Syntectonic Emplacement of Leucogranitic Magma during Oblique Transpression: the Boundary between the Vepor and Gemer Units (West Carpathians)

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This work is primarily focused on the interpretation of leucocratic granite emplaced along the boundary between the Vepor and Gemer crustal units, its internal fabric and timing of intrusion. The age and the role of this intrusion have been a matter of debate among Carpathian geologists for a long time. Andrusov et al. (1953), Klinec et al. (1962) suggested that it is an integral part of the Vepor crystalline basement build up mainly of Grt-Bt schists and leucocratic orthogneisses. However, Kantor (in Vozárova et al., 1979) proposed that the granitoids are Cretaceous in age and were emplaced parallel to the major tectonic boundary between the Vepor and Gemer units. This concept is based on the presence of a narrow contact metamorphic aureole developed in the Slatvina Formation (Late Carboniferous cover of the Vepor crystalline basement). The contact metamorphism affected greenschist facies rocks being marked by the occurrence of biotite schists, almandine-biotite and cordierite-andalusite hornfels. The PT estimates from contact mineral assemblages by Vozarová (1990) indicate the depth of intrusion at 2 kbars.

The greenschist facies metamorphic schistosity in the Slatvina Formation is generally dipping to the south and is overprinted by late lower greenschist S2 fabric. The S2 is a predominant structure, steeply dipping to the SE and bearing stretching and mineral lineation plunging to the SW. The whole sequence is overprinted by late compressional kink-bands indicating an E-W stress orientation. The leucogranite intrusion in footwall of the Slatvina Formation is almost undeformed showing only a weak magmatic fabric. The uppermost part of the intrusion is characterized by finger-like dikes and sills crosscutting the original metamorphic fabric. These dikes indicate coeval magma intrusion with development of S2 cleavage and also with contact metamorphism. The degree of leucogranite deformation increases towards the underlying Vepor basement gneisses. Here, the transition from magmatic to solid state deformation is manifested by narrow shear zones indicating sinistral sense of shear.

The preliminary AMS data show homogenously developed subhorizontal magnetic lineation and mostly steep magnetic foliation. The intrusion shows very low degree of anisotropy and mostly oblate character of magnetic ellipsoid. Structural and AMS analyses reveal that magmatic fabrics and sub-solidus shear zones are geometrically consistent with late D2 oblique transpression. Importantly, the structures and magnetic fabrics in the Vepor basement are discordant with respect to those developed in leucogranite and the Slatvina Formation.

The U-Pb zircon dating (laser ablation ICPMS) of the basement gneisses gave a concordia age of 551 ± 17 Ma (2 sigma), while the zircons from the leucogranite yield an age of 395 ± 8 Ma. We suggest that the latter event represents the age of the protolith, which the leucogranite was derived from. Alternatively, if the leucogranite originated by melting of sedimentary rocks, the early Devonian age would correspond to zircon crystallization in the source of the sediments. In either case, the U-Pb zircon age of 395 ± 8 Ma corresponds to the maximum age of the protolith that contributed to the leucogranite melt. However, the age of magmatic crystallization of the leucogranite still remains to be established.

Despite the fact that the age of granite was not determined to be Cretaceous using the U-Pb method, the structural disconformity between the Vepor basement and the overlying granite and Carboniferous cover indicate also temporal difference in structural records. The coherency of leucogranite internal fabrics with D2 transpressional deformation affecting also Mesozoic rocks may still indicate its Cretaceous age of emplacement. We hope that the Ar-Ar dating currently in progress will help to clarify this problem.

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Successive Intrusion of Three Calc-Alkaline Granites during Oblique Transtension: Central Part of the Vosges (NE France)

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The studied area is situated in the central (Moldanubien) part of the Vosges (NE France). Successive intrusion of three calc-alkaline granites, (the Thannenkirch granite, the Brezouard granite and the Bilstein granite) separating medium-pressure rocks to the north from low-pressure anatectic crust to the south, was investigated. Based on AMS data and detailed structural analy-

sis we propose an emplacement scenario for the intrusions and AMS fabric development in oblique extensional regime.

