# Accounting for 3-D Geo-Mechanical Effects in Basin Modeling

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## ABSTRACT

Prediction of past and present mechanical stresses is decisive in basin modelling and petroleum system simulation, as sediment compaction, fluid flows and natural fracturing are controlled by geo-mechanical effects. However the basin simulators currently used in the industry rely on a strong simplification of the mechanics involved, considering only the weight of the overlying layers in the stress computation. In this work we consider the limits of this approach and discuss strategies to better integrate 3D geo-mechanical effects in basin modelling. To do so, we use an innovative basin simulator prototype, based on an iterative coupling between a finite volume hydro-dynamic code and a finite element mechanical one. With this technique a 3D stress tensor is computed and accounted for at each time step of the basin simulation. The value added by the advanced hydro-mechanical coupling is first appraised on a 2D synthetic model, representative of silico-clastic sedimentation in passive margins. We show that non-vertical geo-mechanical effects like shear and lateral compression are captured by the coupling and that they significantly affect porosity, fluid pressure and rock failure estimates compared to standard simulations. From this observation, we suggest that even in simple structural settings, considering 3D stress states can be crucial for the relevance of basin models. In a second time, we extend the coupled approach to 3D and tectonically complex models. Using operational case-studies, we highlight the benefits of integrating non-vertical geo-mechanical effects in the basin simulation, while considering the challenging implications of the hydro-mechanical coupling on geo-model construction. We notably address the sensitivity of the results to the kinematics and advocate for structural restoration workflows based on mechanical consistency and software interactivity.