TR15

Retrospective Study and Multidisciplinary Optimization Workflow to Address Production Challenges in Ultralow Permeability, Tectonically Active, HPHT D

K. Kanneganti (Schlumberger), A.L. Mahesh* (Schlumberger), J. Salavarria (Schlumberger), C. Fredd (Schlumberger), E. Fidan (Kuwait Oil Company), R.N. Srinivasa (Kuwait Oil Company) & M.N. Acharya (Kuwait Oil Company)

SUMMARY

Using the multidisciplinary unconventional workflow, the heterogeneity in reservoir quality and completion quality are evaluated, both spatially and at well level. The reservoir-centric stimulation design tool, capable of handling “Seismic-to-Simulation” workflow with the integration of stimulation, enabled optimization of drilling, completion, and stimulation designs in a holistic approach, with the optimal completion scheme to maximize appraisal and production opportunities.

Introduction

The deep high pressure/high temperature (HPHT) dolomite formation in Northern Kuwait has been a challenge with varied production, attributable to reservoir heterogeneity. Due to the tight nature of these rocks, matrix acidizing may not produce desired effects, thus requiring hydraulic fracturing to produce at economic rates. However, the tectonic setting and high stress environment has resulted in subpar success and inconsistent results from stimulation treatments.

Figure 1 Field of interest and location of wells; good producers in blue, poor producers in red, zero production in black

A quick look at the well location shows production variation across a short distance. The retrospective study discussed in this paper intends to analyse production variation using a multidisciplinary approach.

Workflow

This paper presents a multidisciplinary approach to address the limited success in the Northern Kuwait Dolomites. Integrated petrophysical evaluation of the current wells will be followed with multi-well Heterogeneous Rock Analysis (HRA), to evaluate the reservoir heterogeneity across the field and identify the ‘sweet spots’ for future drilling locations. Evaluation and lessons learnt from the past stimulation treatments, will be used to understand geomechanical challenges and to help calibrate the Mechanical Earth Model (MEM) for implementation in the future wells. Finally, using a reservoir-centric stimulation design tool, stimulation type (acid vs proppant) and stimulation design optimization for future wells will be developed.

Multi-well petrophysical evaluation of the existing wells was performed and compared to understand the reservoir heterogeneity vis. a vis. production potential. Multiple rock classes were identified within the tight dolomite interval, with a gross thickness of ~250 ft. Starting with log based MEM, results from the image log interpretation and the field observations/measurements from fracture diagnostic tests (MiniFallOff, Calibration Injections) were used in calibrating the MEM and mapping the CQ heterogeneity across the field. This has led to a reservoir level understanding, which allowed planning optimal well locations, target interval and subsequent well placement/completions

methodology. Finally, using the reservoir-centric design tool, an optimum strategy to effectively stimulate the ultralow permeability dolomites is designed. The optimization workflow did not only include a single faceted approach of fracture modeling, but also encompassed a production forecast using the integrated numerical reservoir simulator. Lessons learnt from optimization workflow were further extended to designing horizontal wells (landing point, trajectory for optimal stimulation geometry), and hence to aid in field development strategy.

Figure 2 Multi-well petrophysical data integrated in the study

Figure 2 shows petrophysical evaluation of Middle and Lower Murrat for two wells; good producer (left) and poor producer (right). Target intervals (#2b and #4) is an argillaceous dolomite showing similar lithological properties between the two wells; however, well performance is significantly different. By integrating all data including geomechanics, stimulation using a multidisciplinary workflow, a correlation to production challenge was analyzed in this paper. This study is aimed at capturing lessons learned from the retrospective study, to impact stimulation treatments for future wells.