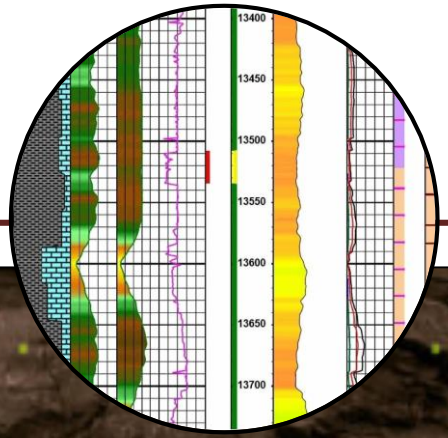
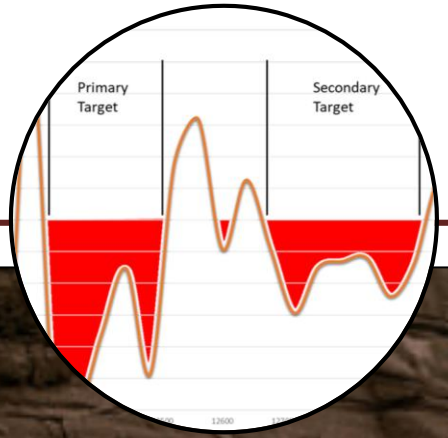




Providing a better understanding of rock properties and heterogeneity

Discussion materials – Drill2Frac Corporation

July 11, 2019

Overview of Drilling Data used for OmniLog deliverable

OmniLog Engine

Basic Data Requirements

Item #	Data Type	Format	Boggess 1H	Boggess 3H	Remarks
1	Drilling Data (prefer direct access to Pason/Totco portal)	CSV	Yes	Yes	Contact EDR provider for access. Pason: usdatahubsupportrequests@pason.com or NOV/Totco: support@welldata.net Request access for user: ***drill2frac*** email: ***data@drill2frac.com***
2	Directional Survey data (TVD, MD, Azimuth, Inclination etc.)	LAS/.XLS/.CSV	Yes	Yes	Need LAS, Excel or ascii to prevent data entry errors
3	Mud Motor Make & Specs - use space below for multple BHAs		Yes	Yes	Need rev/gal & ft-lbs/psi for curve & lateral motors
4	Mud Logs - inclusive of lithology, Total Gas, C1, C2 etc. If available	LAS	Yes (6320' onwards	Yes (6120' onwards	Start depth: End depth:
5	LWD GR (Gamma Ray) - Recorded or Memory Log, not Real Time	LAS	Yes (calibrated)	Yes (calibrated-6130' onwards)	Start depth: End depth:
6	Directional Driller's End of Well Drilling Report	.pdf/word Document/xls	Yes	Yes	BHA reports & motor details
7	Daily Drilling Reports	.pdf/word document/xls	Yes	Yes	Need daily ops details
8	Geometric Perforation plan/design	.XLS//pdf/Word Document	No	No	perfs per cluster, perforation diameter as well as actual locations of perfs
9	Casing Tally	Prefer XLS, CSV, txt	Yes	Yes	Need "as run" Excel or text for perf depth control
10	Wireline GR/CCL	LAS	No	No	Can be furnished any time before completion ops start, including after D2F delivery
11	Geosteering Interpretation plot	LAS/.XLS/.CSV	Yes	Yes	Graphics and digital version of geosteering plot

Plan forward with creating D2F output and how it can be utilized

3.1 OmniLog Profile – Extract rock properties accounting for heterogeneity

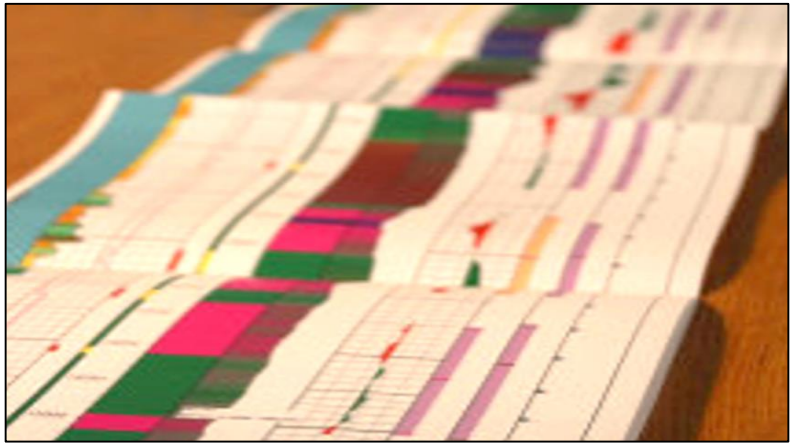
Key features

- Maps detailed rock properties using common drilling data, accounting for heterogeneity, along the wellbore
- No additional operations are required - uses each lateral's existing drilling data to get rock properties
- Applies machine learning methods to QC'ed data and calculates a corrected RockMSE

