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SANDBOX SIMULATIONS OF RELAY RAMP EVOLUTION

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The interaction between two offset overlapping normal faults is characterised by the presence of a relay ramp. In order to investigate the way these structures develop, sandbox experiments were carried out. To simulate the brittle crust, we used dry quartz sand that was extended by means of a rubber sheet located at its base. We imposed the initial configuration of the two interacting normal faults by placing silicone bars at the base of the sand-pack, above the rubber sheet. These, under extension, generated a velocity discontinuity responsible for the development of the normal faults, which later interacted and grew further within the sand package. By varying the initial configuration of the silicone bars, we could easily vary the spacing (distance) between the segments, their overlap, their length and their orientation, and test the influence of these parameters on the development of the ramp between the segments. The modelled faults had aspect ratio's varying between 2.5 and 5.

The relay structures in the experiments were characterised by birth, growth and decay. Birth of a relay ramp marked the onset of interaction and was inferred when a tilt of the sand surface could be observed between the two overlapping faults. Growth was characterised by the propagation of the two interacting faults, increasing the distance of overlap and the tilting of the sand layers. During this growth stage often the deflection of one of the fault traces could be observed. Decay occurred when the two initially isolated faults eventually got connected with each other and the ramp breached.

A large part of the relay ramps that were formed in the models were breached — or were getting breached — before the final amount of extension was reached ($\beta \approx$ 20%). For 55% of these ramps it was the hanging-wall fault that propagated towards

the footwall fault, for 27% the footwall fault linked up with the hanging-wall fault, and for 18% of these breached ramps, a new fault developed that cross-cut the ramp. The new fault developed only in those cases where the original spacing of the faults was very small compared to their length. An experimental relation between the overlap and spacing of two segments was also determined and compared with earlier theoretical work.

Finally, relay ramp evolution in the experiments was also characterised sometimes by several minor-order features which are not commonly observed in natural examples, such as: the further propagation of the fault tips after breaching, an increased displacement gradient just outside the relay ramp instead of inside, etc...