Geophysical Research Abstracts
Vol. 13, EGU2011-3545, 2011
EGU General Assembly 2011

The role of friction and heterogeneity in damage localization.

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The progressive damage in brittle materials, as rocks, displays some common features independently of the microscale details. As the deformation goes on, the damage starts to be diffuse and becomes progressively more localized before resulting in a more or less thick shear band corresponding to the macrofailure. This is associated with an increasing of the damage rate, as observed by acoustic emission activity that increases in rate and in size with the proximity of the macroscale failure. Many scaling laws are observed both for the damage rate (power-law increase of the activity), damage structure (fractal dimension of the cracks network), power-law distribution of damage events size. These observations are consistent with the assumption that the damage localization results from the interaction of many rupture events through long range correlation. Here we propose to use a simple damage model to investigate the progressive localization phenomena. The small scale complexity of the damage mechanisms is summarized using the elastic damage hypothesis. The damage threshold is determined by the Mohr-Coulomb criterion, in which the internal friction appears to be the key factor in damage localization. The variability of the material properties is taken into account by including spatial heterogeneity in the strength of the material. This point appears to be also a key factor for the degree of localization of the damage.
In this work we will present the effect of both internal friction and heterogeneity in the progressive damage process investigated by numerical simulations. In particular we will focus in the degree of localization that appears to be more pronounced as the internal friction increases and as the heterogeneity decreases. We will also present the effect of these two parameters in the appearance of power-law distribution of damage events and of fractal structures. Finally we will discuss on the applicability of these observations for determining precursory behavior before the macro-failure.