

geoLOGIC Technical Showcase

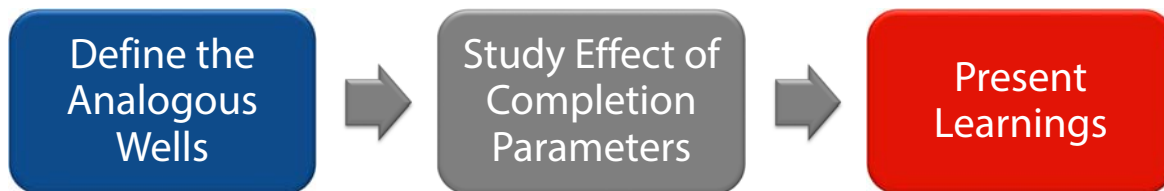
November 16, 2017

Ingredients for Well Success

A Completions Optimization Workflow

Presented by: Melanie Popp, P.Eng., Engineering Director, geoLOGIC systems Ltd.

Completions Optimization Workflow



Define Analogous Wells



Have "enough" data



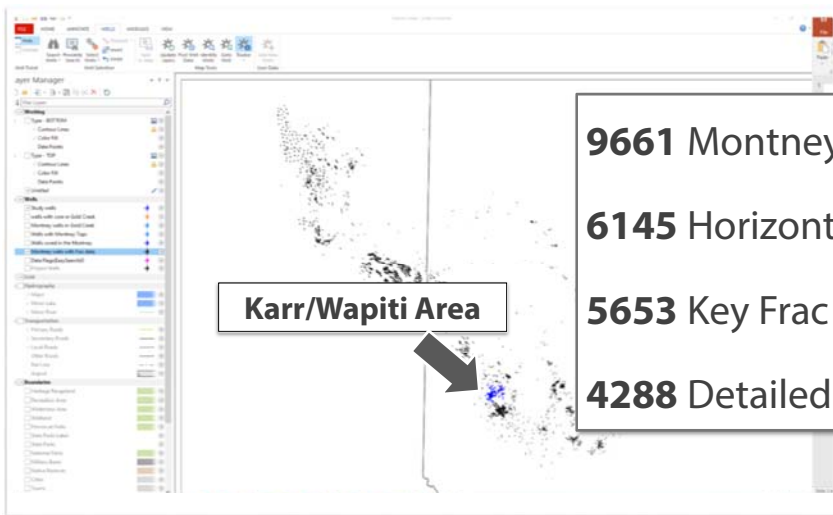
Drilled in similar horizon



Check production reporting

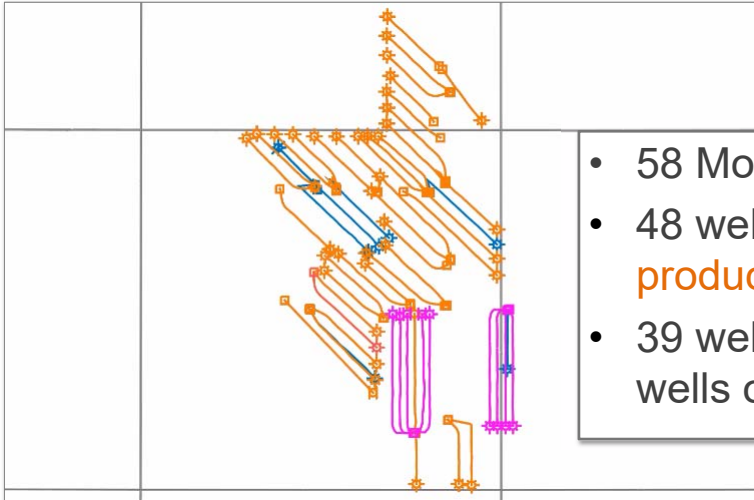
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Montney Fairway: Wells with Frac Analysis



