Magnetic Fabric in Granitoid Plutons of the Jeseníky Mts. and Timing of their Intrusions

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The bulk magnetic susceptibility of the rocks of the •ulová pluton is relatively homogeneous and low, in the order of 10–5 to 10–4 (SI of units is used). This low susceptibility implies that the magnetic fabric is probably controlled by paramagnetic silicates (biotite and ± hornblende), even though minor effects of magnetite cannot be excluded. The anisotropy degree is relatively low, $P<1.05$ in the most specimens. The magnetic fabric is very variable, ranging from clearly linear to clearly planar. The magnetic foliations of the most specimens are flat, the magnetic lineations are mostly sub-horizontal, predominantly oriented NW-SE, i.e. virtually perpendicular to those in the neighbouring areas of the Rychlebské hory Mts. and the Hrubý Jeseník Mts. These AMS features imply that the magnetic fabric of the •ulová pluton is intrusive in origin not affected by the tectonic movements that formed the structures of the Rychlebské hory Mts. and the Hrubý Jeseník Mts.

The bulk susceptibility of the Šumperk granodiorite is very variable, ranging from the order of 10–4 to the order of 10–2. In strongly magnetic specimens, the magnetic fabric is dominantly controlled by magnetite, while in weakly magnetic specimens it is also controlled by paramagnetic silicates (biotite). The anisotropy degree is relatively high and the magnetic fabric is clearly linear. Such a magnetic fabric is rare in granitic rocks where planar magnetic fabrics are very frequent. The magnetic lineations are very well concentrated along its mean direction, being oriented WSW-ENE and plunging WSW 10° to 20°. The magnetic foliation poles are concentrated less perfectly, but still relatively well, moderately plunging SW. The magnetic fabric conforms to that of phyllonite and metagranite surrounding the Šumperk granodiorite and having no doubt deformational fabric. Consequently, the magnetic fabric of the Šumperk granodiorite was controlled by principally the same processes as those controlling the origin of the magnetic fabric in the phyllonite and metagranite, i.e. ductile deformation.

The bulk susceptibility of the Javorník granodiorite is relatively homogeneous and low, in the order of 10–5 to 10–4, implying that the magnetic fabric is probably controlled by paramagnetic silicates (biotite and ± hornblende), even though minor effects of magnetite cannot be excluded. The anisotropy degree is moderate, $1.05<P<1.12$ in the most specimens. The magnetic fabric is mostly planar. The magnetic foliation poles of the most specimens create a cluster gently plunging SE. The magnetic lineations are predominantly oriented NE-SW, i.e. virtually parallel to those in the metamorphic rocks of the Rychlebské hory Mts. and the Hrubý Jeseník Mts. These AMS features imply that the magnetic fabric of the Javorník granodiorite is deformational in origin, affected by the tectonic movements that formed the structures of the Rychlebské hory Mts. and the Hrubý Jeseník Mts.

The re-evaluation of chemical analyses has confirmed the rock classification (the CaO-Na2O-K2O diagram) as granodiorite, revealed a meta-aluminious rock composition (ASI) with exception of the Javorník granodiorite and suggested that all granodiorites belong to the I-type. While the granodiorites are similar in the major element chemistry, trace element composition indicate a light difference. In addition, a difference exists in the REE-distribution. AMS of the •ulová pluton, Javorník granodiorite and Šumperk granodiorite indicate that they must have intruded the metamorphic rocks in different times. While the Javorník granodiorite and the Šumperk granodiorite were emplaced before the deformation phase that formed the magnetic fabric in metamorphic rocks, the granitoids of the •ulová pluton are unaffected by this deformation and should be be younger.

Generalized Angelier-Mechler's/Arthaud's Method

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During the last 20 years, numerical methods of paleostress reconstructions were fairly developed, but no or little progress in graphical methods was recorded, However modern computers and softwere enable good graphic presentation of data. Merit of graphical methods is illustrative relation between data and results. Two basic graphical methods include right dihedra meth-

