Contribution ID: **566** Type: **Oral Presentation**

Quantifying the uncertainty associated with reservoir compaction forecasting: Role of the experimental estimation of the hydrostatic yield stress.

Monday, 30 May 2022 17:20 (15 minutes)

Geomechanical simulators aim at predicting the irreversible deformation taking place in hydrocarbon and CO2 reservoirs to optimise profits and reduce risks associated to the exploitation of chalk fields. In the context of compaction studies, accurate forecasting of the plastic strain relies on well-calibrated constitutive equations to capture the mechanical response of rocks according to, amongst others, the porosity, water saturation, age of the rock, and stress and temperature conditions [1,2]. The constitutive equations correlating lithological, petrophysical and geomechanical properties under various in situ conditions are based on experimental database that show a non-negligible data scattering [3]. Although raising questions about the reliability of the predicted strain, the uncertainty on the representativeness of these correlation functions to capture the plastic behaviour of chalk is not yet addressed in the literature.
The present study assesses how the change in the hydrostatic yield stress (σ_{hy}) estimated from laboratory studies impacts the amount and distribution of plastic strain modelled in four depleted reservoirs from the Danish North Sea (Dan, Halfdan, Gorm, and Kraka fields). The selection of the parameter σ_{hy} is motivated by the difficulty that scientists face to assign a stress value to a specimen tested in the laboratory. The transition from the elastic to plastic regime is not abrupt i.e., occurring at one specific stress value. On the contrary, the elastic-to-plastic transition is progressive taking place over a stress interval delimitated by the initial ($\sigma_{(hy,in.)}$), and final yield stresses ($\sigma_{(hy,fin.)}$). Besides, the method used to determine the representative yield stress ($\sigma_{(hy,rep.)}$) of chalk varies between studies [4–6].
Two 1-D simulation scenarios are carried out per study areas by considering in the constitutive equations the $\sigma_{(hy,in.)}$ and $\sigma_{(hy,fin.)}$value of Danian and Maastrichtian chalk. The first scenario is considered as a conservative approach and the latter is an optimistic approach that results in a smaller deformation. The geomechanical simulator is a strain-rate dependent constitutive model using a modified Mohr-Coulomb yield function to capture the change in mechanical properties as irreversible strain accumulates in the rock [7]. The stress paths are reconstructed from repeated formation tests and the reservoir properties are extracted from well log data. Note that the simulation outcomes are quality-checked by subsidence data.
The results indicate that the creep deformation does not contribute to the contrasts in compaction prediction between the conservative and optimistic model. Secondly, changing σ_{hy} of chalk from its initial to final value obviously shifts the onset of plastic deformation towards high stress conditions. This shifting in σ_{hy} reduces by a factor of 26% to 73% the amount of strain simulated. The contrast in the simulation outcomes between the conservative and optimistic model is dependent on a subtle interplay between rock porosity, virgin stress, and stress path. Thus, the uncertainty related to the determination of the σ_{hy} of subsurface chalk can potentially modify crucial decisions taken during a field development such as, platform height design and the drilling trajectory.

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Time Block Preference

Time Block A (09:00-12:00 CET)

Participation

Online

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