Process flow

1. Collect required data (from Pason files, EOW report, MWD, GR, DDR …)
2. Eliminate extraneous data (e.g. Repeat sections, Abandoned laterals, Vertical sections)
3. Data Quality process applying machine learning methods (MLM) remove gaps, spikes, noise, etc.
4. Calculate Rock MSE (account for rock heterogeneity)
5. Build Depth Correction (LWD-GR and WL-GR/CCL Correlation)
6. Build Facies and Trajectory Plots along the wellbore

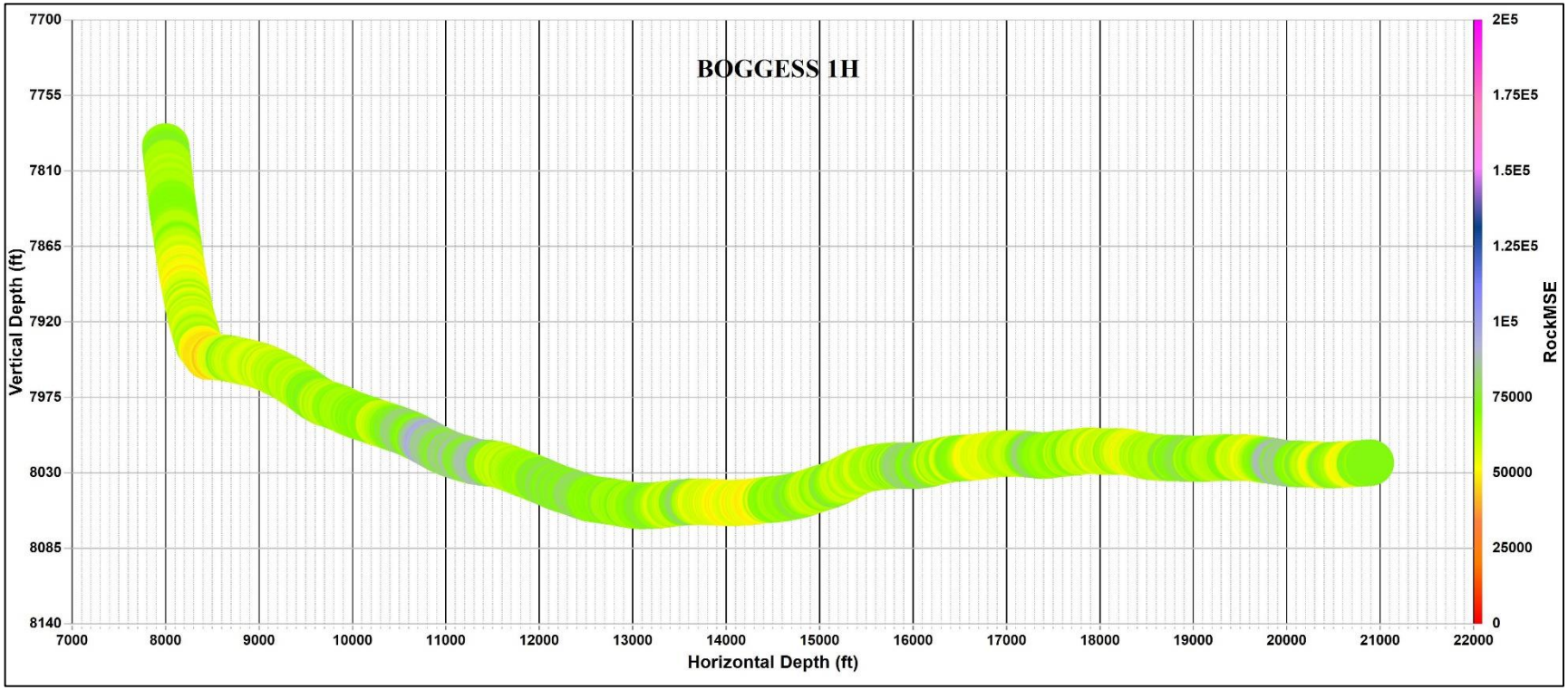
Value to customers



Cost effective and efficient solution:

- ✓ No additional wellsite tools, so there is no HSE risk to personnel from operations
- ✓ Low incremental cost allows the technique to be applied on every well, versus the cost of open-hole and MWD logs with their associated risks
- ✓ Reliable, repeatable, data driven rock MSE calculations, facilitate standardization and automation of key processes
- ✓ Drill2Frac has more experience in analyzing a lithology based MSE than any other service company

