Definition of Mud Weight Window Using 3D Numerical Models for Drilling Through Shaley Formations in Rumaila Field – Southern Iraq

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ABSTRACT: The giant Rumaila oilfield in south Iraq has been plagued by a number of wellbore instabilities. The shaley formations in this field pose the greatest challenges to drilling operations, accounting for approximately 90% of the problems. Stuck pipe, tight hole, and borehole collapse are examples of the incidents commonly encountered even while drilling vertical wells.
The main objectives of this study were to generate a mud weight window cube for different trajectory scenarios by examining the impact of depletion on field performance and drilling integrity for making life-of-reservoir decisions. The derived mechanical properties were taken from their respective 1D mechanical earth models (MEM) by utilizing the available mechanical core test data and populating in 3D space. The final 3D MEM has been calibrated against field observations. This paper presents a well planning tool for translating the geomechanical modeling results to operational parameters, and in so doing, informing well trajectory planning and optimization.

1. INTRODUCTION

Reservoir geomechanics play a vitally important role in minimizing drilling activity costs and informing field development planning. Comprehensive geomechanical models (1D, 3D and 4D) have been built in the Rumaila Field based on a wide array of inputs taken from 14 wells distributed across the field. The analysis examined the stress changes in the main reservoirs—namely: Mishrif and Zubair Main Pay—and addressed the instability issues in all Rumaila formations encountered while drilling, by using the available openhole logs, core mechanical test data, production data, and pressure data. The main objectives of this study were to build a field-scale geomechanical model with a view to assessing the impact of production-induced stress changes on field performance and generating mud weight cubes at different timesteps (Al-Asadi 2021).

2. MECHANICAL EARTH MODEL

A mechanical earth model (MEM) is a numerical representation of the mechanical properties, stresses, and pore pressure for specific formations in a field. The MEM has the information required to analyze all the relevant geomechanical phenomena, such as wellbore stability, sand production, hydraulic fracturing, compaction, and subsidence evaluation (Plumb et al. 2000).

This study started with the building of a series of static well mechanical earth models, or 1D MEMs, along 14 well trajectories. Constructing a 1D MEM involves integrating data from various sources into a model that consistently describes the rock mechanical attributes of the formation. Chardac et al. (2005) gave a lengthy exposition of the associated data requirements. A flowchart of the main 1D geomechanical modeling steps for this study is illustrated in **Fig. 1**.