

## Montney Review of all Refracs Including the Failures

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### Summary

#### Theory / Method / Workflow

The Montney formation utilizes the most products and services in their completion in Canada. The severe lamination geologically combined with frac growth able or unable to join together the various benches for exploitation has led to a long term learning curve field by field. As with all formations, the initial designs on lookback studies are not the best practices found to be best 5 years later. Operational mishaps in the field can also result in an inventory of wells that may need to be stimulated after a period of lower than desired production while being assessed or diagnosed. Damage of wells during years of production often damages permeability, creates scale damage, and other means which results in lower than expected recovery factors. We have collected the entire inventory of wells that have been refractured, and analyzed all the production impacts to indicate a successful or unsuccessful increase in total recovery versus only accelerated production of the original projected recovery. We also assigned a type and sub-type, an engineering design change observation, combined with production successes or failures from the reservoir responses. We combine these results into the only refrac database in North America.

#### Results, Observations, Conclusions

The most common increase of recovery in the data set resulted in 18% more total production that could have been missed without a refrac. At the same time, there were refracs that for various reasons we observed that did not result in incremental recovery but only accelerated production (which was uneconomic like in nearly all formations).

Several issues were found with chemical diverters versus mechanical diversion having failed to increase recovery.

There was a 6 month production period or longer required for us to differentiate what we consider a “refrac” for this study versus continuing the initial completion of a well before being put on production after a pause in fracturing. Often it was determined to be a sand screen-out or a prematurely set plug during plug and perf operations.

Scale inhibitor was found to not have a significant impact on production potential of wells or prevent the need for refracturing.

The cluster spacing trended very highly to recovery, and the early larger cluster spacings had the largest results from refracturing.

Mechanical diverters had a more predictable and reliable success outcome. Chemical diverter refracs lower cost however did show promise in similar NPV with lower capital risk with a lower recovery, which made these attractive.

The work on parent-child well relationships is still being studied in this dataset. Refracs on the parent wells in the USA are found to protect the child well fracs better than “reloading” the parent well without a frac. We are currently looking at this in the Duvernay.

### **Novel/Additive Information**

Vertical wells in many formations were refractured without the technical or operational challenges in Canada. As horizontal multistage fractured wells were drilled in the same field, we have seen that most wells are abandoned versus refractured to obtain the maximum recovery. With ESG aspects, there are far better assets and cash flow to doing refracs on horizontal wells and overcoming the operational challenges, resulting in less drilled wells for the same recovery, and protecting the environment from not needing to drill as many wells as quickly.

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