Study of Heterogeneity and Complexity of Sand Reservoirs Utilizing Surveillance Techniques and Production: A Case Study of the Permian Gharif Sandstones Reservoir in a Giant Heavy Oil Field, South Central Oman

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Abstract

Over the last fifteen years in Mukhaizna, reservoir management teams have used production performance and surveillance methodologies to better understand how steam is actively flooding the reservoir. Mukhaizna geologists have learned to routinely deploy surveillance data to build a systematic and geological understanding of the field.

Fluvial deposits at Mukhaizna have inherent heterogeneity and anisotropy that restricts reservoir unit flow continuity. Using surveillance well data and performance production analysis, we have unlocked an understanding of this reservoir complexity, which has assisted in reservoir performance enhancement. Utilizing this data as input for comprehensive geological understanding also provides the foundation for successful reservoir simulation, drilling, and surveillance activities.

In this heavy oil fluvial sandstone reservoir, production enhancement is created through efficiently manipulating steam injection through flow units. Comparing the history match between surveillance/production data and simulation models, we can better define the reservoir architecture. Through model improvement, we can better manage the steam flood by increasing flood efficiency and reducing costs.

Given the numerous dynamic reservoir inputs such as production, pressure, temperature, areal steam injection distribution and IPL splits, it is challenging to understand the geological versus mechanical controls that determine the success of the steam flood. Incorporating surveillance data within geological mapping software allows a comparison between predicted and actual cases, which helps define prediction uncertainty fieldwide and within individual flood patterns.
This process led to the development of uncertainty maps, with more accurate directional steam paths defined for each zone.

The integration of surveillance data with facies-based geological models is a vital step toward defining critical issues that control injection and production, including directions of sand channels, geobody connectivity, permeability, and the presence of baffling shales within sand bodies. Utilizing dynamic data provides confidence in understanding the heterogeneity and complexity of this Sand Reservoir.