Trajectory Plot

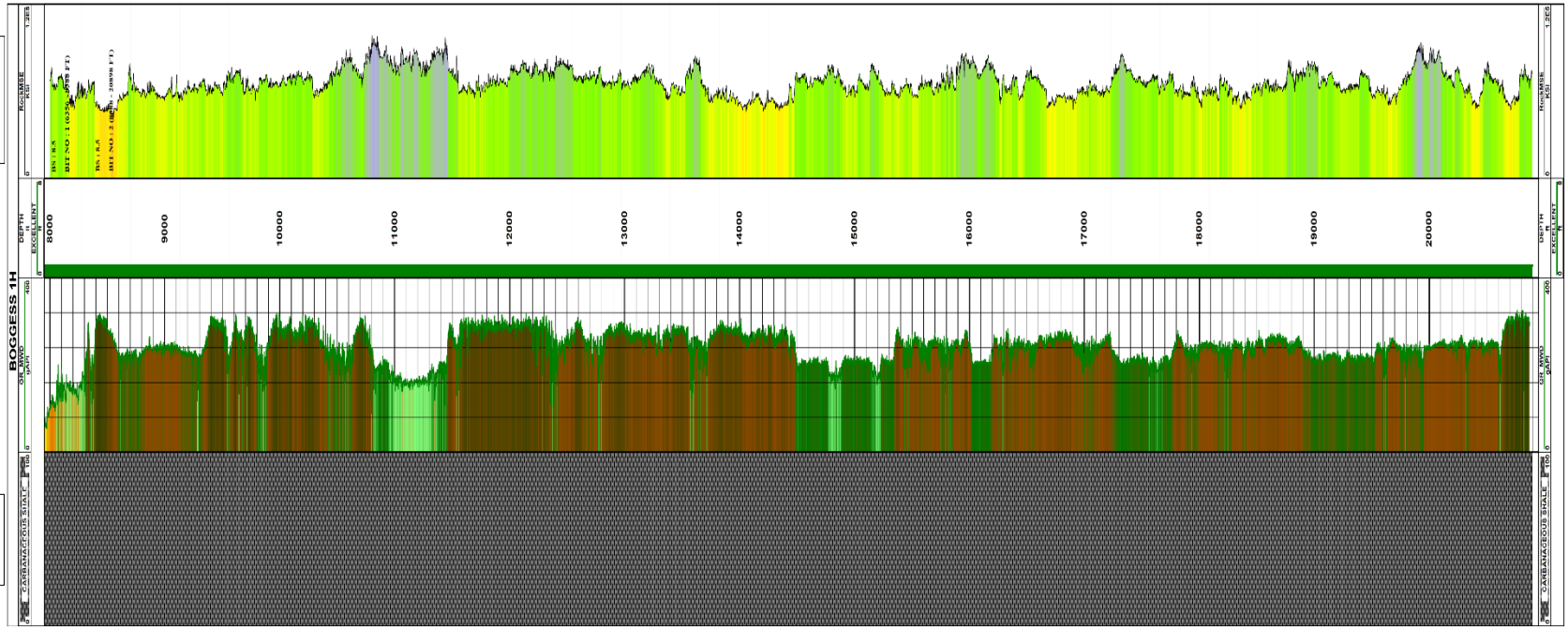


Well Overview – OmniLog with GR

OmniLog Lateral Profile

GR MWD

Mudlog Lithology

