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Problems Related to the Role of Shear-bands as Kinematic Indicators

Ondrej LEXA[1], John COSGROVE[2] and Karel SCHULMANN[1]

[1] *Institute of Petrology and Structural Geology, Charles University, Prague, Czech Republic*
[2] *T.H. Huxley School of Environment, Earth Sciences and Engineering, Imperial College, London, United Kingdom*

Small-scale shear zones inclined at intermediate angles to an earlier anisotropy are often observed in deformed rocks. They are traditionally described as shear bands, C-bands, extensional crenulation cleavage, asymmetric boudinage, asymmetric folds or normal kink bands formed as a result of extension along an older anisotropy (or shortening perpendicular to the anisotropy). Their sense of shear (or internal rotation) and geometry are widely used to describe the large-scale kinematics of deformation and/or the deformational history of a given area. These various structures result from different processes and unless this is fully understood, there is a great danger of drawing wrong conclusions if they are used as kinematic indicators. It can be shown that when these three-dimensional structures are looked at in two-dimensional outcrops or in thin sections, they may seem geometrically identical.

We have developed simple computer techniques allowing geometrical evaluation of all possible sections across folds of arbitrary geometry (degree of asymmetry, shape and interlimb angle). In order to determine shear-band geometry, we used criteria defined by Platt and Vissers (1980) such as the angle of limbs and enveloping surface and the interlimb angle. Planar sections, in which a fold exhibits geometry of a shear band, are quantified using the above criteria and displayed in stereographic projection as shaded areas. In addition, the quality of shear-band shape is visualized by different intensity of shading.

We demonstrate that for any fold geometry, there are two distinct groups of sections close to the axial plane showing shear band-like geometry and opposite sense of shear criteria. The size of areas in a stereogram representing these sections is increasing with the increasing fold interlimb angle. Symmetrical folds exhibit symmetrically distributed areas of the same size in the stereogram whilst asymmetrical folds show areas of different sizes and positions in stereographic projection. Since geologists are traditionally using sections parallel to lineation and perpendicular to foliation to determine kinematics of deformation (and lineations are often parallel to fold axes), there is a high probability of misinterpretation when secondary folds are present. We shall provide two field examples, from the Jeseníky Mountains and from the Vepor basement of Western Carpathians, where reconstructions of structural evolution related to extensional collapse are often based on apparent extensional shear bands, which are in fact oblique sections of compressional folds.

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Cretaceous Collision in the Western Carpathians: Role of Complex Basement Shape on Crustal-Scale Polyphase Deformation Partitioning

Ondrej LEXA and Karel SCHULMANN

Institute of Petrology and Structural Geology, Charles University, 128 43 Prague, Czech Republic

The present structure of the SE Western Carpathians consists of three main tectonometamorphic units. From the north to the south and from the bottom to the top they are: 1) Variscan crystalline basement with Late Paleozoic and Mesozoic cover (Vepor Unit). 2) Early Paleozoic basinal, mostly turbiditic metasedimentary unit (Gemer Unit) overlying pre-Cambrian? crystalline basement (sub-Gemer Unit). The Vepor crystalline complex irregularly surrounds the Gemer embayment from west and east. 3) Mesozoic accretionary wedge (melange) containing blueschist-facies relics (Meliata Unit) is overlain by flat unmetamorphosed Silica nappe.

The pre-Alpine crystalline Vepor Unit and the Gemer Unit in the S show NW-dipping Variscan fabric and inverted metamorphic zoning resulting from south-verging Variscan thrusting. The latter is manifested by overthrusting of high-grade gneisses over Barrovian micaschists in the Vepor unit, and by