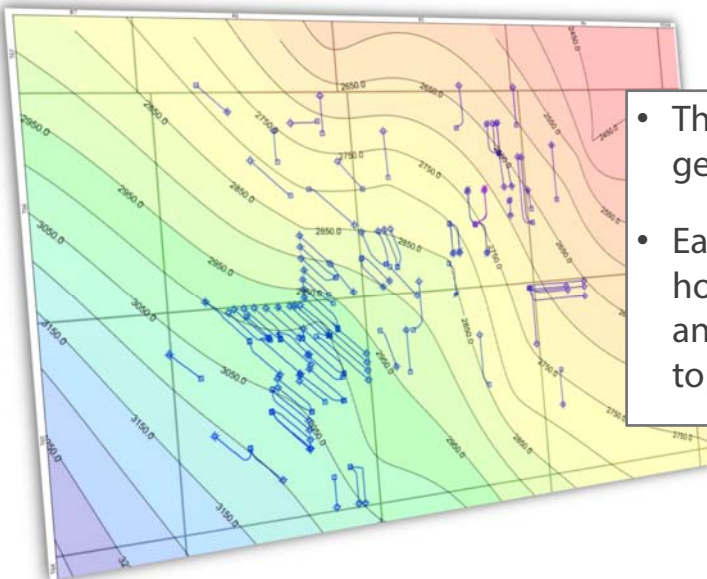
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Defining Analogous Wells: Wells with Data



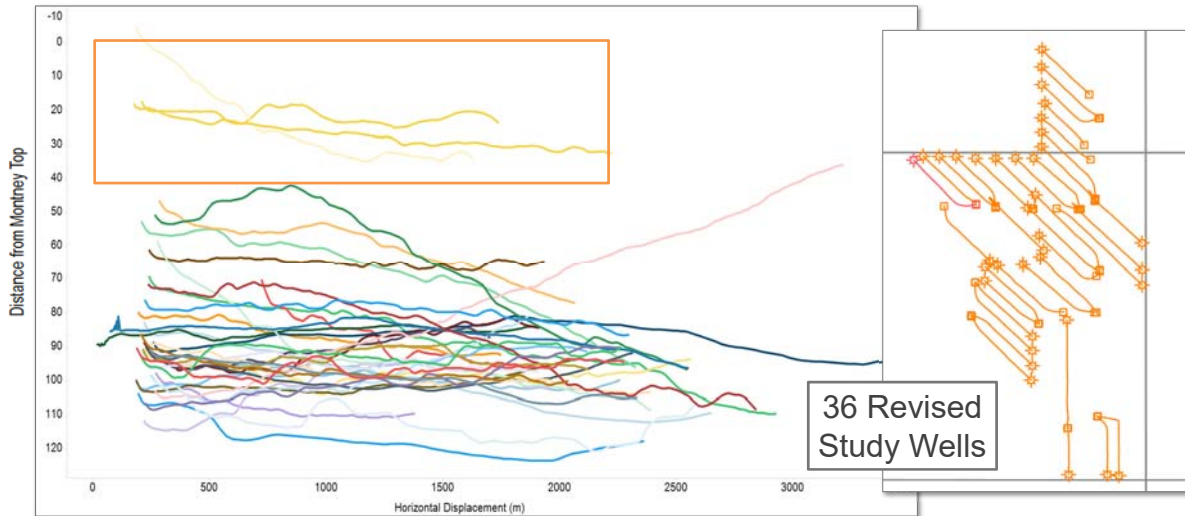
- 58 Montney wells in **area**
- 48 wells with > 6 months **production**
- 39 wells with frac data, 9 wells on **confidential** status

Defining Analogous Wells: Target Interval

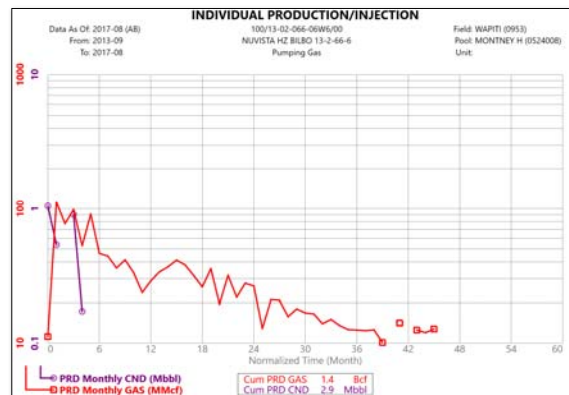
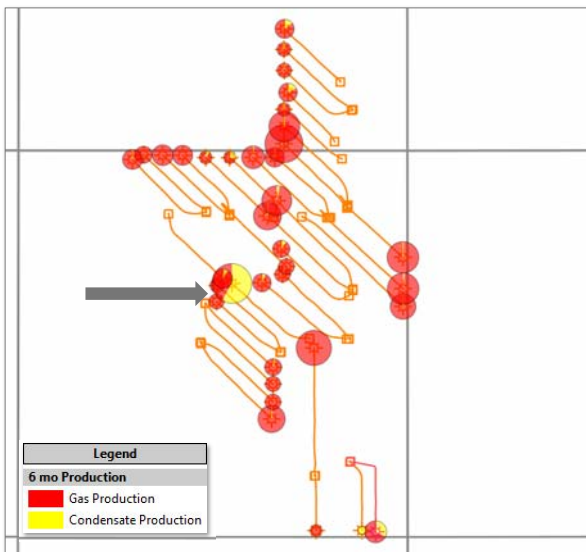