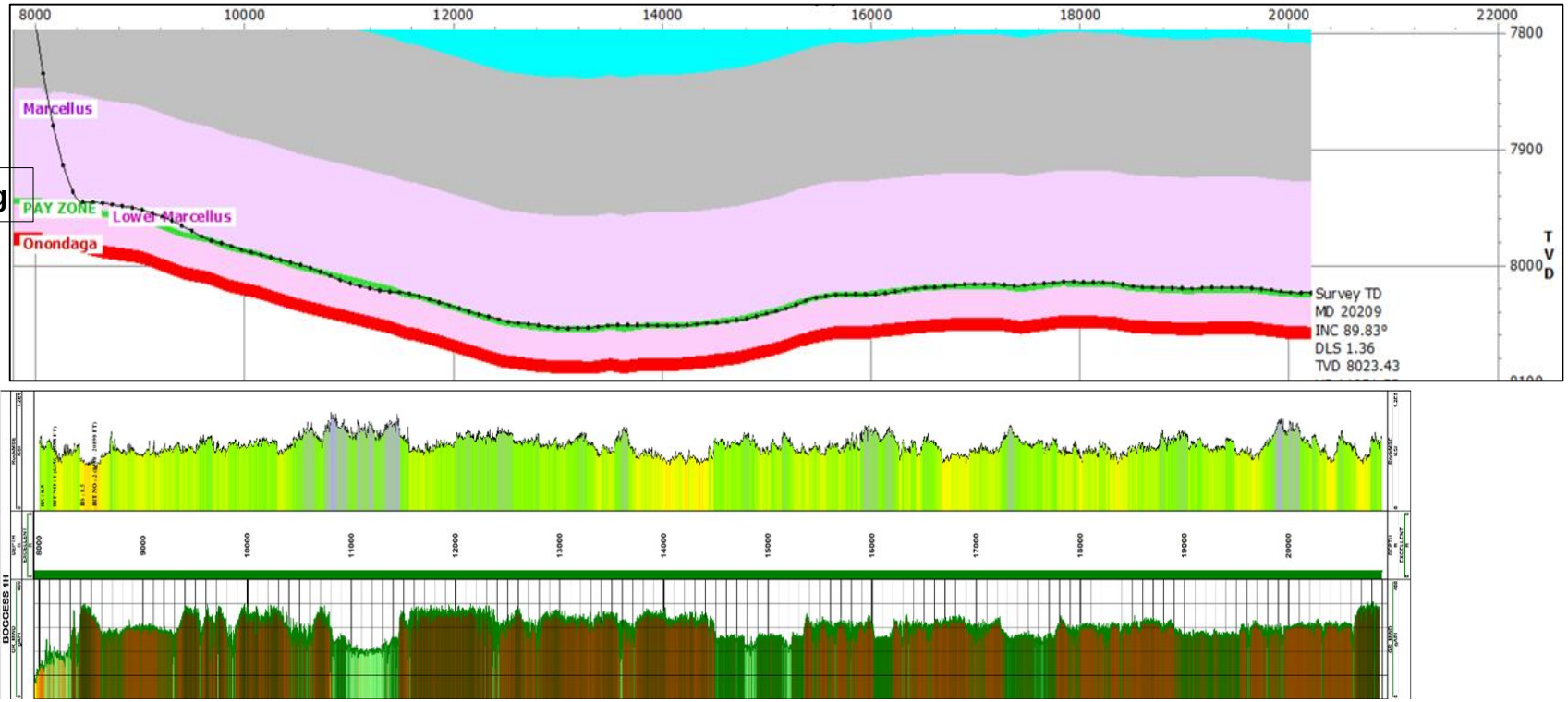


Geosteering Interpretation

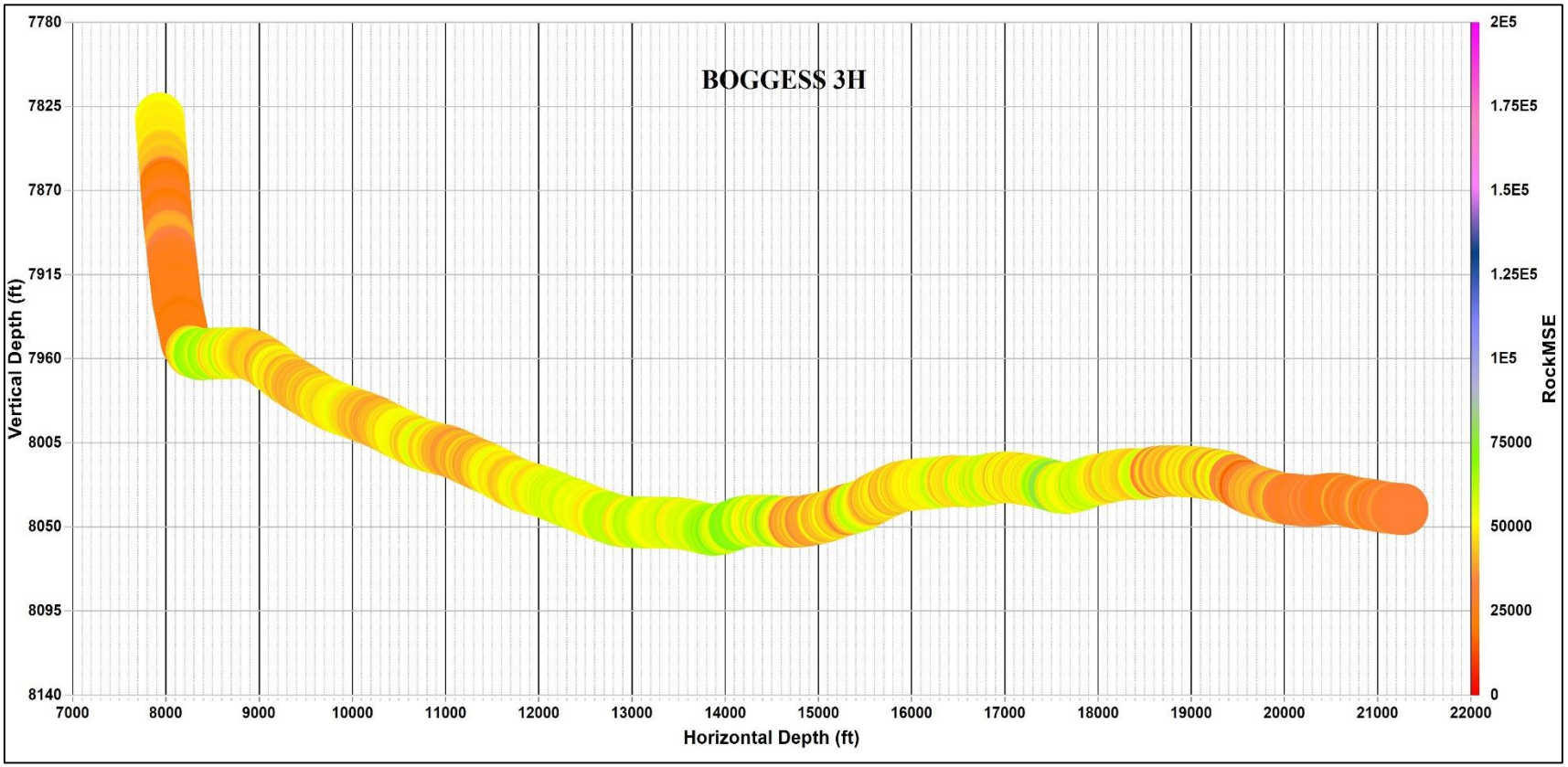
Geosteering

RockMSE

GR
MWD



