

The background of the slide is a photograph of an oil pumpjack in silhouette against a sunset sky. The sun is a bright, glowing orb near the bottom center, casting a warm orange and yellow light across the scene. The pumpjack's long, angled arm extends from the bottom left towards the top right, ending in a counterweight and a hook. The sky is filled with soft, wispy clouds, and the overall atmosphere is serene and industrial.

# Danomics Badhole ID & Repair

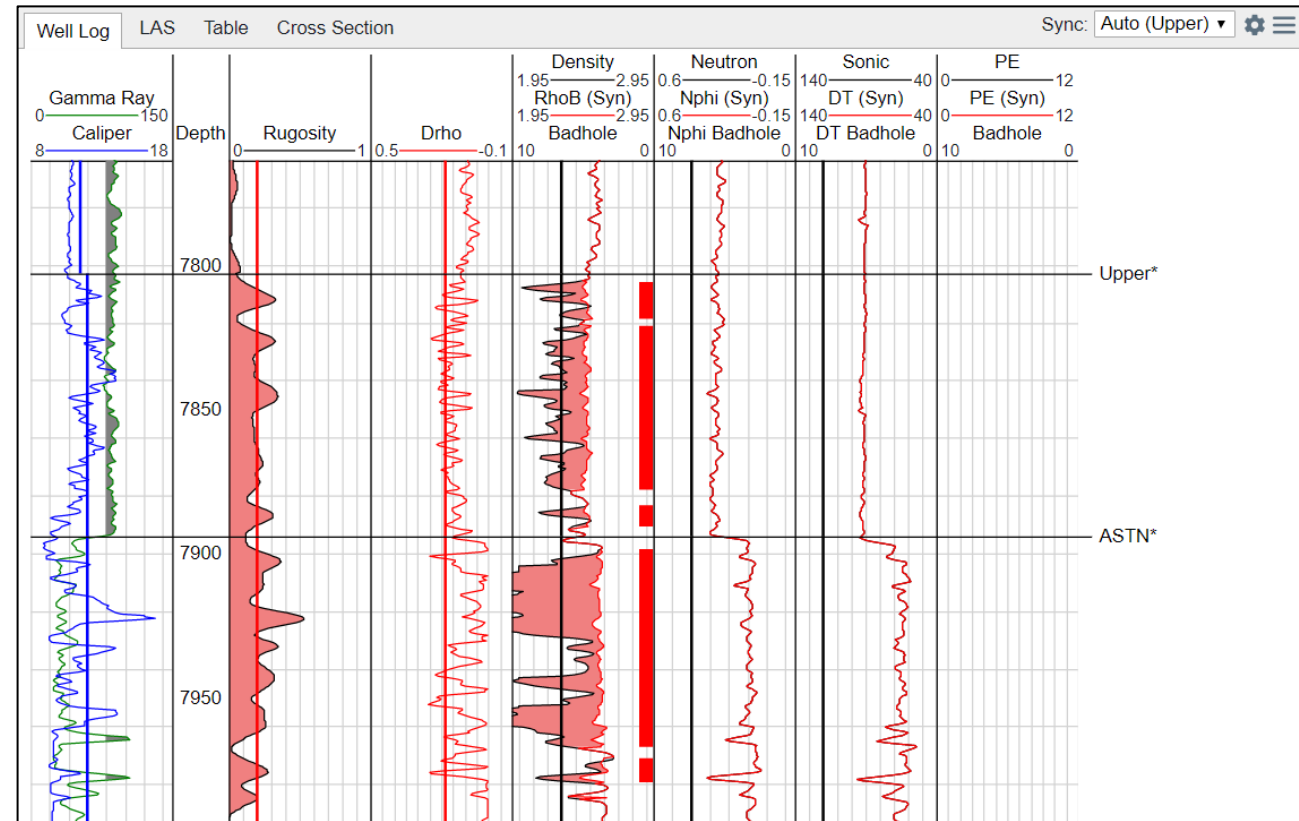
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Improving interpretations through machine learning based curve repair

