Geo-mechanical Control on Natural Fracturing and Overpressure Location in a Synthetic Passive Margin Model

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ABSTRACT

Present-day overpressure prediction and prediction of past and present hydrocarbon migration flow paths are among the main objectives of petroleum system modelling. Both require an accurate description of the interaction between fluid pressure and rock matrix mechanical behavior including compaction and natural fracturing. Only petroleum system simulators can provide quantitative estimates of risk of overpressure or cap rock leakage.

A basic assumption made by petroleum system simulators is that basin deformation during geological history is accommodated by vertical compaction, and is controlled by sediment load and fluid pressure according to 1D Terzaghi's theory. This 1D mechanical model is commonly considered as satisfying when modelling basins showing low tectonic activity.

In the study presented here, we investigate the limits of this hypothesis. We take advantage of a newly developed simulation workflow coupling geo-mechanical computation and petroleum system simulation to investigate how far a generalized mechanical model - instead of the usual 1D model - can change our predictions.

The study focuses on a 2D synthetic model of a passive margin, which is simulated with both a 1D mechanical compaction model and with a coupled generalized hydro- mechanical model. Comparisons of the simulations focus on the development of overpressures and diffuse natural fracturing.