Trajectory Plot

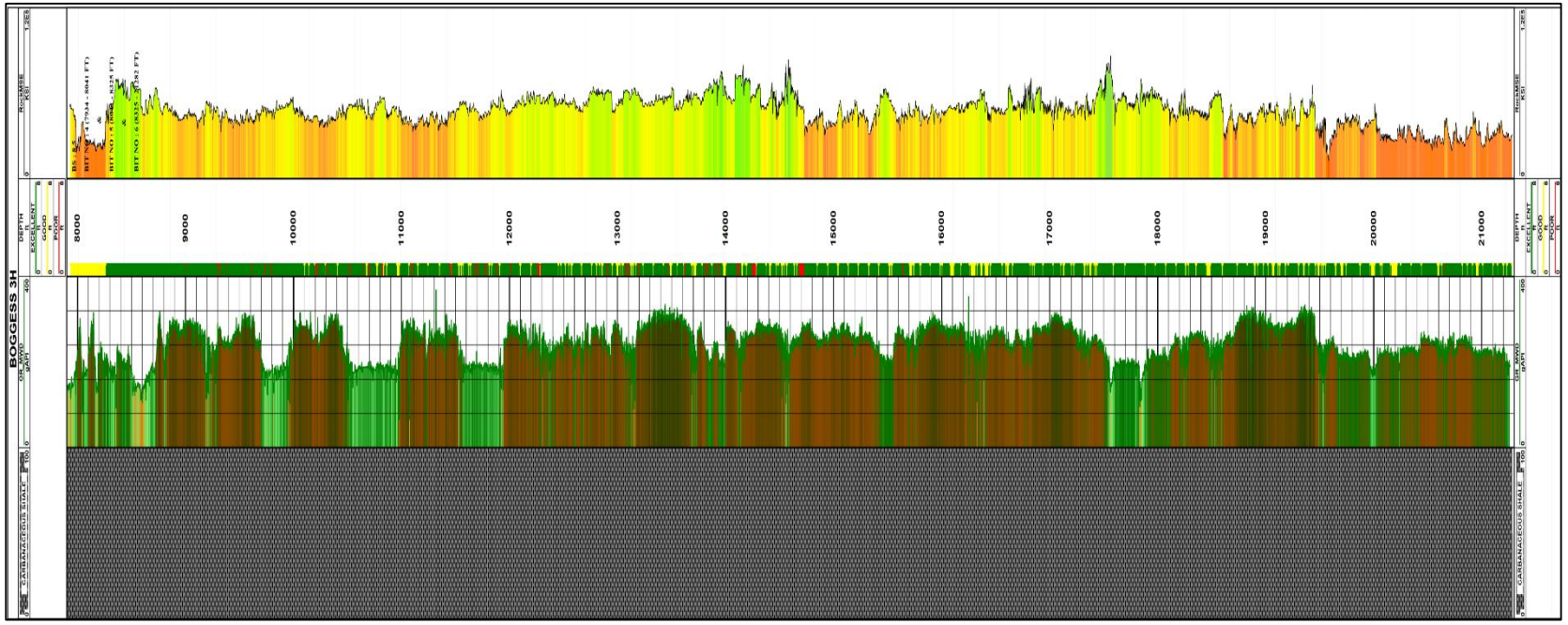


Well Overview – OmniLog with GR

OmniLog Lateral Profile

GR MWD

Mudlog Lithology



