Geophysical Research Abstracts, Vol. 8, 10099, 2006
SRef-ID: 1607-7962/gra/EGU06-A-10099

Velocity fluctuations of a crack front during slow propagation

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The propagation dynamics of a crack front is studied experimentally in a transparent plexiglas block using a fast camera. The preparation of the block allows to incorporate uncorrelated toughness fluctuations along the crack front plane. This results in a strongly intermittent velocity field during the propagation, with a very wide velocity distribution, although the average velocity is well defined and controlled. The velocity distribution is found out to be a power law with exponent -2.7, above the average velocity. This holds for all probed average velocities, ranging from 0.35 to 40 $\mu m/s$. Next, avalanche events defined as regions of high propagation velocity. A seismic moment for each event is estimated from an accurate optical measurement of the avalanche area. The distribution of the seismic moments for a large set of events is shown to be consistent with seismic statistics of natural faults, even if the large scale crack speed is very constant which shows the importance of the fault asperities.

These avalanche events also display an aspect ratio which is a power law of their average size. This anisotropy scaling law of the small avalanche clusters is found to be the dynamic expression of the self affine geometry of the crack front at large scales. Eventually, the crack front morphology is compared directly to the morphology of coseismic slip in natural faults, which also seem to display self affine characteristics.