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Shallow Stratigraphy, Bentonite Swarms, and Thermal Property Contrasts as Controls on Casing Deformation in SAGD Wells, Meota Area, Saskatchewan

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ABSTRACT

The Upper Cretaceous Colorado Group overlies some of the most important thermal heavy oil developments in the Western Canadian Sedimentary Basin, yet its stratigraphy is commonly simplified in subsurface models as the caprock zone. In the Meota area of west-central Saskatchewan, casing deformation in SAGD wells demonstrates that this simplification can obscure critical geological controls on well integrity and development risk. This study presents a Colorado Group case history showing how stratigraphic architecture and lithology, rather than purely engineering factors, governs thermally induced casing deformation.

A targeted shallow stratigraphy program incorporating continuous core, high-resolution resistivity image logs, and closely spaced stratigraphic and SAGD wells significantly improves lithological resolution within the upper Colorado Group, where conventional log suites provide limited discrimination. Detailed sedimentological interpretation identifies laterally continuous swarms of thin bentonite beds interbedded with shale and siltstone that can be correlated over tens of kilometres. These bentonite-rich intervals exhibit a strong spatial association with casing deformation, extending from surface casing depths into the upper sections of the vertical wellbore and directly above the SAGD reservoir.

To evaluate the geomechanical implications of this stratigraphic complexity, interpreted Colorado Group stratigraphy was incorporated into numerical simulations explicitly representing bentonite beds and adjacent lithologies with contrasting thermal and mechanical properties. Model results demonstrate that differential thermal expansion across stratigraphic boundaries localizes strain and shear within mechanically weak intervals, particularly where surface well spacing promotes overlapping thermal influence. Scenario testing shows that increasing surface well spacing and implementing vacuum insulated tubing materially reduce strain interaction within the shallow Colorado Group succession.

While bentonite beds are the most conspicuous control due to their distinct mineralogy and thermo-mechanical response relative to surrounding shales, the modelling confirms that any stratigraphic interval exhibiting strong contrasts in composition, fabric, or cementation may generate a similar response. This case study highlights the importance of rigorous Upper Cretaceous stratigraphic characterization as a risk-mitigation tool and demonstrates how integrating shallow Colorado Group geology into development planning can directly improve well integrity, completion strategy, and long-term production reliability in SAGD reservoirs.

References

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