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Sense and non-sense of shear reloaded: numerical modelling and natural examples of ambiguous kinematic indicators

Bernhard Grasemann (1), Marcin Dabrowski (2), and Martin Schöpfer (1)

(1) University of Vienna, Geodynamics and Sedimentology, Vienna, Austria (bernhard.grasemann@univie.ac.at), (2) Polish Geological Institute - National Research Institute, Wroclaw, Poland

By means of numerical modelling, we investigate the mechanical evolution of a selection of kinematic indicators that are frequently used for inferring large-scale tectonics but are prone to ambiguous shear sense interpretations: (i) Flanking structures including shear bands are complex structures because under general shear conditions co-and counter rotating slip surfaces can experience either syn- or antithetic slip leading to extensional or contractional offsets. (ii) Boudinaged layers may display both syn- and antithetic offset across the interboudin surfaces. Under coaxial flow conditions and with high strength contrast between the boudinaged layer and the matrix, domains of layer-oblique parallel interboudin surfaces can form by chance and their local occurrence may hence lead to misinterpretations of shear zone kinematics. If the viscosity contrast between the boudinaged layer and the matrix is low, domino boudins may strongly deform internally during shearing so that antithetic slip along interboudin surface may lead to shear band boudinage geometries that appear to have formed during flow with an opposite shear sense. (iii) Winged inclusions are pinch-and-swell shaped objects rotating into the shear direction. After several revolutions, these structures can resemble σ-type clasts with stair stepping that formed during shear flow with the opposite shear sense. Natural examples of these ambiguous shear sense indicators are discussed and interpreted with the caveat that well-established shear sense criteria are not always reliable kinematic indicators.