the places of local Cr-enrichment in aluminous metasediments containing a significant proportion of weathering products of metabasites.

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Magma Chamber Construction during Crustal Thickening and Subsequent Exhumation: An Example of Interplay between Magmatic and Tectonic Processes from the Central Bohemian Batholith (Bohemian Massif)

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The Central Bohemian Batholith (CBB), exposed along a major tectonic boundary between two juxtaposed major crustal units (upper crustal Teplá-Barrandian Zone and lower to middle crustal Moldanubian Zone), consist of multiple intrusions of calc-alkaline to potassium-rich granitoids, syenitoids and mafic rocks emplaced during ~351–341 Ma. To the NE of the CBB, country rocks are characterized by low degree of regional metamorphism and comprise Neoproterozoic to Lower Paleozoic volcanic and clastic sedimentary sequences, whereas high-grade migmatites and orthogneisses of the Moldanubian Zone crop out to the SE. The early stages of magmatism in the CBB are recorded by biotitic orthogneisses (370 Ma), which are considered to represent the oldest intrusive events of the CBB, preserved in roof pendants and stoped blocks. Based on geochemical and petrological data, the CBB intrusions are interpreted as mostly island arc granitoids with involved mantle-derived mafic magmas situated above subduction zones.

In the present study, following our previous research on the emplacement of the Sázava tonalite (~349 Ma) during highly oblique transpression (•ák et al., 2001), we evaluate the structural evolution and mainly concentrate on fabrics and structural analysis, complemented by microstructural and AMS data of Kozárovice intrusion (equigranular and phenocrystic granodiorite), Blatná (~346Ma) and Červená granodiorite (in the central part of the CBB) and its internal contacts. The Kozárovice intrusion is characterized by strongly developed steep NE-SW trending magmatic foliations and sub-horizontal magmatic lineations superimposed on older flat relict magmatic fabric of variable orientations. Along contacts with roof pendants, the pre-existing magmatic structures were overprinted by margin-parallel narrow zone of sub-solidus deformation. Both magmatic and subsolidus fabrics are concordant with contractional structures in the host rocks and reflect synmagmatic wrench-dominated transpressional tectonics in the area. Structural pattern of the Blatná granodiorite is more complex, showing both steep magmatic fabrics trending mainly NE-SW, corresponding to transpressional structures in the Kozárovice granodiorite (in NW part of intrusion), and younger magmatic fabric dipping at moderate angles to NNW in the SE part of intrusion. This fabric is parallel to elongation of the intrusion and marks the onset of tectonic switching from transpressional to extensional tectonics. Zones of subsolidus deformation are developed along both NW and SE margins of the Blatná granodiorite. A narrow zone of sub-solidus fabric adjacent to the contact between the Kozárovice and the Blatná granodiorite implies short time interval between these two intrusive events, where the former one was at least partly solidified at the time of intrusion of the Blatná granodiorite. Up to 10 km wide zone of sub-solidus to solid-state deformation developed along SE margin of the CBB (the Červená granodiorite) displays extensional SE-side-up kinematics with moderately dipping stretching lineations being associated with exhumation of the Moldanubian Zone.

Preliminary AMS data from the Kozárovice and Blatná granodiorites confirm that magnetic fabric is in most cases consistent with the observed mesoscopic structures. Magnetic susceptibility ellipsoids show both prolate and oblate shapes, magnetic foliations dip at steep to moderate angles approximately to the NW, whereas magnetic lineations are either subhorizontal (corresponding to transpressive sub-horizontal magmatic lineations) or moderately dipping as a result of subsolidus extensional deformation.

We demonstrate on a given example of the CBB that magmatic processes and internal fabrics of plutons may record complete structural history and evolution of island arcs, i.e., the initial contraction and crustal thickening (Kozárovice granodiorite) and subsequent collapse and exhumation of orogenic root (Moldanubian Zone) – the Blatná granodiorite. Furthermore, the presence of transpressional and extension-related magmatic and subsolidus fabrics within single intrusion suggests rapid switch of tectonic regimes in comparison to pluton cooling rates and shows how complex and dynamic are processes attributed to magma ascent and emplacement during contractional and extensional deformation in ancient island arcs. We assume, that similar relationships between granitoids emplacement and tectonic switching may be, in general, common feature of many plutons throughout the European Variscides (e.g. Vosges, Massif Central, etc.).

