

# 3D Geomechanical Modeling of Complex Salt Structures

Wouter van der Zee<sup>1</sup>, Cem Ozan<sup>2</sup>, Martin Brudy<sup>2</sup>, Marc Holland<sup>3</sup>

<sup>1</sup>Baker Hughes - Reservoir Development Services, Lange Kloofweg 50c, 2288GK, Rijswijk, the Netherlands.

<sup>2</sup>Baker Hughes - Reservoir Development Services, 5373 West Alabama Str., Suite 300, Houston, TX 77056, USA.

<sup>3</sup>Baker Hughes - Reservoir Development Services, Emmerich-Josef Str. 5, 55116, Mainz, Germany.

*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 minibasin. 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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**Ying-Ying Zheng**



### **3d Geomechanical Modeling Of Complex Salt Structures:**

*Characterization, Prediction and Modelling of the Crustal Present-Day In-Situ Stresses* R. Goteti, T. Finkbeiner, M. O. Ziegler, C. Massiot, 2024-08-01 Geomechanics has a marked impact on the safe and sustainable use of the subsurface. Along with an ongoing demand for hydrocarbon resources, there is also a growing emphasis on sustainable subsurface exploitation and development, storage of carbon hydrogen energy and radioactive waste, as well as sustainable geothermal resource utilization. Such activities are accompanied by an ever-increasing need for higher resolution fit-for-purpose solutions, workflows and approaches to constrain present-day subsurface stresses and minimize associated uncertainties. Building high-fidelity geomechanical numerical models provides critical input and understanding for diverse engineering designs and construction, as well as geoscience applications. Such models greatly contribute towards uncertainty reduction, risk management and risk mitigation during the operational life of a given subsurface development and associated infrastructures, both on and below the surface. This Special Publication contains contributions detailing the latest efforts and perspectives in present-day in-situ stress characterization, prediction and modelling, from the borehole to plate tectonic scale. There is particular emphasis on the uncertainties that are often associated with data and models.

**Mechanical Behaviour of Salt**

**VIII** Lance Roberts, Kirby Mellegard, Frank Hansen, 2015-05-13 Technical contributions contained in this volume characterize continuity of science, engineering and modeling regarding the mechanical behavior of salt. These papers evidence relationships from microscopic dislocation structure to modeling applications over kilometer dimensions, a reach of more than ten orders of magnitude. The book is arranged also.

Final Report of Geothermal Energy and High-Performance Drilling Collaborative Research Program (gebo) Cuvillier Verlag, 2015-08-19 The superior goal of the gebo research association was making important contributions for the future reliable drilling under the existing hot hard rock conditions in Niedersachsen and their development to the geothermal drillings with sustainable geological subsurface heat exchangers. This goal should be achieved due to the solid research and innovative technology approaches in their combination within one concept for pioneering methods in deep geothermal drillings in hard rock to be more exact in interdisciplinary cooperation on engineers and scientists in cooperation between industry and University researchers and users. Gebo research association comprised scientists and technicians of different research institutions and universities who are working in 33 projects. The individual projects were assigned to one of the 4 main research fields or focus areas. Gebo research association started its activities with 7 project partners participating: Technische Universität Braunschweig, TUBS, Technische Universität Clausthal, TUC, Gottfried Wilhelm Leibniz Universität Hannover, LUH, Georg-August-Universität Göttingen, UGOE, Leibniz Institut für Angewandte Geophysik, LIAG, Bundesanstalt für Geowissenschaften und Rohstoffe, BGR, Energie Forschungszentrum Niedersachsen, EFZN. Baker Hughes, an industrial partner, participated in the association and supplies it with its experience and additional funds.

Impact of Human Activity on the Geological Environment EUROCK 2005 Pavel Konecny, 2026-02-20

This work focuses on the impact of human activity on the geological environment and contains over 100 papers dealing with laboratory and field research investigations in geomechanics geoengineering and mathematical modelling Topics covered are grouped into eight main themes response of the rock mass to human impact slope stability field research laboratory research stability of underground openings mathematical modelling stress measurements and mineral and rock disintegration *The Leading Edge* ,2009 *Underground Gas Storage* D. J. Evans,R. A. Chadwick,2009 The UK became a net importer of natural gas in 2004 and by 2020 will import up to 90% of its requirements leaving it vulnerable to increasing energy bills and risk of disruption to supply New pipelines to Europe and improvements to interconnectors will meet some demand but Government recognises the need for increased gas storage capacity best met by the construction of underground storage facilities Energy security has also raised the likelihood of a new generation of coal fired power stations which to be environmentally viable will require clean coal technologies with near zero greenhouse gas emissions A key element of this strategy will be underground CO2 storage This volume reviews the technologies and issues involved in the underground storage of natural gas and CO2 with examples from the UK and overseas The potential for underground storage of other gases such as hydrogen or compressed air linked to renewable sources is also reviewed **New Insights Into Structural Interpretation and Modelling** Geological Society of London,2003 Unconventional Reservoir Geomechanics Jingshou Liu,Wenlong Ding,Shimin Liu,Kouqi Liu,Dadong Liu,2023-02-15 *Petroleum Geoscience* ,1995 **Extended Abstracts Book** ,1999 **Extended Abstracts Book** European Association of Geoscientists and Engineers,2001 **Salt, Sediment and Hydrocarbons** Society of Economic Paleontologists and Mineralogists. Gulf Coast Section. Foundation. Research Conference,1995 **Abstracts Volume** ,2005 **Petroleum Abstracts** ,1997 Geological Quarterly ,2014 **Mining Mirror** ,2001 AAPG ... Annual Convention ,2001 Issue for 2000 includes also the abstracts of papers presented in a separately paged section *CIM Bulletin* Canadian Institute of Mining and Metallurgy,1996 Index to Theses with Abstracts Accepted for Higher Degrees by the Universities of Great Britain and Ireland and the Council for National Academic Awards ,2000 □□□□□□ □□□□,1995

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