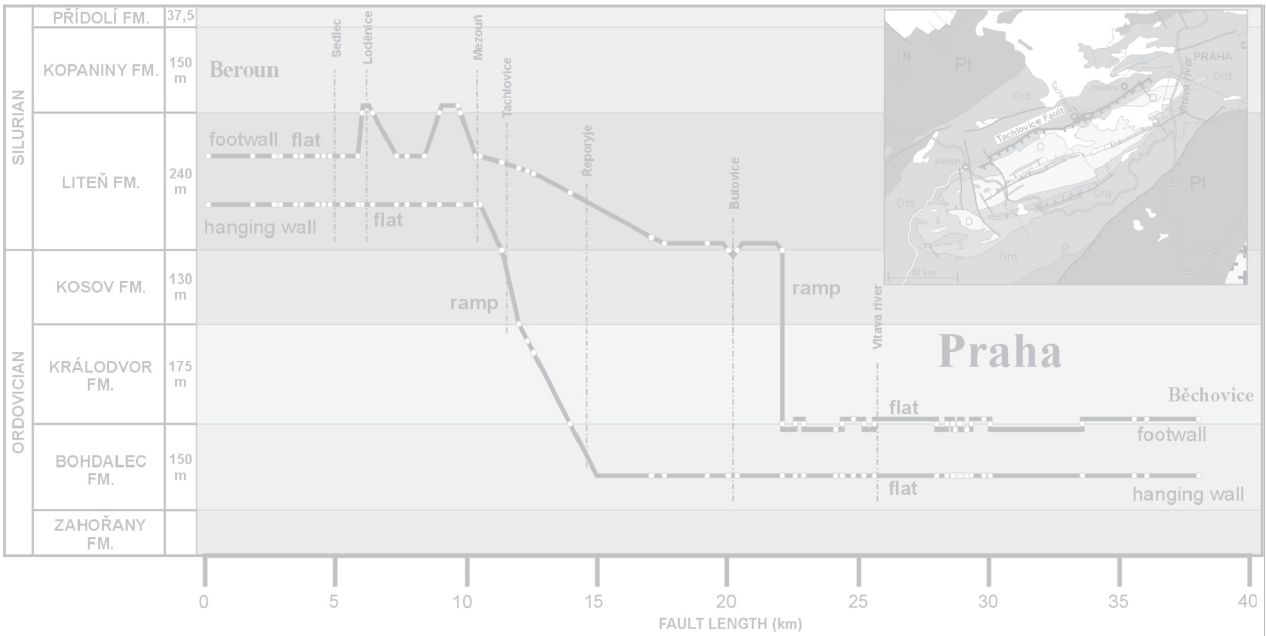

■ **Fig. 1.** Stratigraphic separation diagram (SSD) for Tachlovice Fault and schematic map of the Prague Synform: Pt – Proterozoic, Ord – Ordovician, S – Silurian, D – Devonian.

faulting) was documented by small-scale structures (fault-detachment folds, small ramps, S-C structures and others).

This contradiction is interpreted by a new tectonic model (Melichar 2004): the Tachlovice Fault is a flat-and-ramp fault with large bedding-paralell flats reoriented due to folding to a "normal" fault position. The distance of juxtaposed facies is estimated from several (more than 5) to a couple of dozen kilometers. This study was suported in part by grant GA AV ČR (grant IAAA3013406) and by grant project MSM0021622412.

References

BOUČEK B., 1941. O novém odkryvu siluru u Loděnic. *Zpr. Geol. Úst. Čechy Mor.*, 17: 165-172.

HORNÝ R., 1965. Tektonická stavba a vývoj siluru mezi Berounem a Tachlovicemi. *Čas. Mineral. Geol.*, 10: 147-155.

MELICHAR R., 2004. Tectonics of the Prague Synform: a hundred years of scientific discussion. *Krystalinikum*, 30: 167-187.

SVOBODA J. and PRANTL F., 1948. O stratigrafii a tektonice staršího paleozoika v okolí Chýnice. *Sbor St. geol. Úst. Čs. Republ.*, 15: 1-39.

