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Magnetic Fabric of the Veľká Fatra Mts. Granitic Pluton – A Pilot AMS Study

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The study of the anisotropy of magnetic susceptibility (AMS) of rocks provides a useful tool for structural geology and tectonics. In the Central Western Carpathians (CWC), basic results from magnetic fabric studies of most granitoid core mountains are available (for summary see Hrouda et al., 2002). However, AMS data from the Ľubochňa granite pluton of the Veľká Fatra Mts. are still missing. The Veľká Fatra Mountains typify the Core Mountains of the Tatricum, a major tectonic unit in the CWC. Their crystalline basement is represented by the Ľubochňa granitoid massif, consisting of four principal Hercynian granitic rock types building a multistage composite massif: the Smrekovica tonalite (ST) with xenoliths and wall rocks of paragneisses and orthogneisses, the Kornietov granodiorite (KGD), the Lipová granite (LG) and the Ľubochňa leucogranite (LLG). Field study as well as petrological and geochemical investigations revealed relative independence of the above granite types (Kohút, 1992) that reflect differences in the evolution of the Hercynian orogeny in the study area. Lower Carboniferous ages of magmatism of 340 ± 2 Ma were found for the KGD and 356 ± 25 Ma for the LG (Kohút et al., 1997) or 337 ± 9 Ma using cathodoluminescence-controlled single-grain (CLC) method by TIMS, as well as Ion-Microprobe (Poller et al., 2000). On the contrary, Upper Carboniferous age of 304 ± 2 Ma was detected for the ST (Poller et al., l.c.). In addition, magnetic properties (susceptibility and NRMP) differing in individual types of granitic rocks were revealed by Kohút (1992).

In this contribution we present results of our recent AMS investigation of 251 orientated samples from 23 localities of the Veľká Fatra Mts. The measurements were performed on the KLY-3S Kappabridge (Jelínek and Pokorný, 1997). Bulk magnetic susceptibility of the ST (84 samples / 8 localities) is the highest among all the rocks investigated. It ranges from 326×10^{-6} to $5{,}270 \times 10^{-6}$ [SI] with the mean value being $2{,}200 \times 10^{-6}$ [SI], suggesting I-type character of this granitoid. Bulk magnetic susceptibility of the KGD (67 samples / 6 localities) ranges from 46 to $3{,}960 \times 10^{-6}$ [SI] with the mean value being 620×10^{-6} [SI] and lying within the susceptibility range of S-type granites. Bulk susceptibility of the LG (90 samples / 8 localities) is slightly lower, ranging from 23 to $1{,}570 \times 10^{-6}$ [SI] with the main value being 160×10^{-6} [SI].

The degrees of magnetic lineation as well as magnetic foliation are relatively low in most of the samples, ranging from 1.02 to 1.05, with the foliation degree being slightly higher (1.05–1.10) only in ST. Planar magnetic fabric prevails in all granitoid types. In the ST, the magnetic lineation forms a welldefined maximum with the mean direction oriented WSW–ENE, plunging 10° to ENE. Also the magnetic foliation poles are well concentrated with a maximum indicating NW–SE direction, and flat plunges of 10° to 20° to the NE. In the KGD, magnetic lineation forms an irregular girdle orientated NE–SW and plunging SE at moderate angles. The magnetic foliation poles form an imperfect girdle with three conjugated sub-maxima orientated in a NW–SE direction. In the LG, magnetic lineation forms a well-constrained irregular girdle orientated in the NE–SW direction, plunging to the NW at a low angle. The magnetic foliation poles form a sharp anisometric maximum with a tendency to incipient steep girdle directed NW–SE.

Our AMS investigations revealed slightly different magnetic fabrics in individual granite types supporting an idea of multistage pulse character of the Ľubochňa massif of the Veľká Fatra Mts. inferred from field, petrological and geochemical studies. These differences also testify that the Alpine overprint of the magnetic fabric of the Hercynian granite frequent in other parts of the Western Carpathians (Hrouda et al., 2002) was only weak, if any, in the Veľká Fatra Mts. This enables to identify the original Hercynian magmatic fabric to a large extent. The ST is interpreted as an Upper Carboniferous metaluminous intrusion of the I-type granite into the Lower Carboniferous peraluminous S-type granite of the crystalline basement.

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Upper Morava and Nysa Pull-apart Grabens: Implication for Neotectonic Dextral Transtension on Sudetic Faults System

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Pull-apart basins are an integral part of intraplate and interplate strike-slip fault zones (Sylvester, 1988). Bends or sidesteps (jogs) in the main strike-slip fault system generally produce zones of extension (pull-apart basins) at releasing bends or sidesteps. Releasing sidesteps or jogs characteristically produce rhombic pull-apart basins in the overlying sedimentary section (e.g., Aydin and Nur, 1985; Sylvester, 1988). Published synoptic models usually depict pull-apart basins as simple rhombohedra bounded by two vertical, laterally offset strike-slip faults linked by two steep, parallel, oblique-slip extensional faults (e.g., Crowell, 1974; Aydin and Nur, 1985). The experiments made by Dooley and McClay (1997), however, show that pull-apart basins are significantly more structurally complex than these previous synoptic models.

The performed morphotectonic analysis of the Upper Morava and Nysa pull-apart grabens and adjacent areas is based on 3D visualization and interpretation of digital elevation models (DEM), which have been compiled on the basis of detailed digitization of topographic map of 1:50,000 scale. DEM of particular areas were integrated using general DEM of the present relief of the Bohemian Massif based on GTOPO30 database (http://edcdaac.usgs.gov/gtopo30/gtopo30.html). The interpretation of DEM was compared with field mesoscopic structure-tectonic and paleostress analysis of fault populations. Special attention was focused on the architecture and kinematics of the main Sudetic fault system in the studied and adjacent areas.

The genesis and tectonic activity of the Nysa and Upper Morava pull-apart grabens are genetically related to dextral strike-slip kinematic on WNW–ESE- and NW–SE- striking fault zones, namely the Intra-Sudetic Fault, Bušín Fault, Temenice Fault and Konice Fault. Long-term dextral wrench movements and/or dextral tangential (transtensional) stress fields on the above mentioned fault systems has been sufficiently documented from the Late Variscan tectogeny to the neotectonic and Recent stages (e.g., Grygar et al., 1993; Aleksandrowski et al., 1997; Uličný, 2001; Kontny, 2001, etc.). A typical feature of the Sudetic fault system is the *en echelon* pattern of fault network. Releasing sidesteps or jogs superimposed on individual