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Localisation of deformation in viscous multilayers: a new numerical approach

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A large number of geological observations evidence that deformation in rocks is localised rather than uniformly distributed. There is a wide variety of factors that may play an important role on localisation depending on the mechanical properties of the materials and the scale of study. The objective of this contribution is to present a simple numerical method to analyse the localisation of deformation in bidimensional viscous media. These simulations couple a strain dependent viscous rheology with a non-linear process that updates the viscosity of the elements depending on the strain rate and the amount of finite strain registered in the material.

The method has been used to analyse the role of anisotropy in the localisation of deformation in layered systems. Our analysis is based on the initial contrast of viscosity, the orientation of layers with regard to the deformation axes and the non-linear exponents. Constant strain rate and periodic boundaries were imposed to all the models.

The results show that these simulations are able to predict the mechanical and microstructural evolution of layered systems, and to visualise the transition from uniformly distributed deformation to strongly localised systems where deformation is accommodated by a few large deformation bands. Although the simplicity of this numerical method the simulations evidence the complexity of deformation localisation in layered systems. Different sets of shear bands are formed or aborted with the increase of deformation according to the imposed stress field.