Normal faulting above salt wedges in tilted continental margins: numerical modeling

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Most salt basins are highly deformed and consist of complex faulting systems that is difficult to reconstruct. In contrast, in the Levant basin, the deformation of the Pliocene-Quaternary overburden on top of the Messinian salt is relatively mild, providing a rare opportunity to explore a young salt basin in its early stages of evolution. In the Levant continental margin normal faulting occurs mainly above the wedge of the salt layer where it rapidly thins from a few hundred meters to less than 100m. Recently, chronology of faulting in the Levant continental margin improved. It was indicated that during the Pliocene (duration of 2.7 My) faulting activity was minor. In the Gelasian (duration of 0.8 My) faulting activity peaked alongside huge slumping. Then, in the past 1.8 My, faulting and slumping had both decreased, although they are still mildly active today.

These observations raise questions such as: why didn't faulting start immediately after salt deposition? Why had faulting peaked when it did, and then why did it decrease? In this work we wish to understand the mechanism of normal faulting in continental slopes bordering salt basins. What drives salt motion? How does this motion cause faulting in overriding rocks? Where exactly will faults initiate and how will they progress in space? What controls the rate of faulting and when will they shut down?

This study uses 2D numerical simulations to explore these questions. The model assumes that salt is viscous and its overriding rock is brittle and viscoelastic. The model uses a Stokes flow solver, specifically a finite difference/particle-in-cell numerical approach, that can simulate both viscous and elasto-plastic–brittle rheology.

Answering these questions will contribute to the understanding of halokinematics in young salt basins and will allow better assessment of seismic hazards related to salt related deformation.