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The Rate of Normal Fault Growth: Insight from Analog Experiments

This presentation discusses the results obtained in experiments reproducing the normal fault growth. X-ray tomography allowed us to study the following sequence of deformation: 1) fault nucleation, 2) sudden longitudinal fault propagation; 3) accumulation of throw as fault tips overlap, 4) hard linkage between fault segments leaves fault tips in the hanging wall that continue to accrue throw throughout the experiment. The repeated acquisition of 3-D blocs is used to quantify the growth rate of the structures produced in the experiments. This quantitative information is rarely obtained on natural examples due to high quality of outcrop it requires and to the frequent lack of detailed sedimentary records. Our experiments show preferentially non self-similar growth paths. The fault length is acquired very rapidly and most of the history of the fault consists of throw accumulation. This suggests that the spatial configuration of the earliest faults in an extensional system (en echelon vs. linear) may dictate the future geometry of the basin and the evolution of the growth paths. In addition, the description of relay zones demonstrates that fault tips abandoned after hard linkage continue to accrue throw throughout the experiment. Therefore, abandoned fault tips do not accurately reflect the amount of throw accumulated before linkage as it is classically proposed. These results have implications on the method used to restore extensional basin and on the interaction between tectonic and sedimentation. This is discussed in the last part of the presentation.