mantle and subsequent formation of "I-type" granites at the base of the crust. This period was characterized by a shift from compressional towards extensional tectonics.

Indeed there are small differences between both groups of granitic rocks in the isotopic picture, neither younger metaluminous nor older peraluminous granitic suites have typical geochemical characteristics of continental collisional granites. It is interesting that these isotopic characteristics suggest rather for the origin in volcanic arc with granite melting during subduction of oceanic crust under continental margin, than melting in the consequence collisionally thickened crust.

Magnetic susceptibility of granites worldwide displays a bimodal distribution, with one mode corresponding to the values of 10^{-3} to 10^{-2} and the other one to those of 10^{-5} to 10^{-4} [SI]. The former mode granites, with magnetite representing magnetic minerals, are often represented by an I (igneous) type. The latter mode granites, in which magnetic minerals are represented by ilmenite, often correspond to an S (sedimental) type.