Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01914, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01914
EGU General Assembly 2008

Fault growth processes - insights from analogue modelling

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The geometry of structures observed today in the field or in seismic data often developed during several incremental stages over a longer time span. Large-scale normal faults usually grow by linkage of numerous smaller faults through time. However, this process of fault linkage is not clearly understood yet, especially in terms of fault initiation and propagation, timing of activation and reactivation, and the heterogeneous fracture distribution observed on a smaller scale.

In this study we present scaled 2D physical models simulating extensional deformation of a cohesive mixture of sand and gypsum. The experiments were recorded with a high resolution optical camera, and have been processed with the PIV (Particle Image Velocimetry) system. We studied the evolution of normal faults in order to evaluate their deformation in time and space over a wide scale range. The thereby used short time window and high spatial resolution allowed the observation of significant deformation processes during the experiments.

In these experiments we show for the first time the process of fault growth in detail, and visualise not only initiation and propagation of fractures, but also the linkage of fault segments. We observed for example, that a linkage zone remains as an undulated area on the fault, and that fault activity alternates by propagation of small-scale deformation through the material form one fault to another.