- The grid was created using geoSCOUT tops
- Each station location of the horizontal was assigned a value and distance from the Montney top

Defining Analogous Wells: Target Interval

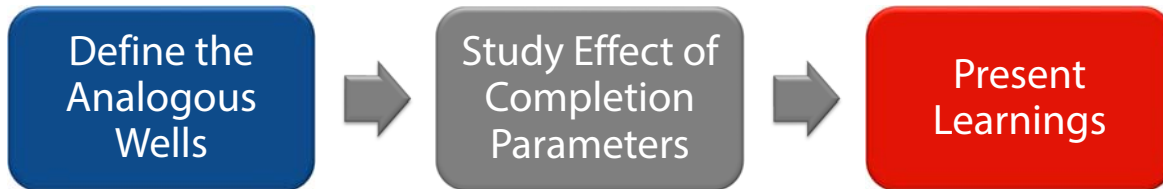


Defining Analogous Wells: Production



Condensate is reported sporadically over the first 1-3 months. Wells will be evaluated on gas production alone.

Completions Optimization Workflow



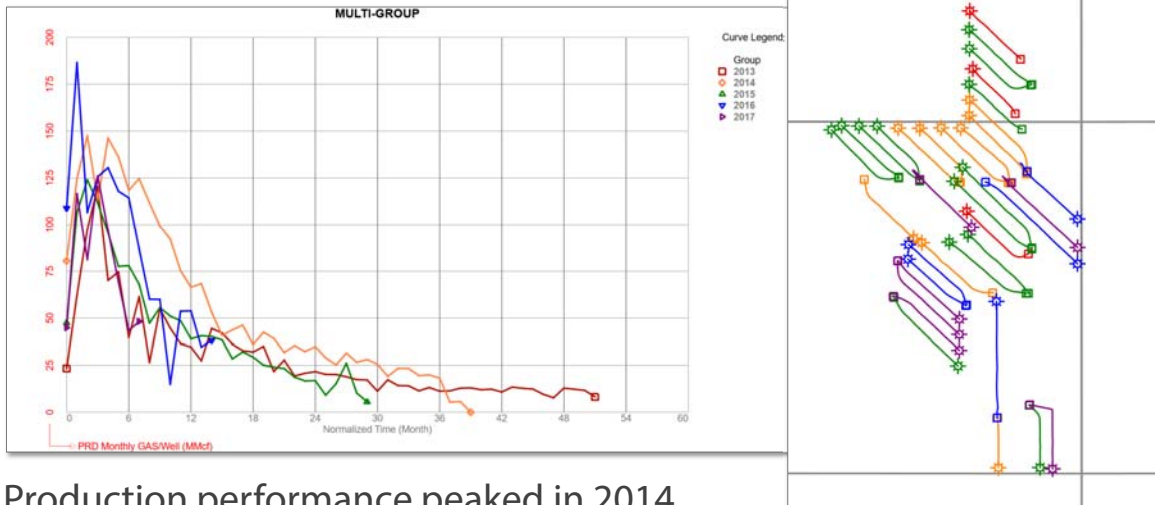
- Wells with data
- Drilled in similar horizon
- Examine production practices

Evaluation of Completion Trends

Comp End Date		UWI	Technology Group	Stages Actual	Completed Length (m)	Avg Frac Spacing (m)	Avg Proppant Placed / Meter (tonne)	Avg Fluid Pumped / Meter (m3)
2013	3	1	Avg.: 14	Avg.: 1476.34	Avg.: 117.15	Avg.: 1.06	Avg.: 7.99	
2014	9	1	Avg.: 18	Avg.: 1887.84	Avg.: 101.86	Avg.: 0.97	Avg.: 6.22	
2015	13	2	Avg.: 21	Avg.: 1988.00	Avg.: 94.78	Avg.: 1.09	Avg.: 7.29	
2016	5	3	Avg.: 32	Avg.: 2226.00	Avg.: 83.78	Avg.: 1.25	Avg.: 10.02	
2017	6	2	Avg.: 33	Avg.: 2012.35	Avg.: 69.56	Avg.: 1.65	Avg.: 12.90	

