

Upper Mannville Heavy Oil Project

Geothermics and Hydrodynamics



ENLIGHTEN
GEOSCIENCE LTD.

PROJECT OVERVIEW

The National Energy Board estimates that there are over 33 billion bbls of conventional heavy oil in place in Western Canada, representing fully 7.5% of the world's oil resources¹. Economically accessing this resource is a critical challenge for operators. Operators would prefer to pursue less capially intensive methods than Steam Assisted Gravity Drainage (SAGD) and focus on projects such as the Marten Hills Clearwater play.

Economic conventional production requires maximizing the inputs to Darcy's Law

$$Q = \frac{\kappa A}{\mu} \left(\frac{\delta p}{\delta x} \right)$$

and the key variables of permeability (κ), viscosity (μ) and pressure (p).

The critical path lies in determining which prospects have the lowest viscosity and highest pressure at formation conditions.

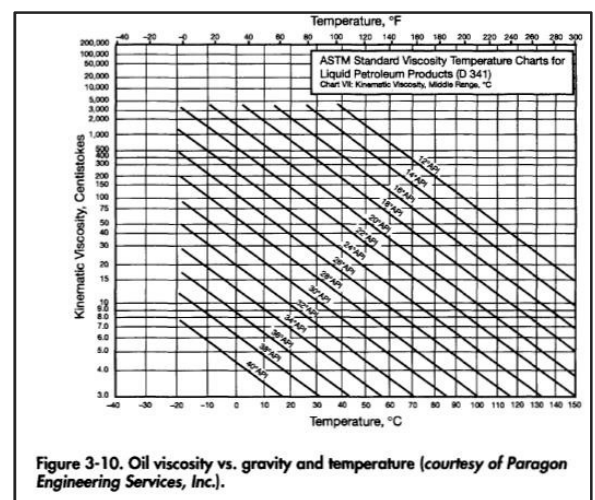
Enlighten Geoscience Ltd. is applying an innovative proprietary mapping technique to answer the following questions:

- How does the geothermal gradient vary within a particular heavy oil area?
- How does the viscosity at formation conditions differ spatially and stratigraphically?
- How do variations in viscosity affect fluid rates, oil cuts and overall recovery?
- How does the hydrodynamic setting vary?
- Where are the "Sweet Spots"?

¹ National Energy Board. 2001: Conventional Heavy Oil Resources of the Western Canada Sedimentary Basin; Alberta Energy Regulator, AER/AGS Open File Report 2017-02, 96 p.



Norman Einstein, from Wikimedia commons



Graph of crude oil viscosity vs. temperature
source: Oil & Gas Process Engineering

THE ENLIGHTEN ADVANTAGES

Immediate Insights™

- Analysis results are delivered as they become available. This means no waiting for final project completion to gain valuable knowledge, and clients have the opportunity to provide early feedback.

Fully Integrated Approach

- Enlighten recognizes that a true understanding of a play depends on knowing how each geological aspect is influenced by, and influences, every other.

Land Sale Analysis

- Efforts will be refocused as necessary to provide a timely evaluation of significant land sale parcels within the study area.

Probabilistic Type Curves and Estimated Ultimate Recovery

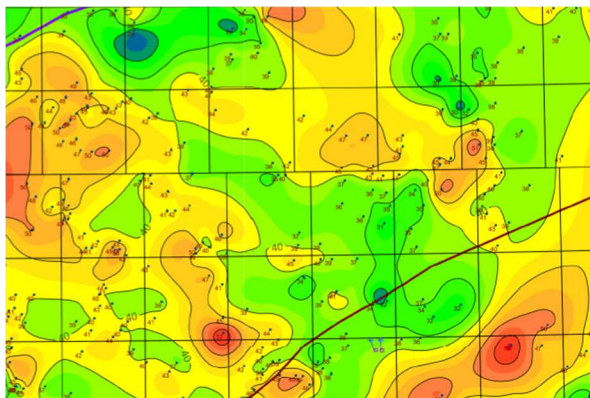
- Results will provide a better understanding of the likely productivity of each play area.

Proven Technical Team

- Our technical team has worked together on many ground breaking regional studies, including the Duvernay, Montney, Second White Specks and Delaware Basin Wolfcamp.

Optional Subscription Updates

- We understand that knowledge advances as the play is developed. Enlighten will continue to integrate newly available data into the study after initial project completion. With subscription updates, the study never goes out of date and clients can get their own new data incorporated earlier.



Part of our Marten Hills Geothermal Gradient Map



Lloydminster Heavy Oil Core.

Used with permission from Chinook Consulting Services

Participation Details

- Cost: \$1,000/Township, (15 Township minimum)
- 50 to 74 Townships: \$50,000
- 75 to 100 Townships: \$75,000
- >100 Townships: \$100,000
- Update Subscription: 20% of initial subscription



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