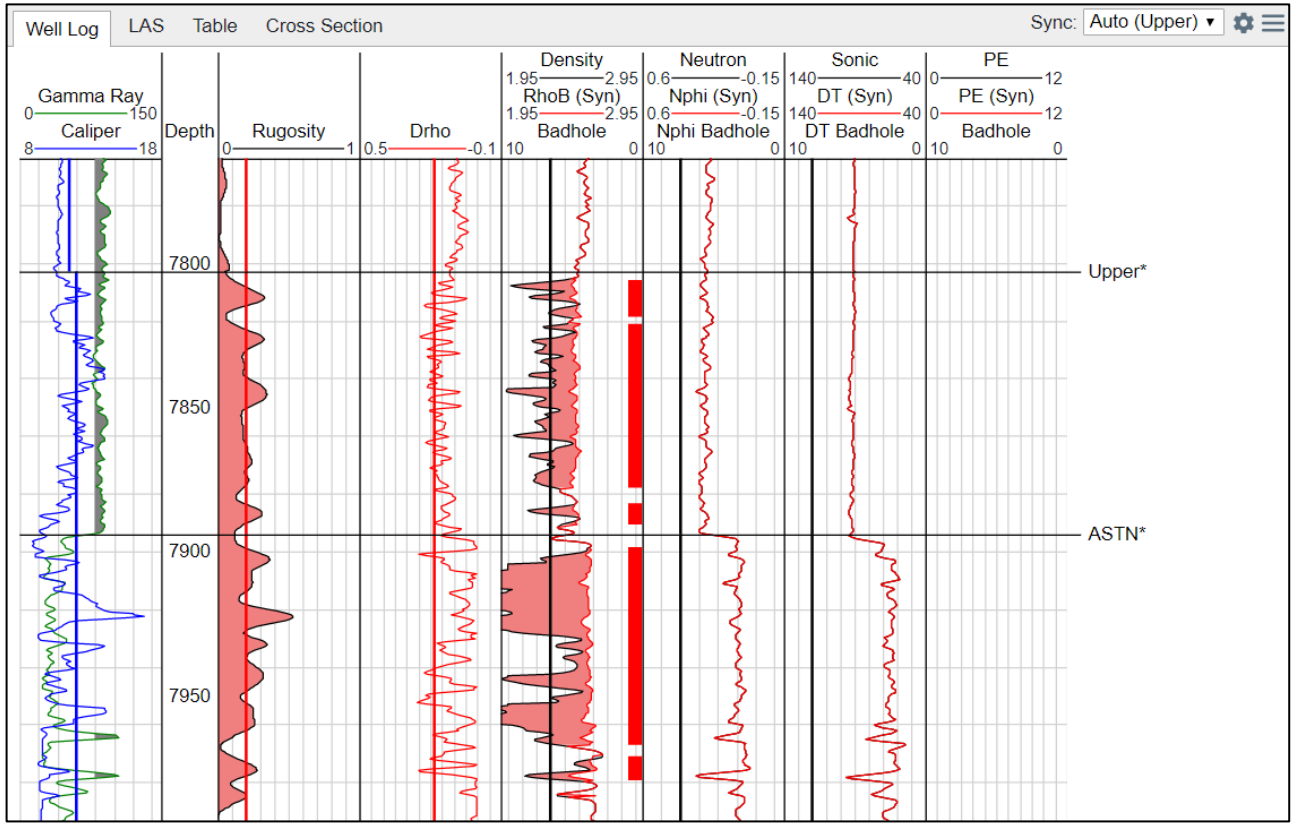
Danomics Badhole ID & Repair

Improving interpretations through machine learning based curve repair

April 2020

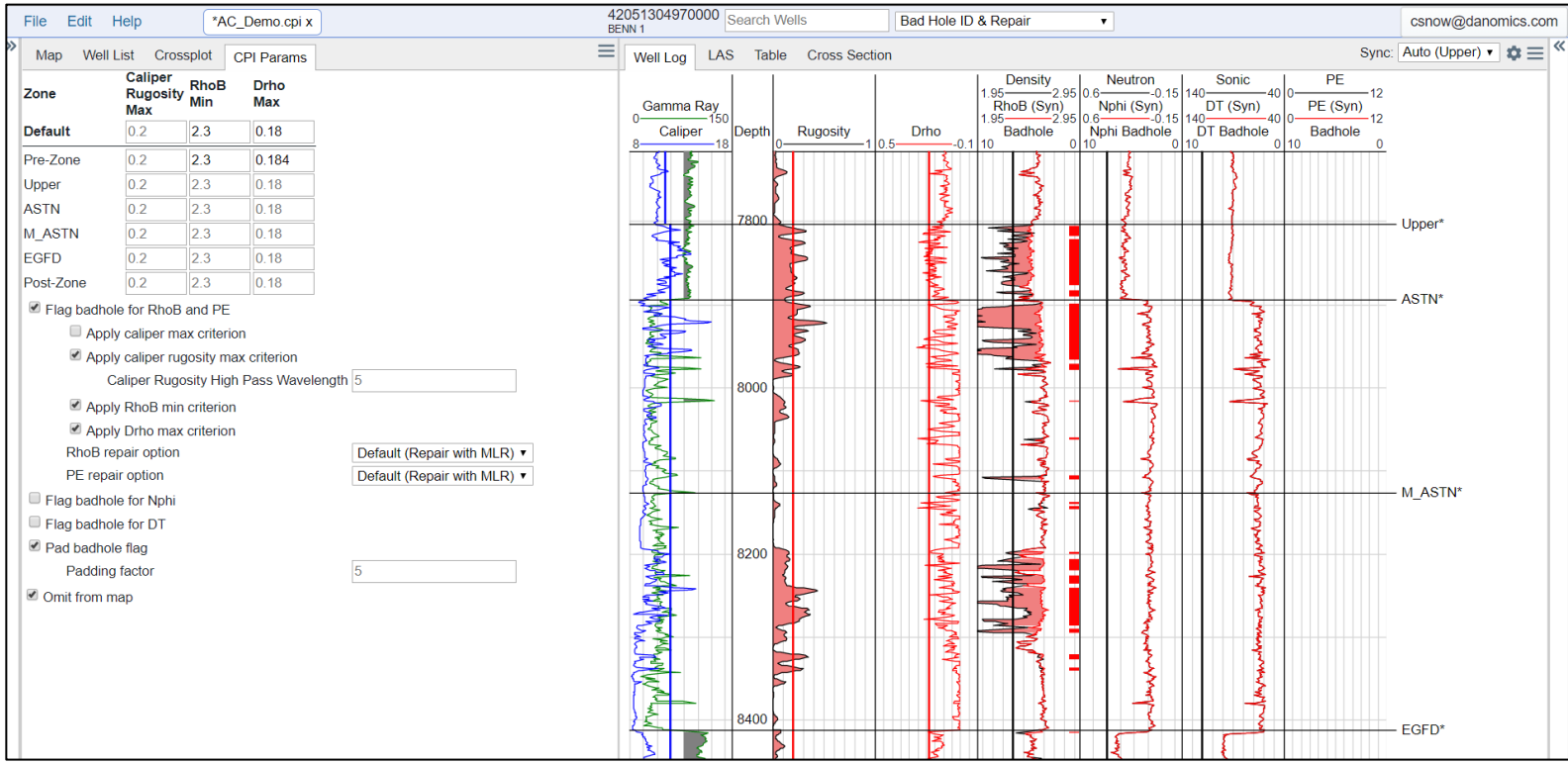
Danomics Curve Repair Objectives

- Increase data available for use in petrophysical calculations
- Eliminate need for users to tune correlation parameters on zone-by-zone basis
- Improve the quality of interpretations by providing high-quality repaired curves
- Reduce the overall analysis time by eliminating time spent QC'ing results in suspect intervals



