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Unfolding single- and multilayers

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When planar structures (e.g. sedimentary layers, veins, dykes, cleavages, etc.) are subjected to deformation, they have about equal chances to be shortened or stretched. The most common shortening and stretching structures are folds and boudinage, respectively. However, boudinage requires additional deformation mechanisms apart from viscous flow, like formation of fractures or strain localization. When folded layers are subjected to extension, they could potentially unfold back to straight layers. Although probably not uncommon, this would be difficult to recognize. Open questions are whether folded layers can unfold, what determines their mechanical behaviour and how we can recognize them in the field. In order to approach these questions, we present a series of numerical experiments that simulate stretching of previously folded single- and multi-layers in simple shear, using the two dimensional numerical modelling platform ELLE, including the finite element module BASIL that calculates viscous deformation.

We investigate the parameters that affect a fold train once it rotates into the extensional field. The results show that the unfolding process strongly depends on the viscosity contrast between the layer and matrix (Llorens et al., 2013). Layers do not completely unfold when they experience softening before or during the stretching process or when other neighbouring competent layers prevent them from unfolding. The foliation refraction patterns are the main indicators of unfolded folds. Additionally, intrafolial folds and cusp-like folds adjacent to straight layers, as well as variations in fold amplitudes and limb lengths of irregular folds can also be used as indicators of stretching of a layer after shortening and folding.

References:

Llorens, M-.G., Bons, P.D., Griera, A. and Gomez-Rivas, E. 2013. When do folds unfold during progressive shear?. Geology, 41, 563-566.