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The thesis of Zita Bukovská about "*Localization of deformation in rocks with existing anisotropy: consequences for geodynamic interpretations*" investigates the deformation localization in rocks with existing anisotropy, which can be seen in the form of a shear band cleavage, and on the interpretation of such fabrics with respect to the tectono-metamorphic evolution of the studied areas. Shear band cleavage has been firstly described by Roper (1972, Geological Society of America Bulletin 83, 853-860) followed by numerous studies (referenced in the thesis) about their geometry, the kinematic interpretation and the mechanics of their formation. Although several studies try to include chemical feedback processes in the investigation of shear band cleavage, many questions especially about the geodynamic parameters, which can be derived from shear band cleavage, are not fully answered. The study follows a multi-scale approach describing shear band cleavage in the regional field and investigating the structures analytically from the hand sample to the microscopic scale. Several areas in Tauern Window (Eastern Alps), in the Central West Carpathians (Slovakia) and in Armorican Massif (France) have been selected as the field laboratory for studying the shear band cleavage. The micro-analytical methods focused on the investigations of deformation mechanisms, pressure and temperature conditions during formation of the shear band cleavage.

After a short introduction the thesis is structured into four chapters, all of which represents individual publications, which will be discussed in the following:

Chapter I “Two separate orogen-parallel extension events in the Tauern Window revealed by crystallization–deformation relations” investigates the geodynamic evolution of the western Tauern Window by means of structural field observations and petrological methods. The studied rocks, which are Variscan intrusions overthrusted by various nappes, have a polyphase history but are dominated by the Alpine nappe stacking and exhumation of the Tauern Window. Structural field studies demonstrate that the dominant S1 fabric corresponds to the nappe stacking recording a E-W trending lineation L1. N-S shortening within the Tauern Window is documented by F2 folds with steep S2 axial planes and W-E trending fold axes. The W-E trending lineation L3 is caused by an orogen-parallel extension and lateral escape towards W. Mineral geochemistry of garnet and thermodynamic modelling with Perple_X record a prograde metamorphic path for garnet with P-T conditions from about 460 °C to 560 °C and 400 to 900 MPa.

Chapter II about “Kinematically unrelated C-S fabrics: an example of extensional shear band cleavage from the Veporic Unit (Western Carpathians)” is already published in Geologica Carpathica 2013, 64(2):103-116. Along the tectonic contact between a basement and cover unit in the Central West Carpathians a shear band fabric (confusingly called C-fabric) overprints an earlier S-fabric suggesting that the two structures have been formed by two distinct tectono-metamorphic events. The first formation of the S-fabric is associated with Cretaceous orogen-parallel flow and the second shear band cleavage formed during subsequent exhumational unroofing. Besides the observation that the two fabrics formed during different metamorphic conditions, the two tectonic phases can be discriminated by an inter-tectonic growth of chloritoid-, kyanite-, monazite-bearing assemblage. U-Th-Pb dating of monazite yielded an age of about 97 Ma demonstrating that least 10 Ma between the formation of S-fabrics and the superposed C-fabrics in the studied rocks.

Chapter III This microstructural study focus on the evolution of the S-C fabrics from South Armorican Shear, which is one of the classical areas, where pioneer work has been done on shear band fabrics. These original studies explain the formation of the structures by simple shearing of synkinematic plutons, which intruded into the South Armorican shear zone around 315–300 Ma. The present study demonstrates a more complex three stage evolution, where the C fabrics develop on microcracks followed by crystal plastic deformation of quartz and coeval dissolution precipitation creep of feldspar. The fabric is overprinted by localized deformation along mica shear bands. The microtectonic studies have some important implications for the strength evolution at the brittle-ductile transition zone. If near the brittle-ductile transition zone not quartz deforming by crystal plastic processes controls the strength of the crust but phyllosilicate shear bands accommodate the deformation, crustal strength may evolve in time and eventually reduce to small values of less than 10 MPa.

Chapter IV Dissolution precipitation creep has been the central topic of numerous recent studies including microtectonic, petrological and geochemical investigations on both, natural and experimental geomaterials. This study, accepted for publication in Contributions to Mineralogy and Petrology, demonstrates evidences for pressure solution along quartz–mica–K-feldspar grain boundaries in orthogneisses using high-resolution analytical techniques (transmission electron microscopy and focused ion beam scanning electron microscopy). Again rocks from the South Armorican Shear Zone were investigated. The study shows that besides well-known effects of local differentia stress and composition of fluids, the relative spatial crystallographic orientation of phases and the local dislocation density plays a major role in the efficiency of the operating processes confirming the crystallographic controlled island and channel network suggested by Wassmann and Stöckert (2013, Tectonophysics 608, 1-29).

In general, I have only three minor points of criticism:

Firstly, I suggest for further publication of the work that all figures of structures should indicate an orientation. Although it might not be relevant for the purpose of the present study, some readers might be interested not only in the exact locations of the pictures (given in GPS coordinates in the Appendices) but also in the orientation of kinematic directions of shear sense criteria or orientations of folds.

Secondly, the density contours of data points in the stereoplots are sometimes inadequately chosen (e.g. Fig. 2 on page 11). The density of point data are usually measured as percentage of the total number of points per % counter area of the stereogram. In the presented stereoplots, I guess a 1% counter area has been selected, which is only valid for a large number of data points (N>891, Pollard and Fletcher, 2005, Cambridge University Press). A proper setting of these values would prevent that the contouring algorithm detects isolated single data points.

Thirdly, and this is probably my major issue, parts of the thesis would benefit from a clear distinction between the different structures, which are collectively described as shear band cleavage (in the thesis called S-C fabric). Although, I agree that there is quite some confusion and inconsistencies in literature about shear band fabric, sc- and scc'-structure or extensional crenulation cleavage, recent numerical models and experimental data have shown, that for example c-type fabrics and c'-type structures may form in totally different model setups (e.g. Dabrowski et al. 2012, JGR 117, B08406, Schmalholz and Maeder, JSG 37, 75-88). Although these models are enormous simplifications of nature and the processes studied in the thesis, I think it is important to clearly discriminate between c'-type and c-type shear band cleavage (as suggested also in Passchier and Trouw, 2005). According to this classification, the structures shown in Fig. 2 on page 65, for example, would be a c-type shear band cleavage but Fig 2 on page 39 shows c'-type shear band cleavage. Obviously, there are transitions between c and c'-type fabrics and the thin sections on page 66 might show such a transition (stage I and stage II are c- and stage II are c'-type fabrics). Whereas c-type cleavage can (but does not necessarily has to, as shown in the thesis) form simultaneously in a single shear deformation event within an un-foliated rock volume, c'-type cleavage always forms on a pre-existing fabrics. This distinction is not only a semantic but thorough multidisciplinary studies, like the present thesis, together with mechanical modelling might result in important knowledge increase about the complex processes leading to the formation of shear band cleavage.

Besides the minor points mentioned above, I conclude that the doctoral thesis of Zita Bukovská represents excellent scientific research and besides the published papers in Geologica Carpathica and Contributions to Mineralogy and Petrology, I have no doubt that a number of other relevant papers will be published from the presented scientific material. Personally, I am very impressed by the versatility of the research of Ms. Bukovská comprising field geology, structural geology, petrology, geochemistry, rheology and geodynamics. Compared with international standards, the thesis is of very high quality and fulfills in my opinion all criteria and requirements necessary for obtaining the PhD degree. Therefore I can conclude that it is for me absolute no question that Ms. Zita Bukovská should be admitted to the oral defense of her doctoral thesis.

With complements, Bernhard Grasemann