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Shear localization in foliated media: numerical experiments with application to the Bethique (Spain).

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Field data have been gathered in the Bethique (Spain) and studied systematically at map, outcrop and thin section scale. The field area has been chosen for being lithologically homogeneous at map scale and the results indicates a systematic angle of 22° between the shear bands and the schistosity. Trying to understand the systematics in this observation, we have design a numerical parametric study that consists of hundreds of numerical runs in which we consider a initial 4 by 1 rectangular section filled by layers of two visco-elasto-plastic material of different viscosity. We neglect the effect of temperature and gravity. Instead of modeling the whole crust, we account for a confining pressure. The sections were sheared up to $\gamma = 1.5$ in bulk.

We varied the angle between the pre-existing schistosity (S) and the shearing direction (C) and found that depending on the sense of shearing versus the dipping direction of the initial layering the model turns into boudinage or folding at angles less than 45°. However, as the angle between the schistosity and the direction of shear increases towards 45° , the obtained structure tends to loss their co-axiality. When the dip was forming an angle of more than 45°, the initial foliation rotates passively until reaching the critical angle of 45°.

In all those cases, we computed the evolution of stress versus strain in the bulk, the strong and the weak layers, as well as detailed map of the finite strain and neoformed foliation. We find that the folding cases always require more work than the boudinage ones. The shear banding instabilities (localization) tends to occurs with a constant angle of 20-25° to the foliation accordingly to observations.