- Activity peaked in 2015
- Number of stages and lateral length is increasing
- Average frac spacing is decreasing
- Proppant and fluid per m is increasing

Production Performance by Year



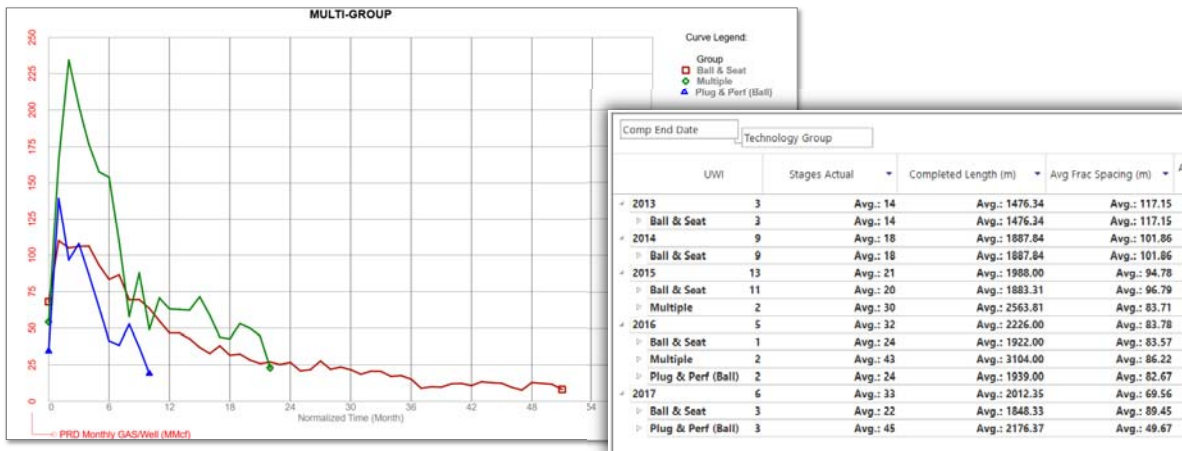
Production performance peaked in 2014.



Production Performance by Technology



Multiple technologies have been most effective, but not used much in 2017. Positive effect may be dampened if normalized on length as multiple technology wells tend to be extended reach.



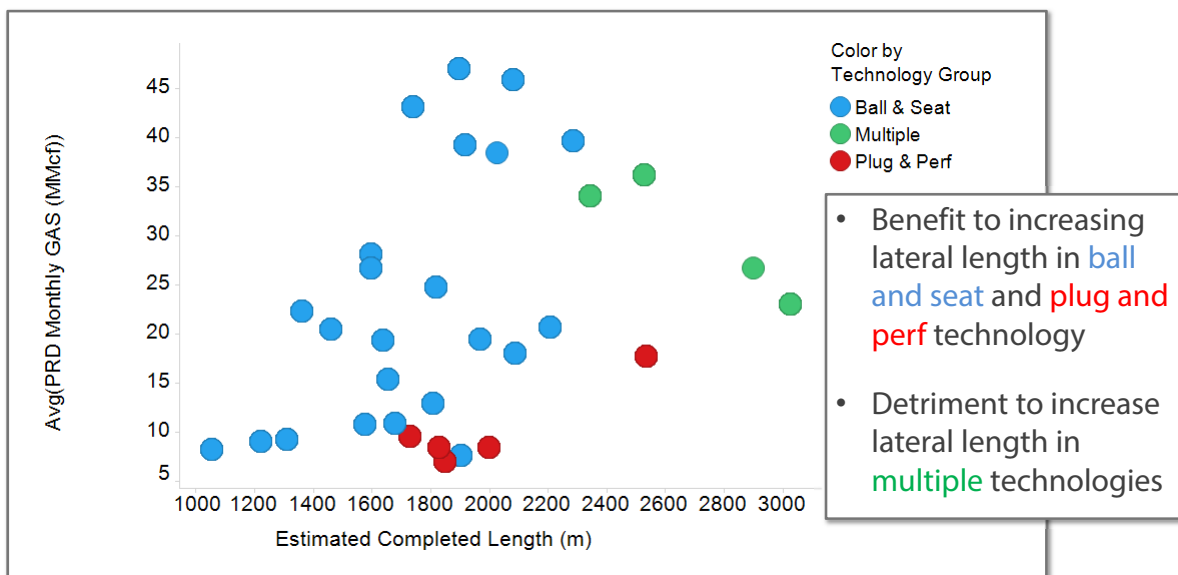
The Taste Test: Categorizing Production Metrics

