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The effects of tectonic and stratigraphic inherited discontinuities on fault development and their surface evidences through analogue models

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In structural, geomorphic, and seismotectonic studies, surface evidences of faults and folds are always highly considered and studied. Their importance is further increased when subsurface data are not available or of bad quality. In these cases, surface evidences of faults and folds are used to infer the subsurface structural setting and sometimes also to derive quantitative information about fault kinematics. Carrying out these considerations it must be carefully taken into account the effects that structural and/or stratigraphic discontinuities may have on fault and fold kinematics, geometry and relative surface evidence. To test and quantify these effects we carried out different set of analogue models, under compressional and extensional tectonic regimes.

A first set of extensional models has been carried out modelling a master fault buried under a homogeneous clay cake. The clay have then been cut in different positions and with different dip angles in order to check how the master fault development is affected (favoured or limited) by the inherited discontinuities with respect to an undisturbed model.

A second set of extensional models have been analysed. In this case, the discontinuities affecting the master fault development have been placed with different strike angles. Our analysis focused on the lateral development (i.e along strike) of the master fault surface expression.

The third and last set of models investigated how stratigraphic discontinuities (weak mechanical layers, bedding) affect the development of a reverse master fault and the related fold shape.

In all cases, the models highlighted a strong influence of inherited discontinuities on the fault propagation and development and in particular:

1) In the first case the presence of a precut can either accelerate or decelerate the upward propagation of the master fault
2) In the second case our experimental results suggest that the presence of a discontinuity exerts significant, though very variable, control on several parameters that are commonly adopted to describe the geometry and behaviour of natural normal faults (as length, segmentation and total displacement).
3) In the third case the fault growing rate is not constant, but varies especially while the new faults interact with precuts;

These findings may improve our understanding of how originally buried fault systems evolve and change their surface expression in presence of inherited structures and/or stratigraphic discontinuities. We also suggest that the analysis of the shape and architecture of folds and fault-related continental basins

carried out in the light of our findings may provide useful constraints for reconstructing the actual geometry of the master fault at depth.