

3D Geomechanical Modeling of Complex Salt Structures

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Abstract: Some of the most active and high profile hydrocarbon plays currently being explored and developed around the world lie below a salt canopy of variable depth, geometry, and thickness. Drilling through a thick salt canopy can provide a more effective way to reach a sub-salt objective rather than drilling through thick overpressured sediments in a supra-salt mini-basin. Unfortunately, wellbore stability problems, such as unexpected low fracture gradient, are relatively common while drilling close and out of these salt structures. Thus, significant drilling costs could be eliminated if these hazards could be identified and avoided in the well planning process.

In this paper, we present the workflow starting from the structural information through the FE mesh creation and population of its properties to the final 3D finite element based geomechanical modeling. The resulting 3D stress field around salt structures helps to significantly improve the wellbore stability predictions. The workflow described provides an efficient way to create realistic 3D finite element simulations from complicated structural data. It is optimized for the best resolution around the area of interest (well trajectory) while limiting the size of the numerical problem to an order that can be handled in reasonable times. The workflow allows for a detailed simulation of the stress field around salt bodies that is new to the hydrocarbon industry and helps to significantly reduce the risk for wellbore failures of increasingly costly wells drilled to exploit, e.g. sub-salt plays in the Gulf of Mexico.

Keywords: Geomechanics, Wellbore Stability, Creep, Visualization.

1. Introduction

Many major exploration and new field developments efforts around the world (i.e., Gulf of Mexico (GOM), Campos Basin (Brazil), Angola, West Africa) take place in near- or sub-salt fields where the salt canopies have variable depths, geometries, and thicknesses. Drilling through these thick salt canopies can provide a more effective way to reach the target reservoir rather than drilling through surrounding overpressured sediments. Unfortunately, wellbore stability problems, such as unexpected low fracture gradient, are relatively common while drilling through and out of these salt structures. Significant drilling costs could be eliminated if these hazards could be identified

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