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Disentangling the Manville Stack: Geological Modelling and Development Planning

Juan Melendez, Novi Labs
Aatish Mann, Novi Labs

ABSTRACT

The Mannville Stack is an informal name for a fairway around Lloydminster containing medium to heavy oil pools, and stratigraphically consists of up to nine members of the Lower Cretaceous Mannville Group. These units are typically associated with shallow marine, shoreface, deltaic, and fluvial depositional environments, and although they can generally be described as coarsening upwards sequences capped by coal beds, in practice their log signatures are highly variable. Geological interpretation is made difficult by incised valley systems and distributary channels erasing identifying surfaces, coal bed markers splitting and attenuating, discontinuous and overlapping reservoir sands, and the irregularity of the underlying sub-Cretaceous unconformity. Despite decades of exploration, establishing a consistent stratigraphic framework remains contentious.

Diversity of development styles in the Mannville Stack reflects its geological complexity. Once dominated by vertical wells, today SAGD projects, hydraulic fracturing, multilateral wells, and secondary recovery techniques such as waterflooding are all seen. Activity continues to accelerate, having posted year-on-year increases in new drills since 2020. Multilateral wells, which are less capital intensive, are particularly noteworthy as these now dominate in terms of lateral length drilled.

This project is the latest attempt at region-scale modelling, comprehensively mapping the nine main units of the Mannville Stack, plus the sub-Cretaceous unconformity, over the fairway. Emphasis is placed on areas with horizontal and multilateral operations. Due to the conventional style of the pools and the inherent unpredictability of their members, maximum well control is necessary, taking advantage of legacy vertical penetrations. A workflow is presented to correlate the well curves, augmenting traditional picking with machine-learning derived auto-picking on approximately 30,000 wells, while additional control is achieved by including over 4,800 raster logs. With these high-resolution surfaces, viscosity, API gravity, porosity, and water saturation are more accurately modelled, pay zones properly visualized, and oil-in-place estimates derived.

By quantifying these parameters, direct comparisons of rock quality to well performance are made. A multivariate analysis incorporates these key geologic drivers alongside engineering metrics to determine the feature importance of various inputs. Statistical findings across the different well types are presented, highlighting the most significant variables and their expected effects on production profiles, as well as trends that may shape future development.

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