Geosteering Interpretation

Geosteering

RockMSE

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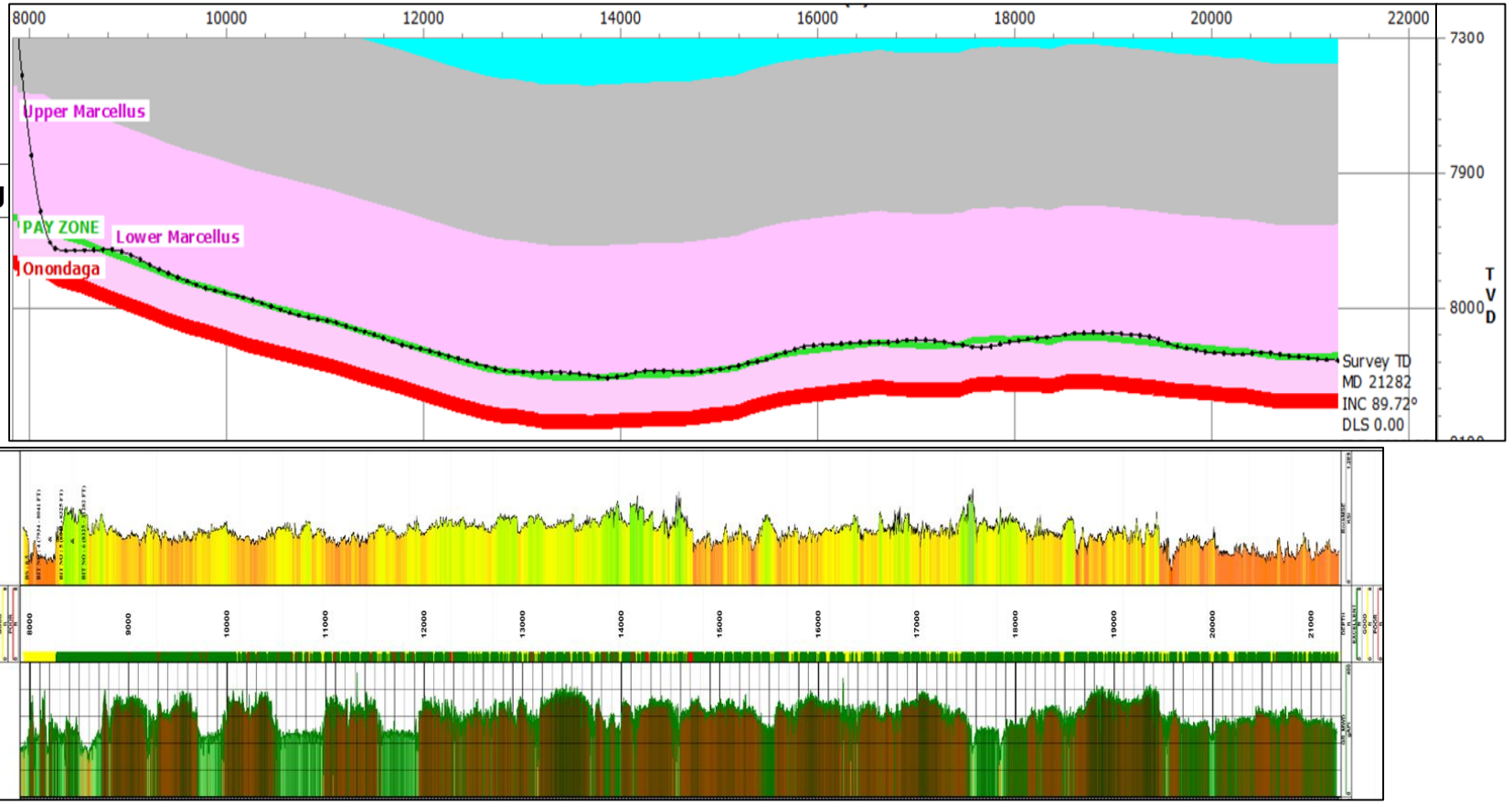