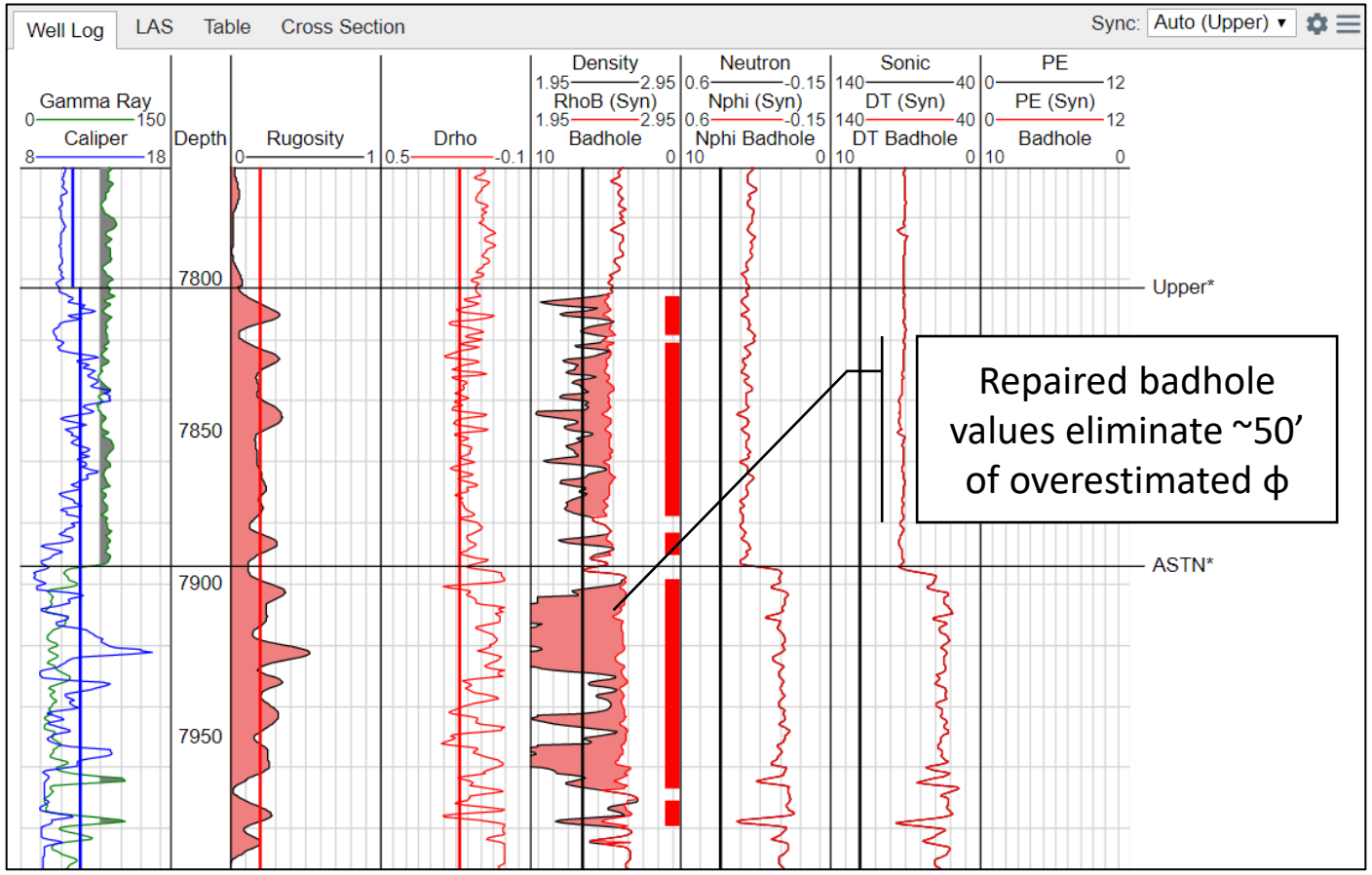
Badhole ID & Repair Interface

- Identify washouts by multiple criteria in simple visual interface
- Choose which curves and what indicators meet your needs
- Automatically repair curves via MLR or Random Forest
- Results instantly available for use in all following calculations



