Localized versus distributed fracturing in the damage rheology model with evolving yield conditions

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Abstract:

The process of rock faulting is different for crystalline verses highly porous granular rocks. While the first tend to form highly localized discrete slip surfaces, the later may develop tabular zones of deformation bands in several areas prior to the formation of a slip surfaces and total yield. On the other hand, some pre-failure phenomenon, such as the Kaiser effect, are observed in a wide range of rocks and materials and showcase the similarity between damage formation process in different materials.

We study the localization pattern of the brittle deformation in a framework of the damage poro-elastic rheology model with evolving yield envelope. Using a series of semi-analytical 1-D solutions, we obtain different patterns of the brittle

deformations including damage localization, de-localization, and transition between the two phases, which allows the formation of runaway slip-surfaces as well as deformation bands prior to faulting. We connect the obtained deformation pattern with the amount of elastic energy stored in the bulk of the material, and the dependency of the yield cap on the accumulated damage.