Magmatic History of Granite-Derived Mylonites from the Southern Desná Unit (Silesicum, Czech Republic)

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In the so far little investigated southern part of the Hrubý Jeseník Mts. (Desná Unit, Silesicum, NE Bohemian Massif) occur granitic orthogneisses and quartz-feldspars mylonites that were variously deformed, metamorphosed and imbricated with the overlaying Devonian volcanosedimentary complex in course of the Variscan orogeny. In such a highly disturbed terrain, where the primary field relations have been nearly wiped out, uttermost care must be exercised in interpreting the field relationships, age, sources and petrogenesis of the igneous protoliths. Only an integrated approach combining detailed mapping with a careful study of petrology, mineral chemistry, as well as whole-rock geochemistry and isotopic composition can be successful, where individual methods in isolation are likely to fail. Such a complex study enabled us to distinguish three main rock groups in the southern part of the Desná Unit:

1. tonalite suite,
2. granite suite, and
3. leucogranite suite.

The tonalite suite is represented by deformed and recrystallized biotite-(amphibole) orthogneisses and stromatitic biotite to muscovite-biotite quartz-feldspar mylonites of tonalitic to granodioritic composition (SiO_2 = 57–69 wt.%). The rocks are calc-alkaline and belong to medium K-series (Peccerillo and Taylor 1976). Zircons are stubby to prismatic, transparent to translucent, colourless to light brown. Almost 65 % grains are indefinable due to the strong resorption. For the rest, a presence of middle to high S-subtypes with peaks in S_{17-18} and S_{22-23} is characteristic. The temperature and alkalinity indexes (I. T. and I. A.: Pupin 1980) are 369 and 642, respectively, indicating a calc-alkaline differentiation trend.

While metatonalites are clearly metaluminous (A/CNK = 0.9–1.0), some samples of mylonites straddle the boundary of the peraluminous domain (A/CNK up to 1.2) probably reflecting secondary loss of alkalis accompanying intense sericitization. The Rb/Sr ratios range between 0.1–0.15 (metatonalites) and 0.07–0.4 (quartz–feldspars stromatitic mylonite). Chondrite-normalised REE patterns are flat with only a slight LREE fractionation (La_N/Yb_N = 3–6.5, La_N/Sm_N = 2.4–2.8, Gd_N/Yb_N = 1.0–2.0); also the negative Eu anomalies are weak (Eu/Eu* = 0.8–0.9). The NMORB-normalized spiderplots display pronounced depletion in Nb, Ti, and P. The LILE are strongly enriched, whilst U and Th show various depletion, more obvious in the most metamorphosed samples. The normalized HREE contents are close to unity.

In terms of the Nd isotopic composition, two analysed tonalite samples are rather primitive, yielding positive ε^{550}_{Nd} values (+3.8 and +3.1) and thus T^{DM}_{Nd} (two-stage depleted-mantle Nd model ages; Liew and Hofmann 1988) of only 0.9–1.0 Ga. Similarly, their $\delta^{18}O$ values are +8.6 and +8.7 ‰ SMOW. The quartz-feldspars mylonite contains surprisingly radiogenic (primitive) neodymium (ε^{550}_{Nd} = +7.3, T^{DM}_{Nd} = 0.64 Ga) and its $\delta^{18}O$ value is correspondingly low (+6.9 ‰ SMOW).

Mostly medium-K calc-alkaline rocks of the granite suite are the most widespread member of the Cadomian basement in the S part of the Desná Unit. The rocks range between porphyroclastic coarse-grained, or fine- to medium-grained, two-mica metagranite and metagranodiorite (SiO_2 = 65–78 wt%). They contain stubby, prismatic zircon crystals, which are transparent to translucent, colourless to light brown. Decrease in the number of high S-subtypes is compensated by increasing role for low S-subtypes and transition to the peaks typical of alkaline subtypes L_5, G_1 and P_{1-4}. Again, Pupin´s (loc. cit.) parameters I. A. = 478–619 and I. T. = 312–553 indicate a calc-alkaline differentiation trend.

The alumina is mostly close to saturation (A/CNK = 1.0–1.1), Rb/Sr ratios are variable (0.2 to 0.8). Chondrite-normalized REE patterns are more fractionated as demonstrated by fairly high LREE/HREE ratios, flat HREE and distinct negative Eu anomalies (La_N/Yb_N = 4.1–14.7, La_N/Sm_N = 2.2–5.2, Gd_N/Yb_N = 1.0–2.0, Eu/Eu* = 0.2–0.8). The NMORB-normalized spiderplots resemble those for the tonalite suite, but the HFSE troughs are significantly deeper. The heterogeneity in the Cs and Rb data implies a metamorphic remobilisation and Pb peak a contamination by mature crustal material. The rocks, together with the previous group, plot into the Volcanic Arc Granite (VAG) field in the diagram of Pearce et al. (1984).