Purely magmatic structure in the Thannenkirch granite is defined locally by strong alignement of feldspar phenocrysts. In the Brezouard granite is preserved transition from magmatic fabric, high temperature solid-state to low temperature solid--state, typical of syntectonic intrusions. Very weak magmatic fabric with no visible foliations and lineations is characteristic of the internal part of the intrusion. Towards the southern margin, the magmatic structure grades into sub-solidus S-C fabrics with steep pervasive foliation and development of a sinistral shear zone. The Bilstein granite is heterogenously deformed in green – schist facies conditions showing sinistral S-C structures, subvertical magmatic foliations and horizontal lineations. Shallowy dipping sillimanite gneisses exposed in northern part of the intrusions follow exactly the geometry of the plutons.

The magnetic fabric in all intrusions is generally characterised by low degree of anisotropy. The highest value of P` parameter corresponds to marginal parts of the intrusion, whereas towards the central part of intrusion the P` decreases. The shape of magnetic ellipsoid (parameter T) varies from oblate and neutral in the central parts, and prolate in marginal parts of the plutons. The AMS fabric in the Thanennkirch and Brezouard granites are characterized by the developement of NW-SE trending lineations in central parts of the plutons and E-W trending lineations along these borders. The Bilstein granite shows homogenous WNW-ESE lineations. The results of AMS are consistent with observations in the field.

Based on the above – mentioned assumptions we suggest that the depth of emplacement progressivelly decreased during the transtension deformation. Generally NW-SE stretching in the central and wide parts of plutons and dominantly horizontal flow in association with the development of sinistral shear zone in the pluton margins and the Bilstein granite reveal the importance of strain partitioning. We assume that the Thannenkirch granite intruded in mid-crustal levels controlled by two major tranccurent faults. Further extension is responsible for active thinning of gneissic unit, its strong anatexis (the Kaysersberg and Trois Epis migmatites) and coeval intrusion of the Brezouard granite. Finally, the Bilstein granite intruded already strongly thinned and molten crust in transccurent regime. This mechanism of successive magma batches is responsible for the actual disposition of medium-grade metamorphic rocks to the north and low pressure migmaties to the south stitched by granitic comlex. Telescoping of Ar-Ar cooling and U-Pb intrusion ages (330 Ma) and geochronological data in the migmatites (330 Ma) proved that the intrusion activity was coeval with crustal thinning and occured during a short period of time.

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Deformation Mechanisms, Mineral Chemistry, and P – Wave Velocity Patterns from Mylonitic Metagabbros Deformed at Amphibolite and Granulite Facies Conditions

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We have investigated two mylonitic metagabbro belts of C-O protolith ages (Staré Město belt, Czech Republic) deformed at oblique transpressive regime. The upper gabbro sheet was underplated by a Variscan tonalite body, one to two kilometre thick. The second gabbroic sheet occurs in the footwall of the tonalitic intrusion, from which it is separated by a 1 km wide sequence of metasediments. The temperature of metamorphism is therefore higher in the upper sheet than in the lower one. The aim of this study is to compare deformation mechanisms of gabbros deformed under the same tectonic regime approximately at the same time but at different temperatures. These data are compared with P-wave velocity patterns in order to make implications for seismic anisotropy of mafic lower crust deformed at different thermal regimes.

The structural evolution includes pre-Variscan C-O fabrics in weakly deformed parts of both metagabbro belts. The main Variscan fabrics show indentical foliation and lineation patterns as well as kinematics in both metagabbro sheets represented by the N-S trending W dipping steep planar structures and dextral kinematic indicators. However, deformation styles in the two metagabbro nappes are different. In the lower unit, the deformation is concentrated into localized shear zones which separate undeformed boudins with preserved magmatic textures. Whole unit is bounded by two mylonitic thrust zones at the top and at the bottom respectively. The deformation intensity in the upper unit is stronger, relict magmatic textures are rare. The metagabbro shows a well-developed planar structure with monomineral hornblende-plagioclase bands.

The main metamorphic phase is of Variscan age and it can be correlated with the deformation and also with the tonalite intrusion. Mineral associations in the metagabbros are following: hbl + pl ± ttn ± opq in the lower sheet and hbl + pl + grt ±