Understanding sand body geometry and lithofacies in horizontal oil sands wells – Wireline and MWD image examples

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Summary

Electrical borehole image logs have greatly aided our understanding of subsurface sand body geometry and lithofacies interpretations over the years. The quality and reliability of these interpretations has led some operators in the Canadian Oil Sands to switch from coring every well to coring fewer (often one in ten or less) and relying on properly interpreted wireline images to provide lithofacies and sand count information. The question now is how well these interpretation methods can be applied to horizontal production and injection wells, how the change in view direction (horizontal instead of vertical) affects the kinds of geometries that may be encountered, and how we can visualize those geometries and lithofacies in 3-D space.

Introduction

Since the first Oil Sands FMS was recorded for Syncrude in 1987, borehole image logs have illuminated and enhanced our understanding of subsurface stratigraphic geometries and geology. Although our understanding of these environments has developed significantly in the intervening years, only a small number of the horizontal steam-assisted gravity drainage (SAGD) production wells have been imaged. In recent years, this trend is reversing with the development of measurement while drilling (MWD) electrical, gamma-ray and density imaging tools, as well as a number of successful pipe-conveyed wireline image logging runs. The onus is on us to determine how these new data can be used to aid our understanding of subsurface reservoir composition and geometries.

Method

To understand the situation in the subsurface, we must draw analogies to cores and image logs in vertical and deviated oil sands wells. The three main oil sands reservoir components, clean sand flow cross-bedding, IHS lateral accretion bedding and sedimentary mud breccias, are examined in vertical and deviated well examples. These structures are projected and drawn in cross-section to understand how they would appear in a horizontal well and then similar structures seen in horizontal wells are then compared to these modeled projections.

Further, some vertically-oriented sedimentary structures (such as channel margins) are seen more frequently in horizontal wells because of the change in sampling bias due to the borehole's orientation. Examples of these laterally-visualized structures will be examined to see what can be learned to further our understanding of oil sands reservoir architecture.