April 2020

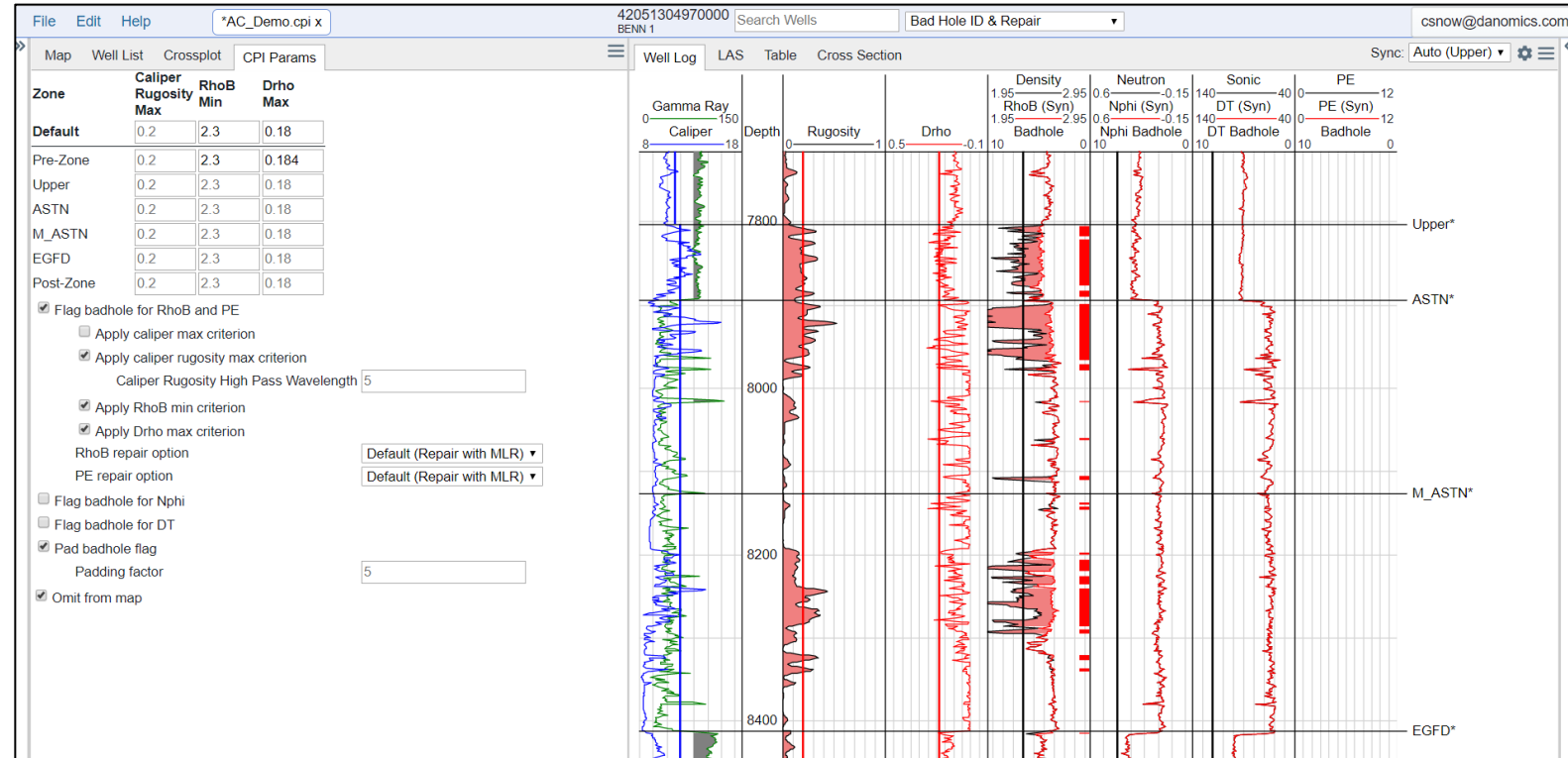
# Danomics Curve Repair Objectives

- 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



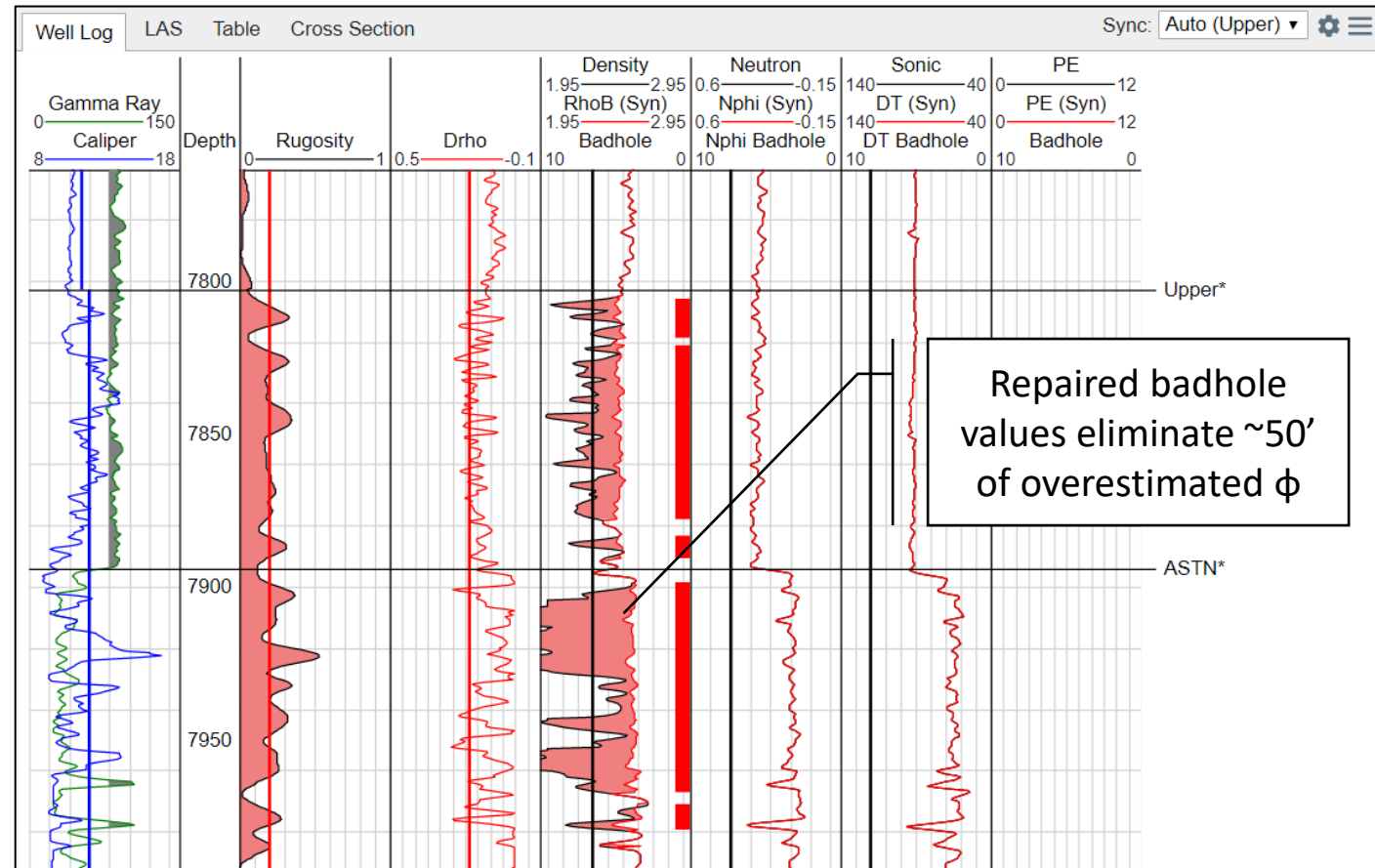
# Badhole ID & Repair Interface

- 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



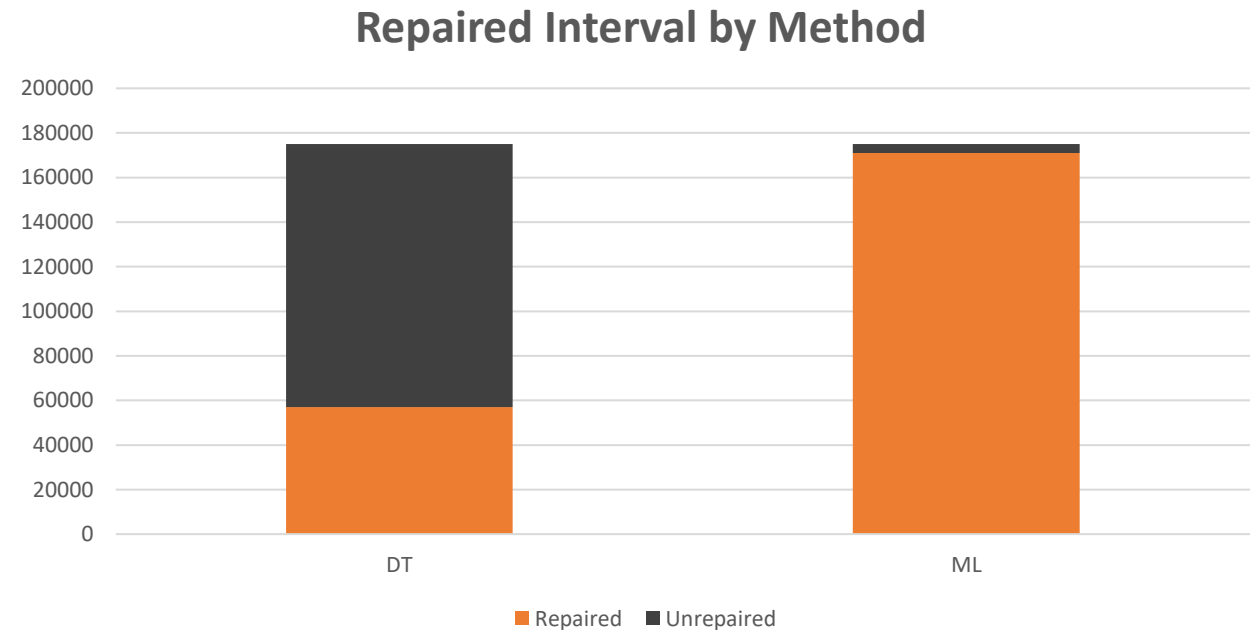
# Badhole ID & Repair – Single well example

- 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