3.3 PerfAct Engine – Integrate rock properties

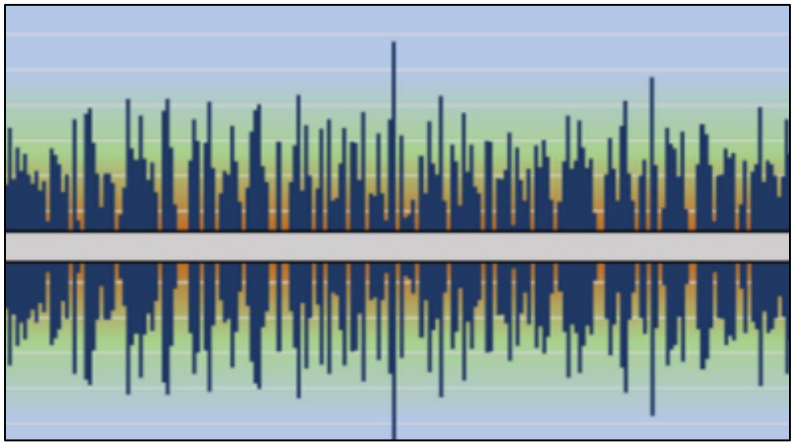
Key features

- Uses the accuracy of RockMSE to provide a unique, reliable value that is a proxy for unconfined compressive strength
- Uses an automated, computation workflow to give a modified completion design in a lateral, optimizing perforation placement in seconds.
- Can use any data input obtained in the lateral

Process flow

1. **Data inputs**
   - Logs, Rock MSE
   - Base completion design
   - Perforation plan
   - Pump schedule
2. **PerfAct Engine**
   - Stage Optimization, perforation placement
   - Calculating fluid distribution
   - Diversion strategies
3. **Optimal completion design**
   - PerfAct optimized outputs

Value to customers

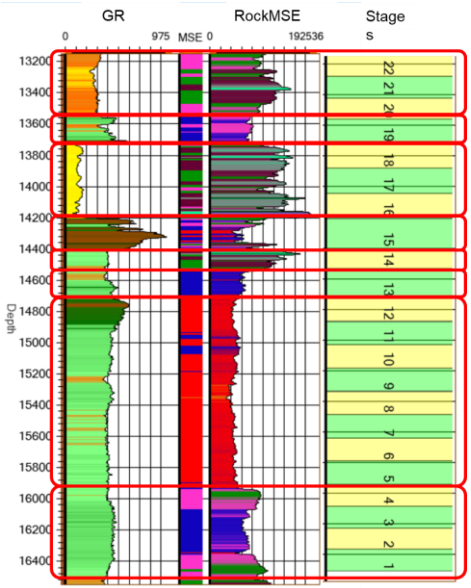


Cost effective and efficient solution:

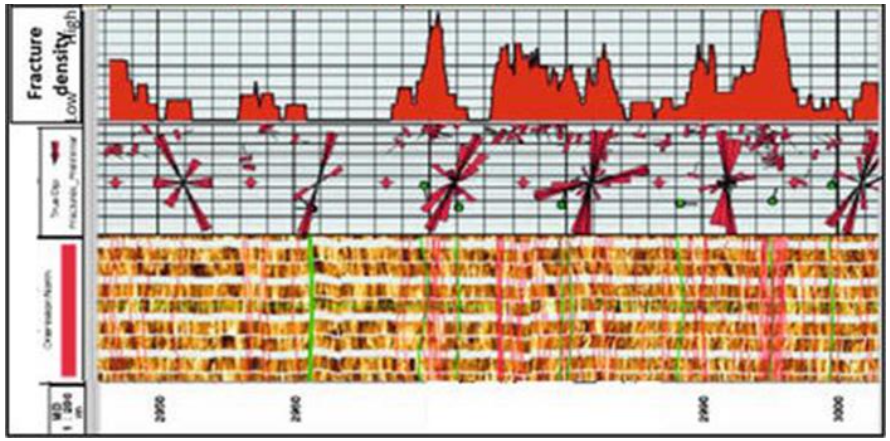
- ✓ Improves frac effectiveness by optimizing perforation placement based on multi-variate analysis and treatment preferences
- ✓ Can use legacy completion design, or re-design based on reservoir properties
- ✓ Has been shown to improve production by up to 20%
- ✓ Documented reduction in completion time and water usage
- ✓ Can be used to design diversion strategies when combined with D2F's proprietary Engineered Diversion Service