The Nd isotopic composition of the two samples of the metagranites is rather similar to the tonalite suite (ε^{550}_{Nd} = +1.9 to +2.9 and T^{DM}_{Nd} = 1.0–1.1 Ga); the $\delta^{18}O$ values are more variable (+6.7 to +9.9 ‰ SMOW).

Both the tonalite and granite suites seem to belong to a single Cadomian calc-alkaline tonalite–granite association. Fairly primitive nature thereof is shown by the low $^{87}Sr/^{86}Sr_{550}$ ratios (0.7034–0.7038). The Sr-Nd-O isotopic data are compatible, in accord with the rest of the whole-rock geochemical signature, with Neoproterozoic derivation by fractional crystallization of depleted mantle-derived magmas or by remelting of rather young and geochemically unevolved igneous crust. The latter scenario would be supported by the presence of 1.0–1.1 Ga old zircon xenocrysts in some of the metaigneous rocks from the Desná Unit further N (Hegner and Kröner 2000, Kröner et al. 2000).

In addition, the preservation of abundant mafic microgranular enclaves (quarry Krásné), as well as isotopic and geochemical variation, point to some role of magma mixing. Perhaps the most realistic is the scenario in which abundant mantle-derived magmas triggered the partial melting of local immature crust, allowing for some crustal contamination of mantle-derived magmas and mixing between distinct magma batches.

The granite-tonalite association can be correlated with acid-intermediate plutonites of the eastern Brunovistulicum (the so-called Slavkov Terrane), as proposed by Finger et al. (2000). These represents most likely dismembered fragments of deeper levels of a Cadomian continental-margin magmatic arc (Dudek 1980).

Leucogranites (including Polanka and Rudná intrusions) show mutually comparable geochemistry. These alkali feldspar granites are slightly peraluminous (A/CNK = 1.0–1.15) felsic rocks (SiO_2 = 74–78 wt%). Cataclastic medium-grained two-mica leucogranites occur commonly as small lens-like bodies (up to 1 km in length) distributed throughout the studied area. The only little deformed two-mica Rudná granite shows intrusive contacts to the adjacent Desná gneisses, proving its relatively younger age.

Leucogranites show the lowest Sr, P and Ti abundances; the concentration of Rb (Rb/Sr > 3), Th and U is much higher than in the remaining suites resulting in an increased radioactivity. Characteristic are pronounced Eu negative anomalies (Eu/Eu* = 0.15–0.4). Degree of REE fractionation is very low (La_N/Yb_N = 2.2–5.7) and, in case of two samples from Polanka, slightly in HREE (Gd_N/Yb_N = 0.6–1.4). The total REE abundance in the Rudná granite is nearly three times higher than in the leucogranites. Leucogranites show an affinity to, and the Rudná granite plots into the field of, Within Plate Granites (WPG: Pearce et al. 1984).

However, some intrasuite differences exist in magnetic properties, zircon morphology and oxygen isotopic signatures. Stubby to long prismatic zircons in most of the leucogranites are dark brown to nearly opaque or in colour. Frequent are stubby crystals of the G_1 subtype, less so prismatic-bipyramidal zircons of the G_{2-3} subtypes. In the Rudná granite prevail dark brown prismatic zircons of D and P_{2-5} subtypes. Limited proportion of acicular crystals was found in both rock suites; the I. A. and I. T. indexes of Pupin (1980) correspond to an alkaline differentiation trend.

The $\delta^{18}O$ of the Rudná granite are in range of fractionated I type granites (7.0 ‰ SMOW). Two samples of the Polanka leucogranite on the other hand have $\delta^{18}O > +11$ ‰ (+11.0 and 11.9 ‰) and thus are likely to having originated by partial melting, assimilation of, or high-temperature exchange with, the upper crust that contained a significant fraction of rather ^{18}O-rich (meta-) sedimentary or volcanic rocks (Taylor 1978, Hoefs 1997). Their intracrustal derivation would be also in line with the increased contents of the radioactive elements. The chemistry of leucogranites (high silica, fractionated REE patterns, high Rb/Sr ratios, negative correlation of Sr, Ba, Zr, and Eu/Eu* with the SiO_2, enrichment in Rb), resembles that of fractionated granite suites crystallizing feldspar(s) and zircon (Miller and Mittlefehldt 1984, Chappell 1999).

