Fan-Like Structure in Central Part of the Snieznik Dome – A Result of Episodic Exhumation

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The aim of this work is to study the structural and metamorphic evolution of central part of the Snieznik dome in order to characterize synconvergent mechanisms of the exhumation process. The Snieznik dome consists of Cambro-Ordovician orthogneisses and volcanosedimentary Stronie group. Bodies of lower crustal rocks such as eclogites and HP granulites indicating peak conditions of 18kbar/900°C during Carboniferous orogeny were reported within the orthogneisses, while the Stronie series shows only medium pressure metamorphic overprint.

The first studied profile is situated at Velká Morava near Králíky and includes banded and mylonitic orthogneisses, and a strip of the Stronie group composed of mica schist, marble and quartzite. First recognized foliation S1 is preserved in relics being marked by thick monomineralic bands of recrystallized quartz and feldspar in the orthogneisses or by compositional banding in the Stronie group. The S1 foliation is folded by asymmetrical W-vergent close to isoclinal folds with axial planes dipping under intermediate angels to the east. The folding leads to almost complete transposition into the S2 foliation, which is characterized by destruction of the monomineralic HT bands in the orthogneisses into fine-grained mylonitic fabric. The metamorphic evolution in the micaschists of the Stronie group is characterized by the following succession of mineral assemblages: Ctd-Grt, St-Grt-Bt-Ms-Plg and Chl-Ms. The straight inclusion trails in garnets, which are oriented often at high angles with respect to the external foliation and ctd and st inclusions indicate the growth of chloritoide, garnet and staurolite to be contemporaneous with the S1 foliation. The S2 cleavage is associated with the crenulation of S1 quartz bands coupled with the mechanical rotation of matrix staurolite, muscovite and biotite. The D2 deformation, in some samples, is associated with growth of chlorite and white mica at the expense of plagioclase. In order to obtain information on the PT evolution of the observed structures, the development of the mineral assemblages in metapelites was modelled in the KFMASH system using the THERMOCALC software, and the maximum PT conditions were calculated by the average PT method.

The second studied E-W profile is situated near Gieraltow. The dominant rock types are orthogneisses exhibiting different degree of anatexis and mylonitization. Boudins of eclogites are also present. The first recognized foliation in the orthogneisses is a HT monomineralic banding of subhorizontal orientation. It is folded by W-vergent open to isoclinal folds with subhorizontal hinges and E-dipping axial planes. Domains with S2 transposed foliation are dipping under steep angles to the east being characterized by destruction of thick monomineralic bands into fine-grained texture. F3 folds are E-vergent with W-dipping axial planes and subhorizontal axis. The metamorphic conditions of the observed structures were not studied due to the lack of suitable lithologies.

The earliest HT foliation in the orthogneisses shows subhorizontal trend, however, its tectonic significance remains unclear. The second observed structure is developed in both studied profiles. It is dipping to the east being characterized by the west-vergent folding which is attributed to compressional forces possibly induced by the subduction zone located in the Rudawy Janowickie. The third observed structure characterized by east-vergent folds and west- dipping foliation is responsible for the eastward exhumation. It is interpreted to be a result of the indentation of rigid margin of the Silesian domain in the east.

Multiple Fabric Patterns and Emplacement Mechanisms of a Composite Batholith: A Result of Polyphase Tectonic Evolution of Continental Magmatic Arc (Central Bohemian Batholith, Bohemian Massif)

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The Central Bohemian Plutonic Complex (Bohemian Massif, Czech Republic), is a large composite batholith made up of multiple individual plutons emplaced over relatively short time span of about 10 Ma. Structurally and petrologically contrasting domains are exposed along batholith margins. To the NW, the host rocks are dominated by low-grade Neoproterozoic to Lower Paleozoic volcanic and sedimentary sequences of the Teplá-Barrandian Zone, whereas along the SE margin of the batholith

the high-grade migmatites, orthogneisses and paragneisses of the Moldanubian Zone crop out. Based on geochemical and petrological data, most of intrusions of the batholith are interpreted as magmatic arc granitoids with involvement of mantle derived mafic magmas situated above subduction zone. Late stages of magmatism are represented by abundant dike swarms cutting through both granitoids and host rock. In the present study, we use geometry, macroscopically determined as well as anisotropy of magnetic susceptibility fabric patterns and likely emplacement mechanisms of individual plutons to interpret the polyphase tectonic evolution of the Variscan magmatic arc and we demostrate how internal fabric patterns of plutons may be used for reconstruction of temporal evolution of strain and stress fields in magmatic arcs and convergent orogens.