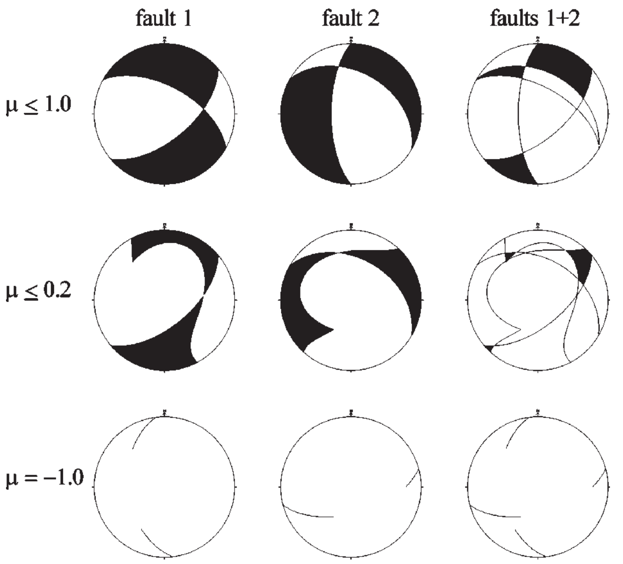

Fig. 1. Equal-area plots for different methods of ó1-determination based on one-fault inversion: Angelier-Mechler's method ($\mu \leq 1$), descripted method (variable μ, e.g., $\mu \leq 0.2$), Arthaud's method ($\mu = -1$, no solution in this case).

od (Angelier and Mechler, 1977) and M-plane method (Arthaud 1969). These two methods are the two marginal cases of general inverse method based on one-fault inverse analysis.

Using fault coordinate system, where l-axis is striae lineation, n-axis is normal to fault plane and m-axis complete right-hand orthogonal system lmn, it is easy to derive equation for Lode parameter $\mu = (2ó_2 - ó_1 - ó_3)/(ó_1 - ó_3)$ in dependence on direction of ó$_1$ and ó$_3$ respectively. This function limits field of possible ó$_1$-directions with decreasing of mmax (Fig. 2a) and ó$_3$-field with increasing of mmin. The field of ó$_1$ is equivalent to right dihedra quadrant for $\mu \leq 1$ as one extreme and is reduced to part of M-plane for $\mu = -1$ as the second extreme (Fig. 1). Base on this idea we can make equal-area plot for fields of ó$_1$ and ó$_3$ with isolines of μ (Fig. 2b, c). With these plots we can determine upper and lower limits of μ (μ_{max}, μ_{min}), and corresponding fields of ó$_1$ and ó$_3$ respectively.

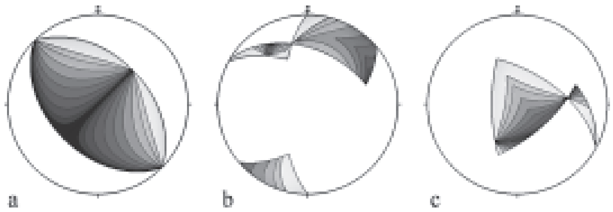

Fig. 2. Equal-area plots of distribution s1 and s3 showing field reduction in dependence on μ_{min} and μ_{max}: a – one fault, ó$_1$-plot with mmin isolines; b – ó$_1$-plot of mmin for two faults from Fig. 1; c – ó$_3$-plot of mmax for the same faults. Isolines of μ: −1.0, −0.9, −0.8, −0.6, −0.3, 0, 0.3, 0.6, 0.8, 0.9, 1.0.

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CELEBRATION 2000: P-Wave Velocity Models of the Bohemian Massif

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In the framework of Celebration 2000 seismic refraction project, an international scientific experiment aimed at investigation of deep lithospheric structure of Central Europe, regions with different tectonic development such as Precambrian East European Craton, Trans-European Suture Zone, Carpathian Belt, Bohemian Massif and Pannonian basin can be studied. The fieldwork for the project was completed in June 2000, when 147 shots were fired along most of the recording profiles with total length of about 8900 km, which resulted in obtaining of 160,000 seismic records.

The region of the Bohemian Massif was studied along two refraction profiles, CEL09 and CEL10, crossing the territory of the Massif and enabling to study its contact with neighbouring tectonic units. The respective seismic sections on the profiles in the Bohemian Massif show good quality recordings with clear first arrivals of crustal and mantle phases, Pg and Pn waves resp., usually up to the distance of 250 km. The Pg waves are observed at offsets to about 150 km with apparent velocity 5.9 km/s for the Bohemian Massif. At larger offsets, Pn waves can usually be observed with apparent velocity of 8.0 to 8.1 km/s. In some sections, higher attenuation of energy of Pg phase is visible at distances between 90–130 km, which may be connected with a specific upper crustal structure.

For interpretation, the tomographic inversion routine of Hole (1992) was used as an efficient tool to determine the seismic P-wave velocity distribution in the crust using first arrivals. The tomographic models were verified by forward ray tracing modelling where apart from first arrivals also further phases were included. This method was based on well established algorithm developed by Červený and Pšenčík (1983) elaborated in further modifications by Zelt (1994).

2-D inversion of first arrivals and reflected phases shows high P-wave velocity gradient zone reaching the depth of 5–7 km followed by small gradient and laterally homogeneous P-wave