- The following plots were prepared using the average PRD (producing daily average) Gas Rate per month, averaged over the life of the well
- The Average PRD gas rates were then **normalized** to lateral length to account for reservoir access



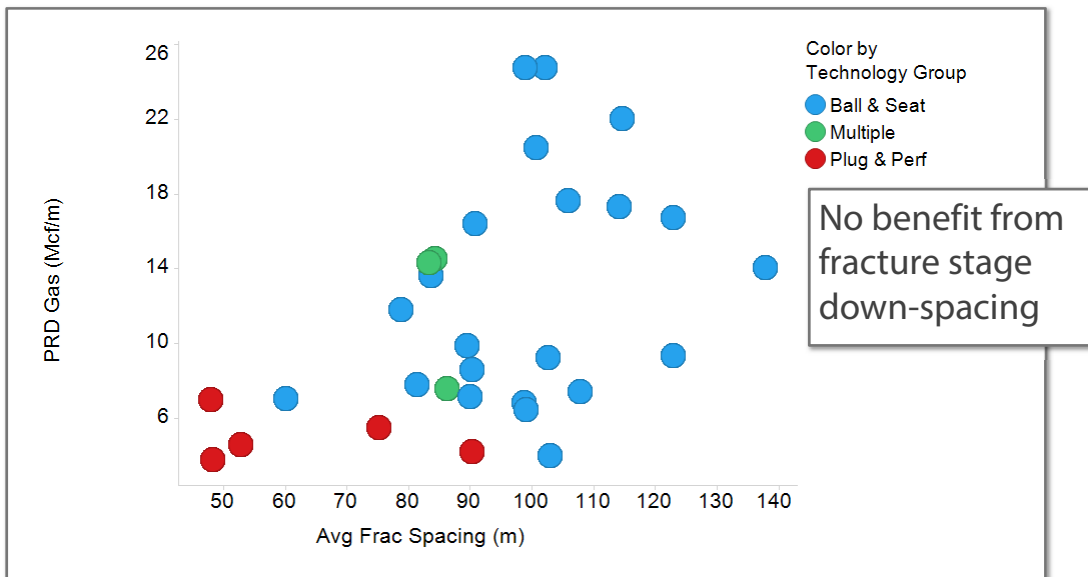
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Completed Length and Effect on Production



