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Can we understand rocks without anisotropy?

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An effectively isotropic heterogeneous medium subject to deformation should develop compositional layering parallel to stretching direction. A layered anisotropic rock subject to layer-parallel extension may undergo mechanical instability leading to internal boudinage development. The question that arises is as to whether the formation of layering could be hampered by boudinage formation before the compositional layering is well developed. With regard to the issue, the three critical questions are: (1) How does the rock fabric evolution depend on the mechanical properties of rock constituents and the initial microstructure? (2) How does the mechanical (viscous) anisotropy relate to the shape anisotropy of a composite rock? (3) How does the internal boudinage development manifest in a rock consisting of elongated elements rather than well-developed layers?

I will numerically investigate the development of shape preferred orientation and mechanical anisotropy in a composite two-phase rock undergoing stretching. A two-dimensional inclusion-host type of composite, in which an interconnected host embeds non-overlapping inclusions, is considered. Different inclusion fractions, shapes and size distributions are studied. The initial spatial distribution of the inclusions is intended to be random, statistically homogeneous (no clustering) and isotropic. In a series of complementary simulation runs, periodic inclusion arrays are analyzed. Both the inclusion and host materials are considered as viscous fluids and the intrinsic viscosities of the inclusion and the host phases are isotropic. A coherent inclusion-host interface is assumed and interfacial processes such as surface tension or diffusional mass transfer are neglected. The deformation is studied in the Stokes limit and under no gravity.

A self-developed FEM code (www.milamin.org, Dabrowski et al., 2008) is used to find the velocity vectors at the inclusion interfaces. Unstructured triangular computational meshes fitting all the internal inclusion boundaries are used in the simulations. To achieve the necessary resolution of the complex geometry of evolving inclusion-host interfaces, a large number of computational points is required.

References:

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