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Deformation Produced By Normal Faulting Beneath Salt Or Shale: An Eexperimental Study With Implications For Seismic Interpretation

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We have constructed a series of scaled physical models to study the deformation produced by normal faulting beneath salt or shale. In the models, a constant-thickness layer of silicone putty represents a ductile layer, and a layer of homogeneous dry sand or wet clay represents the sedimentary cover. Movement on a precut, 45°-dipping surface below the silicone putty simulates deep-seated normal faulting. We have tested the sensitivity of the modelling results by varying the thickness of the putty layer, the thickness of the sand/clay cover, the magnitude of the fault displacement, and the rate of fault displacement.

Our modelling results show that a broad forced fold forms above the deep-seated normal fault. The width of the monoclinal limb increases as the thickness of the ductile layer increases. The dip of the limb increases as the magnitude of the fault displacement increases and the thickness of the ductile layer decreases. Our modelling results also show that secondary normal faults can form in the sedimentary cover above the salt/shale layer. These secondary faults commonly form near the footwall hinge of the monocline and are offset and detached from the underlying deep-seated normal fault. They are more likely to develop if the salt/shale layer is thin, if the sedimentary cover is thick, and if the displacement on the deep-seated normal fault is large.

Our experimental results show that the geometries of shallow structures can provide information about deep-seated normal faults. Seismic examples from offshore Norway and the Gulf of Suez support these conclusions.