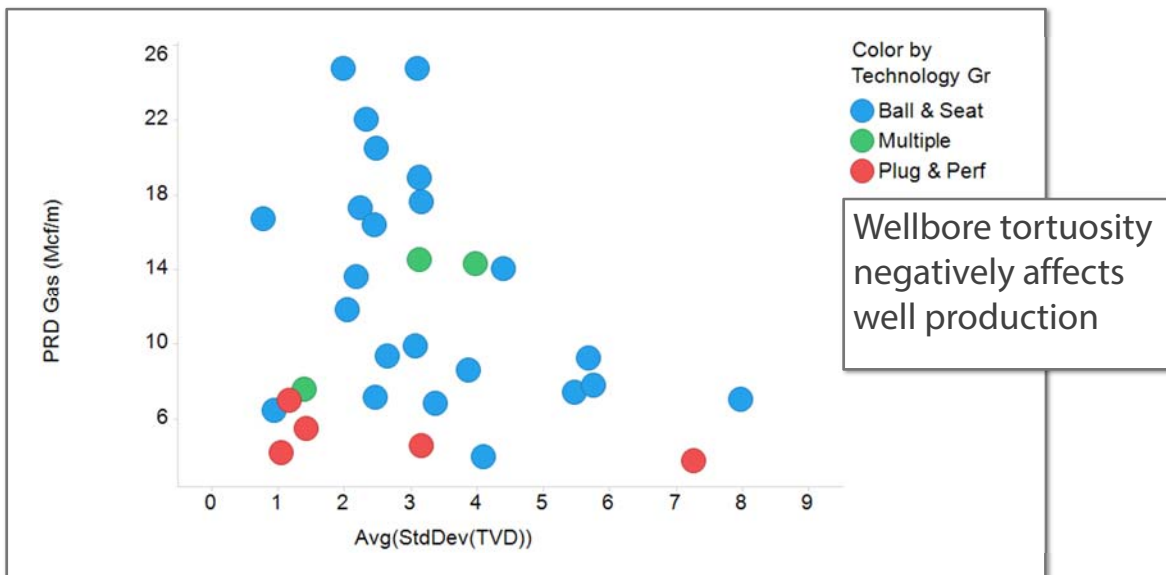
TIBCO Spotfire 14

Frac Spacing and Effect on Production



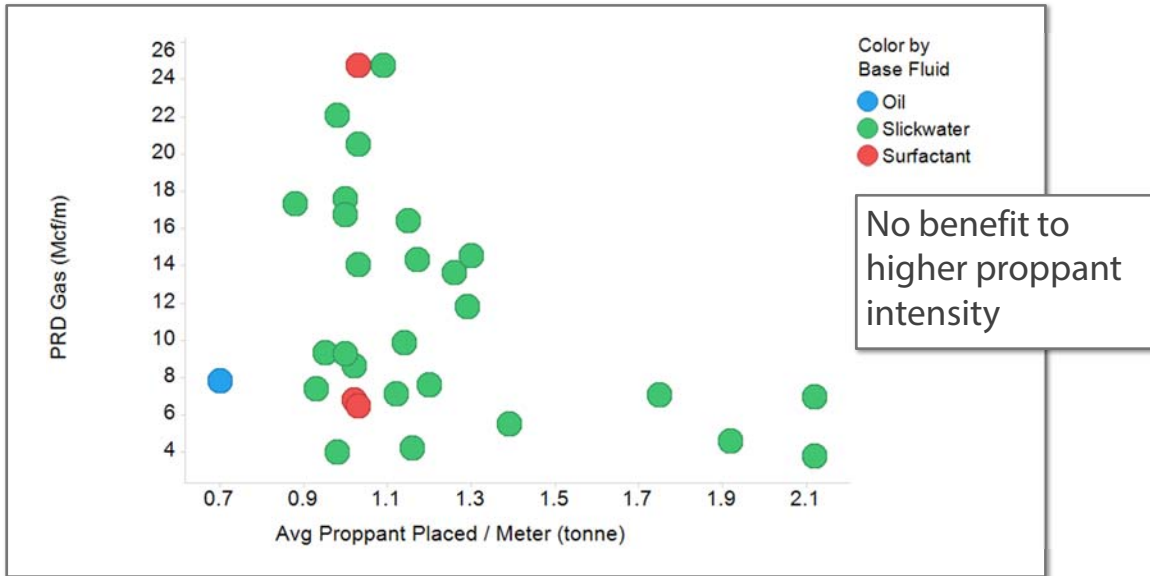
TIBCO Spotfire 15