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Eastern Margin of the Tuolumne Intrusive Suite (Sierra Nevada Batholith): Magmatic Fabrics, Internal Structures, Host Rocks Deformation and Emplacement Models in a Continental Island Arc Magma Chamber

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The Tuolumne Intrusive Suite (TIS) (~2000 km^2) crops out in the central part of the Sierra Nevada Batholith (California, USA), which represents highly voluminous continental margin arc emplaced during the Jurassic to Cretaceous. The TIS (91–82 Ma) is normally zoned from outer mafic phases (Glen Aulin and Glacier Point tonalites to the west and Kuna Crest granodiorite to the east) to progressively more silicic inner phases (Half Dome and Cathedral Peak granodiorite and Johnson granite porphyry). Geochemical and geochronological data show that TIS consist of 5 different pulses and the entire suite was emplaced and crystallized over a 10–13 Ma period. The TIS host rocks are represented by the 102 Ma El Capitan granite or Early Cretaceous granitoids and thin metasedimentary pendants along the western margin and metasedimentary and metavolcanic rocks with complex polyphase structural history to the east. Deformation of the eastern margin of the TIS is interpreted as a result of steep syn-crystallization shear zones (Gem Lake and Cascade Lakes shear zones) displaying mostly steep to moderate stretching lineations and more than 20 km dextral offset. Geophysical measurements and field relations suggest that the exposed part of the TIS represent the upper part of much deeper magma chamber with vertical contacts that may extend downward 7–10 km.

Our structural work focused mainly on the eastern central part of the TIS including host rocks and internal contacts between several different intrusive phases. Country rock adjacent to the contact with the Kuna Crest granodiorite, dominated by Ordovician and Mesozoic metasediments and metavolcanics, are strongly deformed (Gem Lake shear zone), characterized by steep foliation dipping to the E or ESE parallel to the intrusion margin and steep to moderate stretching lineation. We have not observed consistent kinematics along the eastern margin of the TIS, which shows both dextral and sinistral shear sense, suggesting more complex kinematic history of the Gem Lake shear zone. According to our observations, we suppose that concepts of shear zones adjacent to intrusion margins could have mixed up local shears with contact aureoles. In places, pure shear component of transpression dominates. Deformation of host rocks along intrusion margin was strongly controlled by the presence of syn-deformational melt, either in-situ or injected from the adjacent granodiorite.

Magmatic fabric in the outermost Kuna Crest granodiorite is characterized by steep lineation and steep foliation striking NW-SE, oriented at high angles to the contact, which are overprinted by margin parallel steep sub-solidus fabric and shear zones. In the internal parts of the TIS, our structural mapping revealed mostly homogenous orientation of magmatic fabrics oblique to contacts between internal units, characterized by steep lineations and steep foliations striking NW-SE. Locally we find steep magmatic foliation striking NE-SW forming two perpendicular sub-fabrics. Zones of cumulates, mafic schlieren, ladder dikes and volatile-rich schlieren tubes are most common in the Cathedral Peak granodiorite and increase in number near contacts throughout the studied part of the TIS, mafic schlieren are sometimes oblique to magmatic fabric. Internal contacts between intrusive pulses diplay various geometries, from clear and sharp contacts between the Half Dome and the Cathedral Peak granodiorite to complex sheeted instable contact between the Half Dome and Kuna Crest granodiorite with wide range of disequilibrium structures. Internal magmatic fabric patterns, cross-cutting contacts between intrusive phases within the TIS suggest that fabrics in magmatic systems originate after or during the final stages of magma chamber construction and represent last strain increments before complete crystallization.

Various emplacement models have been proposed for the TIS, including expansion of concentrically emplaced plutons, passive emplacement into tensional bridges between en-echelon P-shear arrays and nested diapir model, where multiple material transfer processes operated during emplacement. Although preliminary results of our structural work suggest that emplacement of the TIS could have been controlled by both transtensional and contractional tectonics, where most of material transfer occurred in a vertical direction, further research will result in evaluating and testing the above mentioned emplacement models. In addition, abundant geochronological data in the TIS, provide a basis for estimation of magma chamber construction rates and strain rates within intrusion aureoles. Strain intensities in the host rock vary significantly with distance from intrusion margin, indicating that deformation rates associated with intrusion of large volumes of magma may be much faster (in range of 10–4 – 10–13) than rates of regional deformation, as proposed by previous research, kinematic models and preliminary strain analysis in host rocks of the TIS.