Based on field relationships, geometry, fabric patterns and inferred emplacement mechanisms, we have recognized four main types of plutons making up the Central Bohemian Plutonic Complex, we describe each of these in detail below. (i) Plutons emplaced in supracrustal level during regional transpression (~ 350–346 Ma): these plutons are exposed along NW margin of the batholith and comprise strongly elongate and sheet-like (Vltava granodiorite, marginal and Milín granodiorite, Kozárovice intrusion) to more elliptical and irregular bodies (Sázava pluton – aspect ratio 2/3 in map view) emplaced during transpressional deformation. Their common characteristics are elongate shape in map view (with longer axis parallel to the margin and trend of regional structures) and strong internal fabrics, entirely coupled with Barrandian host rocks (NE-SW striking steep foliation and sub-horizontal NE-SW trending lineation determined by mean of AMS, mostly oblate to plane strain fabrics). Mechanisms which may have accommodated pluton emplacement during transpression involve multiple material transfer processes, large-scale pressure solution, ductile shortening of host rock and magmatic stoping. (ii) Nearly circular plutons with coupled or partially decoupled fabric patterns (Požáry and Nečín trondhjemites, ~350 Ma) emplaced during regional transpression in higher crustal levels have typically very weak magmatic fabrics, commonly parallel to margins and subhorizontal in central part of the plutons. We interpret this partially decoupled internal fabric pattern as a result of higher ascent velocity in contrast with strain rate of regional traspression. Little field evidences, except the presence of stoped blocks near pluton roofs, do not allow us to interpret emplacement mechanisms of these plutons in detail. (iii) Intra-arc, younger irregularly shaped plutons emplaced into earlier magmatic bodies as well as into high-grade migmatites and paragneisses are represented by high-K granodiorites (Blatná and Červená granodiorites) and minor granitic sheets along southern margin of the batholith. Fabric pattern of the Blatná granodiorite is more complex, showing both steep transpressional magmatic fabric trending mainly NE-SW and younger magmatic fabric dipping at moderate angles to NNW in the SE part of intrusion. The SE margin of the Central Bohemian Plutonic Complex was overprinted by up to 10 km wide zone of sub-solidus to solid-state deformation displaying extensional SE-side-up kinematics with moderately dipping stretching lineations being associated with exhumation of the Moldanubian Zone. Emplacement of these granitoids was probably related to gravitational collapse and exhumation of the orogenic root domain. (iv) Tabular plutons: tabular shape was proposed according to gravity measurements for porphyric durbachites (Čertovo Břemeno, ~343 Ma). This pluton has elliptical shape in map view with E-W longer axis; our intial fabric study revealed flat to moderately dipping magmatic fabrics, which may reflect the tabular shape of this body. In the Votice area, durbachites also occur as moderately dipping sheet-like bodies displaying highly localized sub-solidus deformation and S-side-up kinematics resulting from exhumation of the Moldanubian Zone. Floor depression or roof uplift due to relaxation of vertical component of stress field may explain the emplacement and tabular shape of the pluton. All the above described plutons are cut by E-W dike swarms of variable composition reflecting late N-S extension. The dike swarms testify for stress regime reversal under still high magma pressure, established after gravitational collapse.

By summarizing structural, fabric and emplacement characteristics of individual plutons making up the Central Bohemian Plutonic Complex and adjacent host rocks, we show that magmatic processes and internal fabrics of plutons may record complete structural history and evolution of magmatic arc from the early crustal thickening to subsequent collapse and exhumation of deep rocks and re-establishment of original stress regime. Our data along with precise geochronology may serve as an example of reconstruction of temporal evolution of ancient strain and stress fields in transpressional magmatic arc.

Physical Processes Along Internal Boundaries In An Continental Arc Magma Chamber: Tuolumne Batholith, Central Sierra Nevada, California (USA)

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Incremental growth of magma chambers by epizodic assembly of magma pulses, as proposed by recent models of magma chamber construction, dramatically affects the nature of internal processes, the rates and mechanisms by which heat and mass are transported through the crust (and therefore rheology and deformation of orogenic belts), and how we view and thus solve the emplacement problem. Understanding internal processes and their structural expression in plutons is crucial