Wellbore Tortuosity and Effect on Production

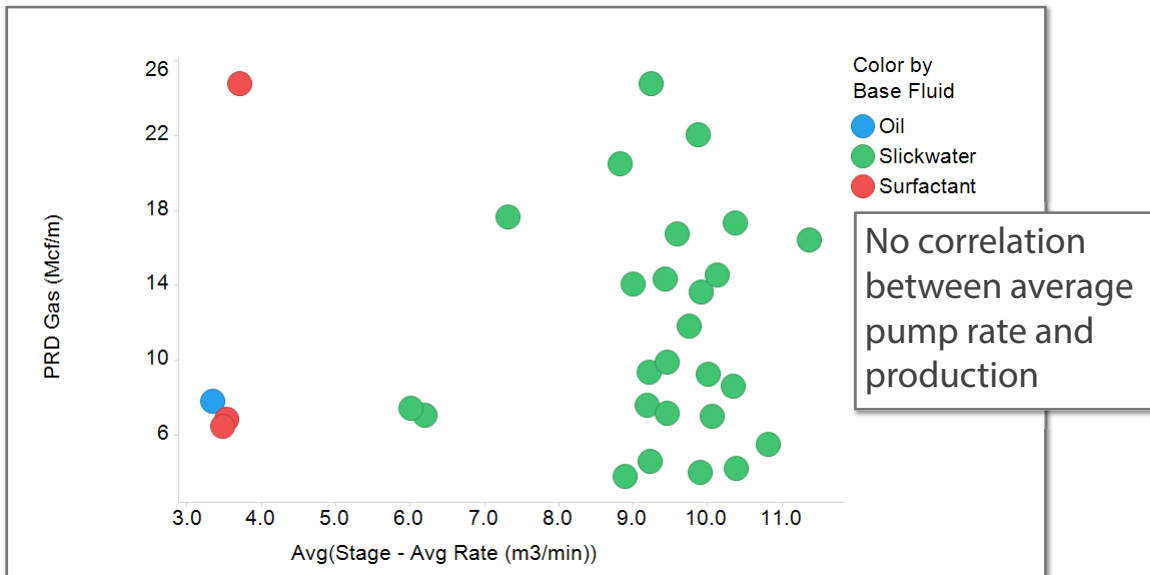


TIBCO Spotfire 16

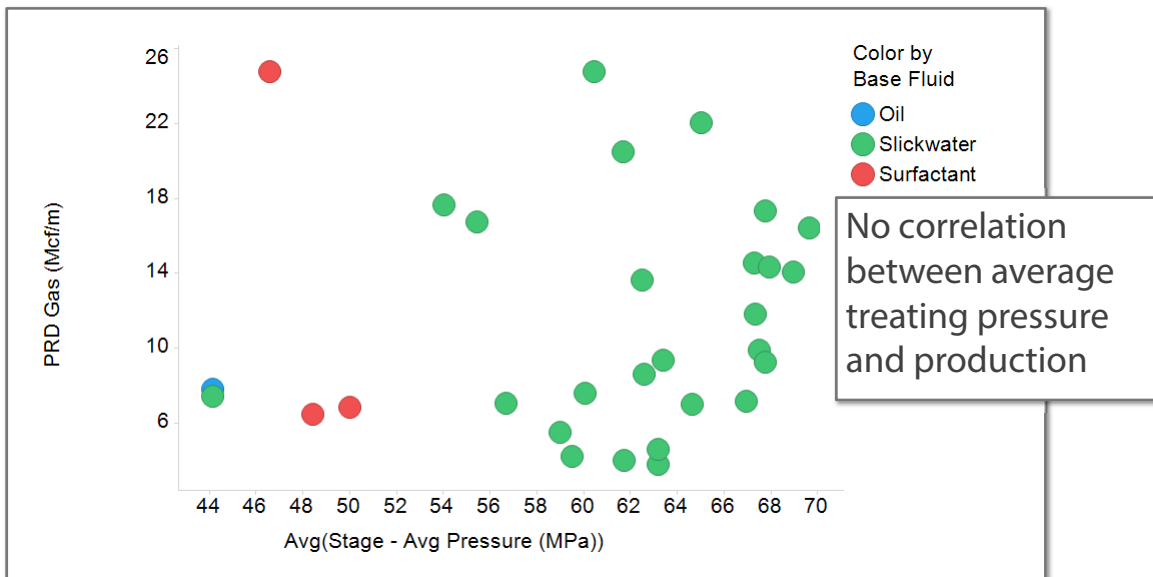
Proppant Intensity and Effect on Production



