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The Mode of Flow and Emplacement of a Trachyte Body of the České Středohoří Mts. Studied by Means of AMS and EBSD Techniques

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The structural investigation of volcanic rocks is restricted by the small size of fabric elements, if macroscopic fluidality is not present. Therefore AMS is often employed, which is a powerful technique precisely investigating the orientation of the magnetic minerals (for review see Tarling and Hrouda 1993). The internal fabrics induced by flow of magma studied by AMS have focused mainly on the basaltic types, forming dykes or lava flows (e.g. Elwood 1978, Herrero-Bervera et al. 2001). Detailed structural analysis of more viscous volcanics due to magma composition and/or high crystal content (e.g. Smith et al. 1993) often forming domes and laccoliths was carried out much less frequently and AMS was rarely employed. The crystal-rich volcanic rocks often show conjugate textural domains (or microshear zones) interpreted to form due to extension or shear of the solidifying magma induced by "viscous drag" of still mobile magma and the bisector of conjugate shear sets indicates directions of maximum stretching and shortening (e.g., Smith et al. 1993).

In our study we have used an integrated AMS and EBSD approach to investigate the kinematics of magmatic flow within a trachyte body Hradiště u Habří and outline the style of its emplacement. We refer to the excursion guide of Šmíd et al. (2003) for the geological characteristics and petrology of the studied trachyte. The structural investigation was carried out using oriented thin-sections parallel with K_1K_3 and K_2K_3 planes of the AMS ellipsoid. The orientation of crystals within the textural domains was measured using the EBSD technique from total 12 thin-sections. The symmetry of the fabric was revealed on the basis of relative aerial representation of synthetic and antithetic microshear domains from image analysis of microphotograph sets of both perpendicular thin-sections. The correlation of the image analysis results and cluster patterns of the susceptibility directions of individual AMS specimens (8 cubes / locality) revealed three types of fabric, which form due to compression at high angle to the magmatic layering. Type I fabric shows equally developed conjugate sets of textural domains in both sections and is matched by girdle of K_2 and K_3 directions from 8 trachyte cubes measured. Type II fabric is typical with clusters rather than girdles of K_2 and K_3 directions and shows well and equally developed textural domains overprinting the primary crystal alignment exclusively in the K_1K_3 section. Type III fabric shows predominance of synthetic shear domains in the K_1K_3 section and equally developed conjugate domains in the K_2K_3 section and are characterized by very narrow clusters of the AMS directions. Type I and II fabrics are denoted as bearing orthogonal and Type III monoclinical symmetry. Since the fabric symmetry corresponds to the symmetry of deformation which caused it (Sander 1970, in Smith 2002) we can use the discrimination of fabric types to unriddle the symmetry of deformation and shear sense throughout the studied cupola using the AMS stereoplots. The interpretation of AMS clustering patterns using this classification assigns coaxial flattening and stretching parallel with the steep western margin of the body in the western rim, strong coaxial flattening in the central part resulting in intense subhorizontal fabric and non-coaxial flow on the northern margin and the eastern slope. In contrast to the rest of the body typical with strongly flattened fabric coupled with intense fabric-parallel fracturing, the southeastern part of the body exposes outcrops irregularly folded or trachytic fabric that is less clearly defined and less intense fracturing. The fabric in this area shows intense folding of the steep vertical magmatic fabric in the K_2K_3 section developing crenulation folds like in metamorphic rocks and the K_3 direction is perpendicular to the newly developed planar fabric element (c-planes). Textural domains showing regular kinks developed due to layer parallel compression of primary subhorizontal fabric are also present. The kinematic analysis revealed that compression axes inferred from several localities which show folding converge to one point and thus locate the feeding conduit. The magma flow and emplacement of the studied body is therefore also characterised by ascent of successive pulses, which cut discordantly through the already present magma and produce folds in the surrounding trachyte due to inflation of each magmatic pulse.

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Tectonometamorphic Evolution of the Svratka Crystalline Complex (NE Bohemian Massif): Evidence for Wrench-Dominated Tranpression along the NE Margin of the Variscan Orogenic Root

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Based on our structural and petrological data from the Svratka Crystalline Complex (SCC) in the northeastern part of the Variscan orogenic root (Bohemian Massif), we interpret tectonometamorphic processes during the later stages of the Variscan orogeny. The SCC is made up of high-grade migmatites, mica-schists, paragneisses and metagranites. The dominant regional fabric observed in these rocks is represented by ~NW-SE metamorphic foliation that dips at steep to moderate angles to the NE or SW. This foliation bears gently to moderately plunging NW or SE stretching lineation. The regional foliation is also roughly parallel to the contacts against the nearby geological units. Various stages of fabric development were recorded in microstructures of the coarse-grained and porphyric metagranites where two domains with different microstructures and finite strain patterns were recognized: (i) Low-strain domain (Vysoký kopec) is characterized by prolate finite strain ellipsoid, slightly fractured quartz aggregates retaining their magmatic shape, initial stages of K-feldspar recrystallization where the lattice preferred orientation (LPO) of new grains is homogenous and discordant to the regional fabric, and total recrystallization of biotite and muscovite. (ii) High-strain domain (Rabuňka) recorded oblate finite strain and is characterized by complete recrystallization and micro-scale deformation of all mineral phases with compositional banding, mechanical twinning and albite exsolution lamellae. LPO of the recrystalized aggregates is in this domain sub-parallel to the regional fabric. Furthermore, our petrological study from the micaschists indicates that that the SCC reached maximum PT conditions of 9 kbar and 670 °C. However, the regional fabric rather reflects the retrograde metamorphic conditions of 6 kbar at 640 °C.

Therefore, we argue that the regional fabric along the NE margin of the orogenic root recorded dextral wrench–dominated transpression at mid-crustal level. This study is supported by projects of Czech Geological Survey (CGS6328 and CGS6352) and by MSM 0021622412.