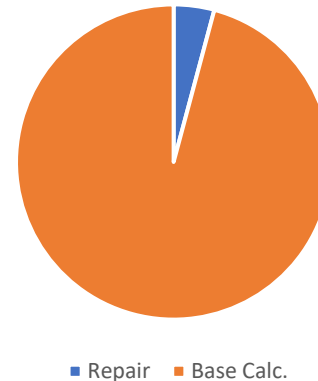
- Flagged > 175,000' of bulk density as badhole - 9% of total footage in 675 well project
- Sonic logs only covered 32% of dataset resulting in ~58,000' of repaired section
- ML-based approach allowed over 97.7% of section to be repaired – over 170,000'



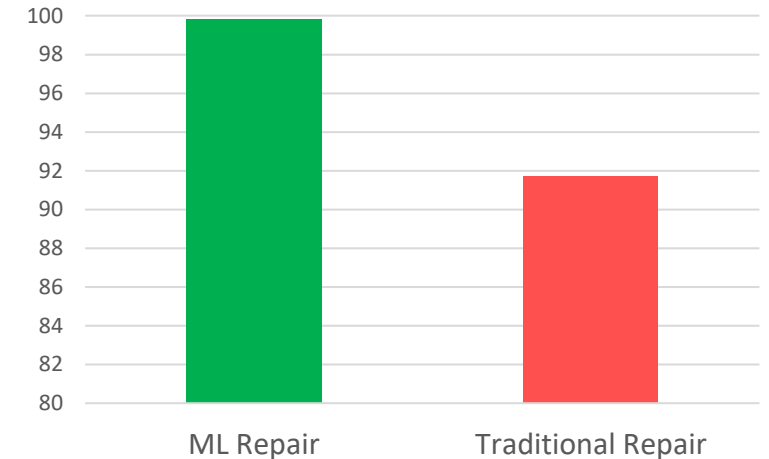
# Badhole ID & Repair – Speed and Accuracy

- 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

Calculation Time w/ ML Repair



Usable Data (%)



\* 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

Curve Aliasing

Unit Standardization

Matrix Standardization

Curve Compositing

Curve Normalization

Curve Repair

Data Prep & Conditioning

Bad hole Identification

Clay Volume

TOC Analysis

Mineral Inversion based Porosity

Sw Interpretation

Cutoffs Analysis

Volumetrics, Geomechanics, etc.



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**