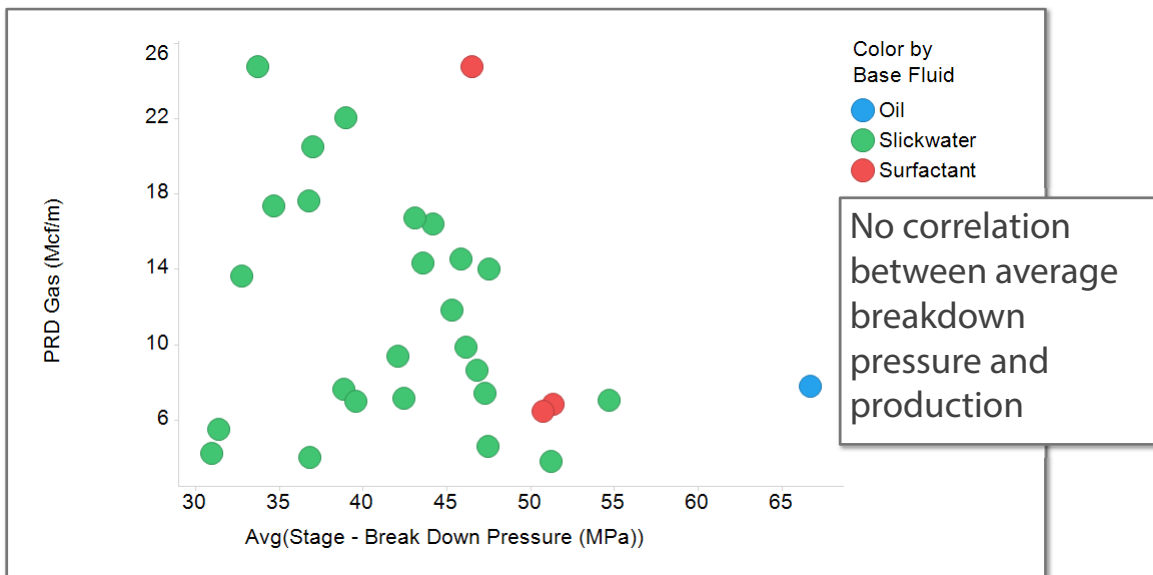
Pump Rate and Effect on Production



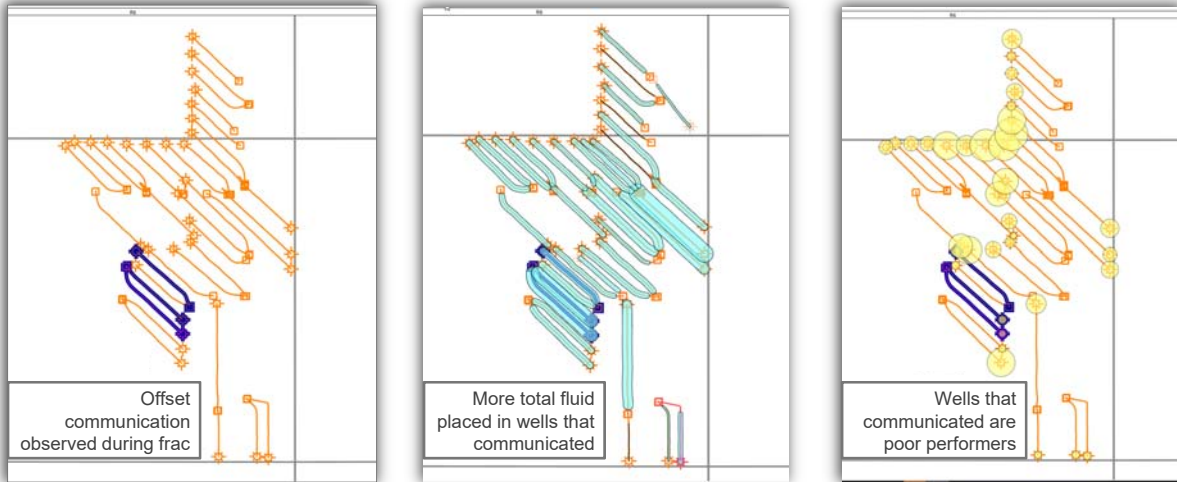
Average Treating Pressure and Effect on Production



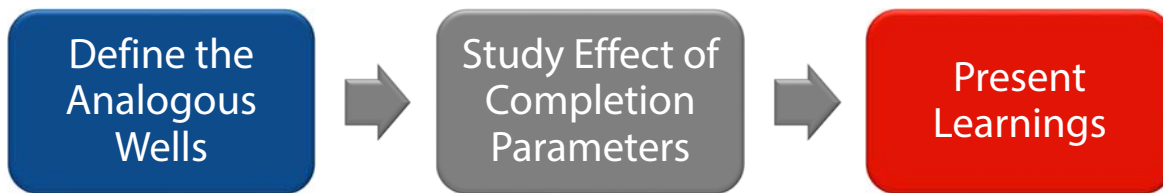
Average Breakdown Pressure and Effect on Production



Influence of Offset Wellbore Interference



Completions Optimization Workflow



- Wells with data
- Drilled in similar horizon
- Examine production practices

- Completion system
- Completed length and stage spacing
- Proppant and fluid intensity

- Landing depth and wellbore undulations
- Base fluid type
- Pump pressures and rates

Learnings



- Increasing lateral length benefits plug and perf and ball and seat completions while impairing multiple completions
- No benefit from fracture down spacing
- Increased wellbore tortuosity negatively impacts production
- Laterals placed at ~90-100 m from Montney Top perform better

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Learnings



- No benefit to increasing fluid intensity
- No benefit to increasing proppant intensity
- Pump rates, breakdown pressures and average treating pressures do not affect well production
- Offset wellbore interference may have contributed to poorer performance

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Next Steps



- Additional analysis to quantify dependencies between completion parameters
- Utilization of fluid analysis to better understand condensate contribution
- Evaluation of wellbore spacing and influence of infill drilling on productivity

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Want More Information? Frac Analysis

If you would like more information about
geoLOGIC's Frac Analysis options
please contact Sales@geoLOGIC.com