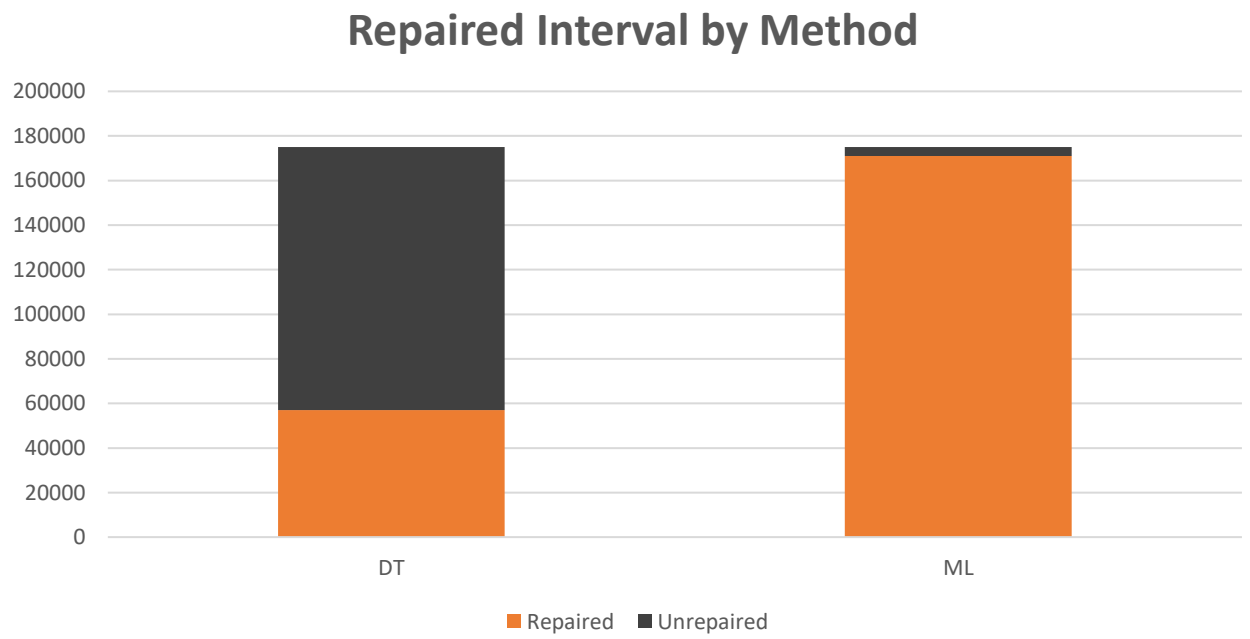
Badhole ID & Repair – Single well example

- Repair options generate realistic values using models trained on good data
- Quickly inspect results for accuracy with simple visual indicators
- Explore results using different methods and criteria – all calculations are done on the fly and take < 0.1 sec/well



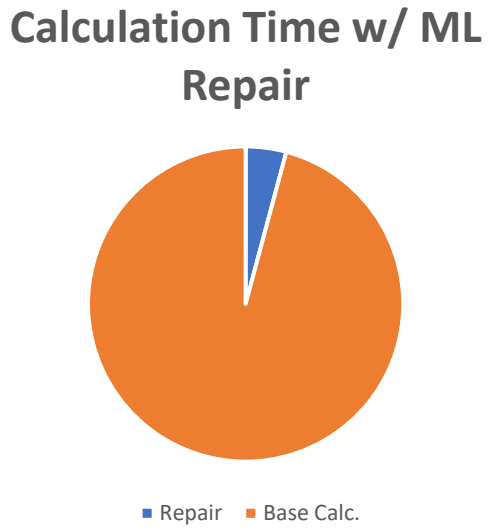
Badhole ID & Repair – Project Example

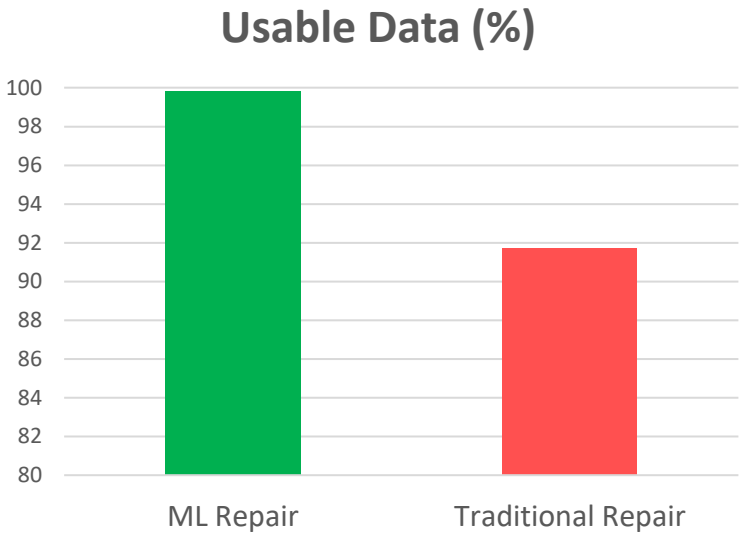
- Flagged > 175,000’ of bulk density as badhole - 9% of total footage in 675 well project
- Sonic logs only covered 32% of dataset resulting in ~58,000’ of repaired section
- ML-based approach allowed over 97.7% of section to be repaired – over 170,000’



Badhole ID & Repair – Speed and Accuracy

- By using blind tests over blocked off intervals Danomics showed outputs with less than 1% overall error*
- Full repair of 4 curves/well over a 675 well project added ~33 seconds of calculation time – ~0.05 sec/well**
- 99.8% of data available for use in calculation w/ ML repair vs. 91.7% using traditional repair methods