The geochronologic data for felsic granites of the southern part of the Desná Unit are unfortunately missing. However, the Rb–Sr isotopic system yields an indirect indication of a Variscan age, as the Sr initial isotopic ratios age-corrected to Cadomian ages would be impossibly low. Were the intrusions indeed Variscan, the initial Nd isotopic compositions ($\varepsilon^{330}_{Nd} = +0.8$, $T^{DM}_{Nd} = 0.98$ Ga for Polanka and $\varepsilon^{330}_{Nd} = +2.3$, $T^{DM}_{Nd} = 0.86$ Ga for Rudná) would be closely comparable to the tonalite–granite association at that time. On this basis it can be speculated that compositionally similar rocks could have been produced by a Variscan remelting of the local Cadomian crust ($\varepsilon^{550}_{Nd} = +7.3$, $T^{DM}_{Nd} = 0.64$ Ga), analogous to the rocks of the tonalite–granodiorite association. The A-granite (WPG) affinity of the studied felsic rocks could be most plausibly related to magmatic activity during the Devonian break up of the Brunovistulicum.

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References

CHAPPELL B. W., 1999. Aluminium saturation in I- and S-type granites and the characterization of fractionated haplogranites. *Lithos*, 46: 535–551.

DUDEK A., 1980. The crystalline basement block of the Outer Carpathians in Moravia: Brunovistulicum. *Rozpr. Čs. Akad. Věd, ř. mat. přír. Věd*, 90: 3– 85.

FINGER F., HANŽL P., PIN C., VON QUADT A. and STEYRER H.P., 2000. The Brunovistulian: Avalonian Precambrian sequence at the eastern end of the Central European Variscides? In: W. FRANKE, V. HAAK, O. ONCKEN, and D. TANNER (Editors), Orogenic Processes: Quantification and Modelling in the Variscan Belt. Geological Society Special Publication 179, London, pp. 103–112.

HEGNER E. and KRÖNER A., 2000. Review of Nd isotopic data and xenocrystic and detrital zircon ages from the pre-Variscan basement in the eastern Bohemian Massif: speculations on palinspatic reconstructions. In: W. FRANKE, V. HAAK, O. ONCKEN, and D. TANNER (Editors), Orogenic Processes: Quantification and Modelling in the Variscan Belt. Geological Society Special Publication 179, London, pp. 113–129.

HOEFS J., 1997. Stable Isotope Geochemistry, 4th ed. Springer-Verlag, Berlin.

KRÖNER A., ŠTÍPSKÁ P., SCHULMANN K. and JAECKEL P., 2000. Chronological constrains on the pre-Variscan evolution of the northeastern margin of the Bohemian Massif, Czech Republic. In: W. FRANKE, V. HAAK, O. ONCKEN and D. TANNER (Editors), Orogenic Processes: Quantification and Modelling in the Variscan Belt. Geological Society Special Publication 179, London, pp. 175–197.

LIEW T. C. and HOFMANN A. W., 1988. Precambrian crustal components, plutonic associations, plate environment of the Hercynian Fold Belt of Central Europe: indications from a Nd and Sr isotopic study. *Contrib. Mineral. Petrol.*, 98: 129–138.

MILLER C. F. and MITTLEFEHLDT D. W., 1984. Extreme fractionation in felsic magma chambers; a product of liquid-state diffusion or fractional crystallization? *Earth Planet. Sci. Lett.*, 68: 151–158.

PEARCE J. A., HARRIS N. W. and TINDLE A. G., 1984. Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. *J. Petrol.*, 25: 956–983.

PECCERILLO A. and TAYLOR S. R., 1976. Geochemistry of Eocene calc-alkaline volcanic rocks from the Kastamonu area, Northern Turkey. Contrib. Mineral. Petrol., 58: 63–81.

PUPIN J. P., 1980. Zircon and granite petrology. *Contrib. Mineral. Petrol.*, 73: 207–220.

TAYLOR H. P. Jr., 1978. Oxygen and hydrogen isotope studies of plutonic granitic rocks. *Earth Planet. Sci. Lett.*, 38: 177–210.