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Using Fracture Extension Pressure from (Treatment) Stage Fall-Off Analysis to Accurately Predict Closure Pressure & Identify Anomalies in the NE BC Montney

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A critical review of ~100 public-record Diagnostic Fracture Injection Tests (DFITs) in the NE BC Kiskatinaw Seismic Monitoring & Mitigation (KSMMA) area Lower Triassic Montney formation was undertaken between 2019 and 2022. This work was part of two studies by Enlighten (2021, 2022) to investigate induced seismicity in KSMMA. DFIT interpretation using Pressure Transient Analysis (PTA) techniques developed by Bachman et al (2012, 2015) and Nicholson et al (2019) were used for the review and analysis. The new results were compared to those presented by the Operators in the public record.

This review highlighted very different values for Fracture Extension Pressure (FFEP) compared to the Operator Initial-Shut-In-Pressure (ISIP) values as shown in Figure 1.

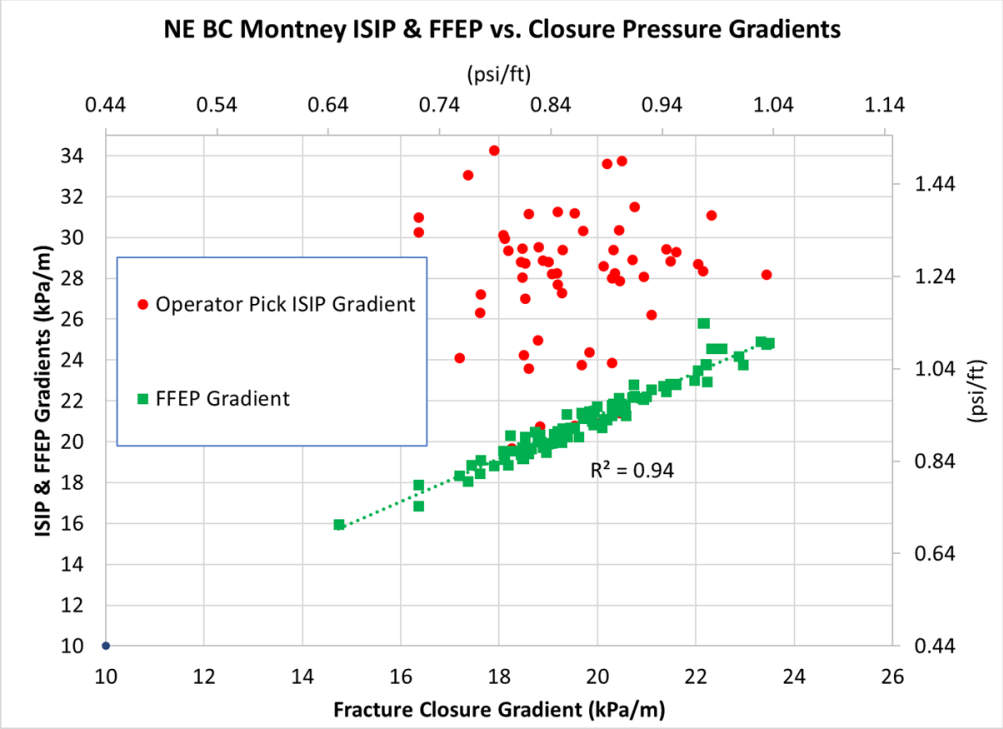

Figure 1: Fracture Extension Pressure Gradient vs. Closure Gradient for 100 Lwr Montney DFITs

The implications of this discovery are significant:

1. Net pressure (defined as Fracture Extension Pressure – Closure Pressure) is likely overestimated and inconsistent using ISIP. This means that many fracture simulation models that rely on ISIP for calibration are incorrect.

2. The strong correlation between the PTA-derived FFEP and closure can be used to estimate closure in situations where closure pressure has not been measured directly. Closure pressure measurement requires specialized, time-consuming tests like DFITs. However, as Nicholson et al 2021 illustrates, FFEP can be measured in a short-duration (often minutes) fall-off test. To use the correlation between FFEP and Closure a significant dataset is needed.

3. Since FFEP may be measured in a short test, this data can be gathered in nearly any end-of-treatment fracture stage to estimate stress changes due to stage stress-shadowing, faults, offset well depletion, and geological changes in a single lateral or on a pad of wells.

4. The use of treatment stage-fall-off analysis is also proving valuable for the design and evaluation of perforation friction in Limited Entry “Plug and Perf” completions.

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