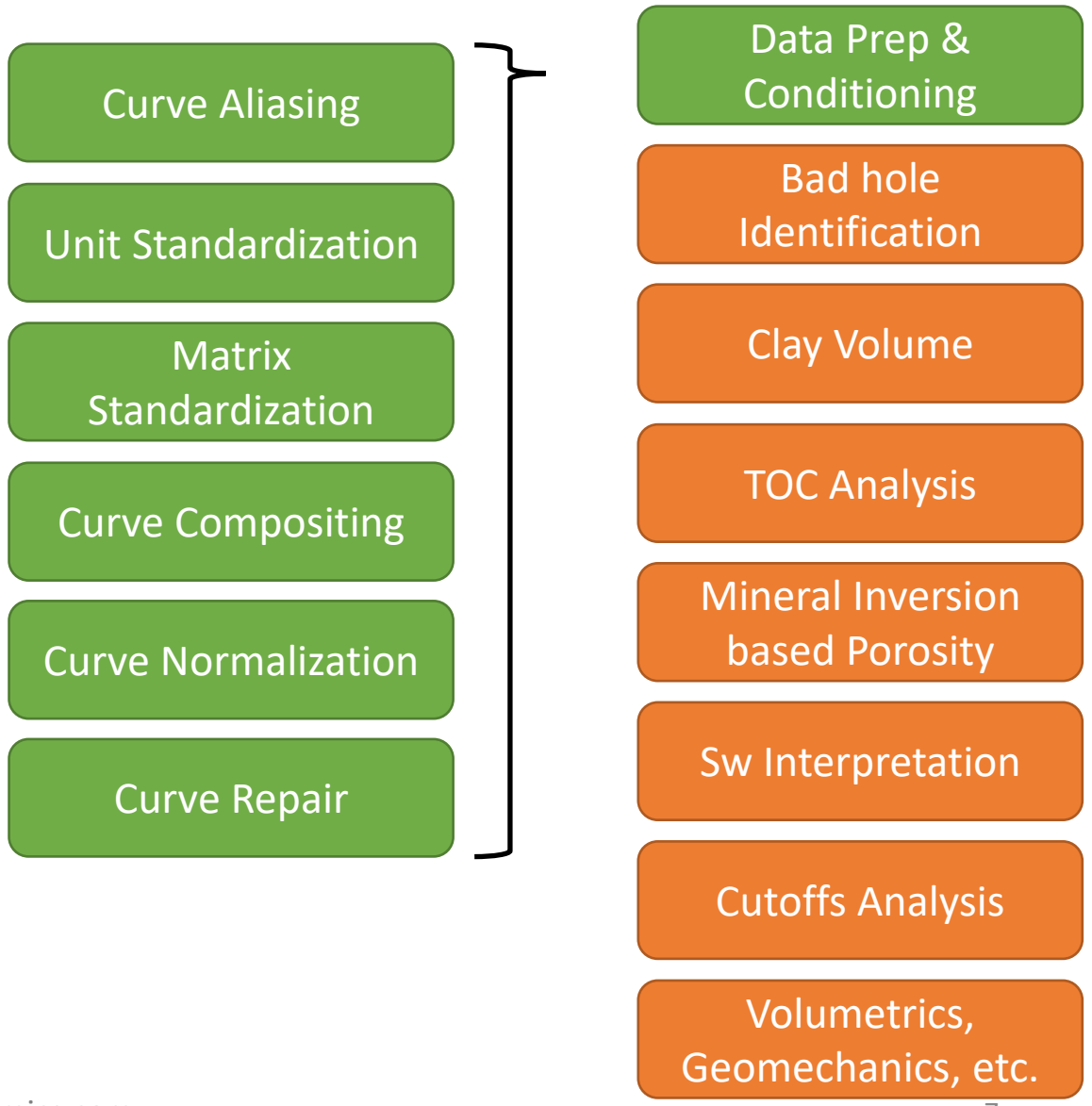


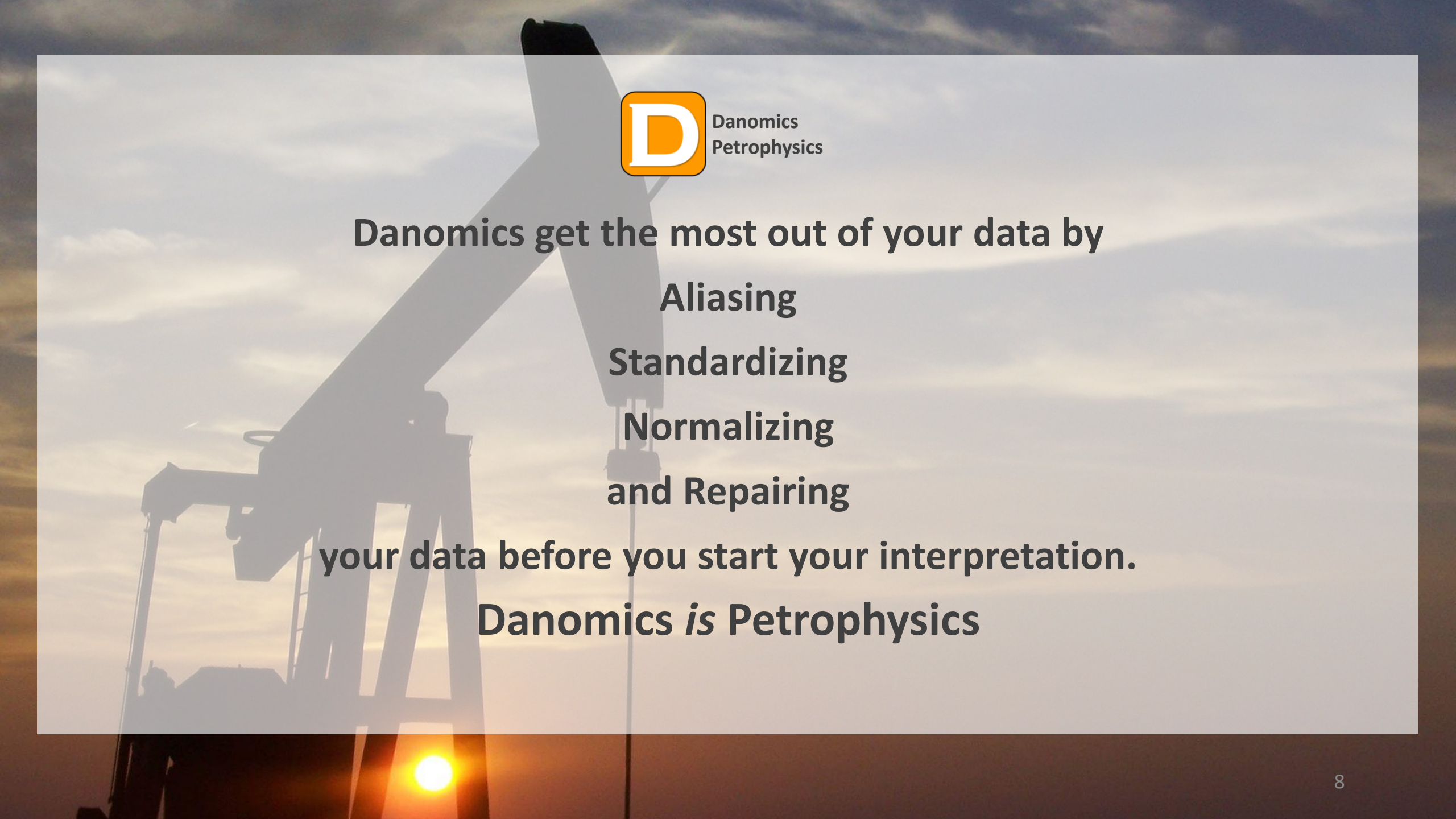


** As measured using mean absolute error on a sample-by-sample basis over a blind test on a continuous 200' interval*
***Utilizing MLR for repair on bulk density, photoelectric, neutron, and sonic logs*

Curve Repair – Critical Final Step in Data Prep

- Comprehensive aliasing means more data is ready to use on load
- Unit standardization handles disparities between percent and decimal inputs
- Matrix standardization ensures accurate results by casting all results in same space
- Curve compositing allows multiple runs and log types to be used in analysis
- Curve normalization removes inconsistency from having multiple vendors and tool generations
- Curve repair ensures interpretation's accuracy by repairing data across badhole intervals





Danomics
Petrophysics

Danomics get the most out of your data by

Aliasing

Standardizing

Normalizing

and Repairing

your data before you start your interpretation.

Danomics *is* Petrophysics