Prediction of pore pressure and stress conditions around salt structures in frontier exploration settings can often be limited by the lack of data constraints. In this article we present a case study where geomechanical modelling of a salt structure has been used to provide insights and constraints on stress state prediction ahead of drilling a wildcat well. The structure discussed is a salt dome sitting above a fault-controlled step in the base of the salt. Above the salt dome bathymetry is greater than 1000 m and drops significantly basinwards across the salt structure. Finally, sediments above the salt are expected to be a diatomaceous ooze with probable low cohesion and strength. The nearest wells to the studied structure are in the shallow offshore tens of kilometers away and are not considered to provide relevant constraints in terms of stress state of pore pressure. Therefore, to derive meaningful observations, a stepwise approach to modelling has been chosen.

We have identified the key elements suspected to play dominant control on the stress state around the diapir to be: geometry of the top of the salt body, geometry of the base of the salt body, geometry of the seabed, and rheological contrast between the salt and sediments. For each of these elements we have built synthetic models ranging each element within a reasonable range of possibilities. For the geometric variables, the uncertainty in seismic image or the along-strike variability of the features have been used to define the ranges tested. For rheology, a range of viscosities to account for a more halite-rich or sylvite-rich evaporite has been tested. Modelling reveals that, in this case, uncertainties in the geometry and rheology have limited impact on the stress expected above and below the salt structure. A state of relaxed stress (near-tensile) is found to exist above the salt dome, whereas below the salt total stress slightly higher than lithostatic is expected. These observations have an impact on the expected pore pressure above the salt structure, the possible over-compaction of the sub-salt sediments. These conclusions in-turn impact the risks that could be encountered while drilling and the well design to be executed.
INTRODUCTION

Prediction of pore pressure and stress conditions around salt structures in frontier exploration settings can often be limited by the lack of data constraints. In this paper we present a case study where geomechanical modelling of a salt structure has been used to provide insights and constraints on stress state prediction ahead of drilling a wildcat well. The structure discussed is a salt dome sitting above a structure are in the shallow offshore tens of kilometers away and are not considered to provide relevant information. The nearest wells to the studied structure are in the shallow offshore tens of kilometers away and are not considered to provide relevant constraints in terms of stress state of pore pressure. Therefore, to derive meaningful observations, a stepwise approach to modelling has been chosen.

RESULTS

• Lowered horizontal stress expected above diapir, and up-slope from step in bathymetry.
• Stress reorientation expected below the evaporite unit (risk to loss of reservoir porosity).
• Evaporite tectonics across base-salt step is driven by differential sediment loading, downslope gliding of sediment and upward flow of salt.

CONCLUSIONS

• Uncertainties in the geometry and rheology have limited impact on the stress expected above and below the salt structure.
• A state of relaxed stress (near-tensile) is found to exist above the salt dome, whereas below the salt, total stress slightly higher than lithostatic is expected. These observations have an impact on the expected pore pressure above the salt structure and the possible overcompaction of the sub-salt sediments.
• These conclusions in-turn impact the risks that could be encountered while drilling and the well design to be executed.

BIBLIOGRAPHY