World Oil AWARDS 2018 WINNER Best Completions Technology Award

Integrating Image Logs in to the PerfAct Engine



1. The PerfAct engine is specifically designed to incorporate any and all data obtained in the lateral
2. Lithological boundaries identified in image logs, including faults, can be used to precisely identified segment boundaries
3. A fracture intensity log created from the image data can also be used as in input to the automatic perf picking algorithm. For example:
   - Can preferentially target areas containing high levels of natural fractures
   - Can avoid areas that have a high concentration of induced fractures



3.4 FracCheck Service – Post frac analysis

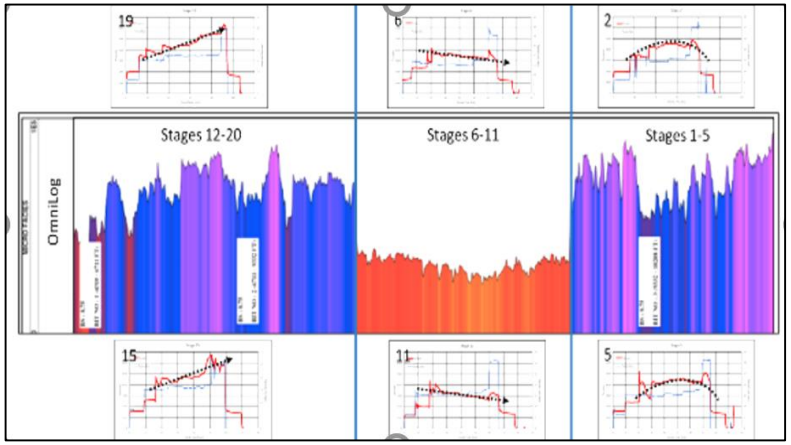
Key features

- Integrated service that combines RockMSE from drilling data, frac pressures, rates and other measurements to provide a detailed assessment of fracture performance and completion efficiency
- Helps to build a database of frac performance vs rock properties and treatment parameters, enabling key data analytics.

Process flow

1. Collect rock property and treatment data
2. Data validation and cleanup
3. Data aggregation
4. Multi-variate analysis
5. Expert review
6. Summary and recommendations

Value to customers



Cost effective and efficient solution:

- ✓ Provides insights into the causes of differences in the effective performance of fractured wells to improve frac efficiency and reduce costs
- ✓ Since no new data is required, a group of wells that had screen outs, frac hits etc. can be analyzed to better understand the relationships between rock properties, the treatment plan and actual frac performance
- ✓ Provides reliable, repeatable technical guidelines for evaluating the economics of re-fracturing programs, drilled but uncompleted completions, and the effectiveness of treatment programs
- ✓ Eliminates screen outs

Next steps

Drill2Frac pleased to join this project

- D2F planned deliverable includes the following

	Purpose
Trajectory Plot	Overview of rock properties along the lateral. Visual indication of heterogeneity in the lateral
Lateral Montage	Single graphic representation of all the data available for each lateral
Well Segmentation	Optimize stage lengths utilizing the rock properties on each lateral
PerfAct Optimization Parameters	Ability to select rock properties for each lateral to optimize reservoir management
Fluid Distribution	Minimize number of under/over stimulated clusters for better long term production. Fewer over stimulated clusters will minimize frac hits.
Sample Segment Analysis	Detailed analysis of each segment.
Perforation Depth Control	Will adjust depth references based on GR/CCL so that perforation depths are on same depth as OmniLog
Post Completion Analysis	Use data analytics and engineering principles to better understand relationships between rock properties and treatment performance. Learnings can be used to fine tune treatment schedules.

Recommendations/Needs

- Perforation plan-Baseline
  - Top and Bottom depths of areas to be perforated (Heel vs Toe)
  - Planned stage lengths/number of stages planned
  - Cluster strategy- geometric vs engineered (spacing)
  - Perforation details- phasing, size perforation, perfs/cluster, min plug setting spacing req
  - NNE planned workflow to identify stage breaks and perf clusters
  - Data source to be used for picking stage breaks and perf locations
- PerfAct engine-input into weighting
  - Rock MSE- low MSE, same MSE, rapid change in MSE
  - Gas shows- mud logs, mass spectrometer (total gas)
  - Fracture intensity logs (to target or avoid fractures)/interpreted borehole images
  - Other logs
- Comparison of Baseline to PerfAct design fluid distribution predictions
- FracCheck
  - Treatment reports
  - ASCII data
  - Engineer notes- change of management