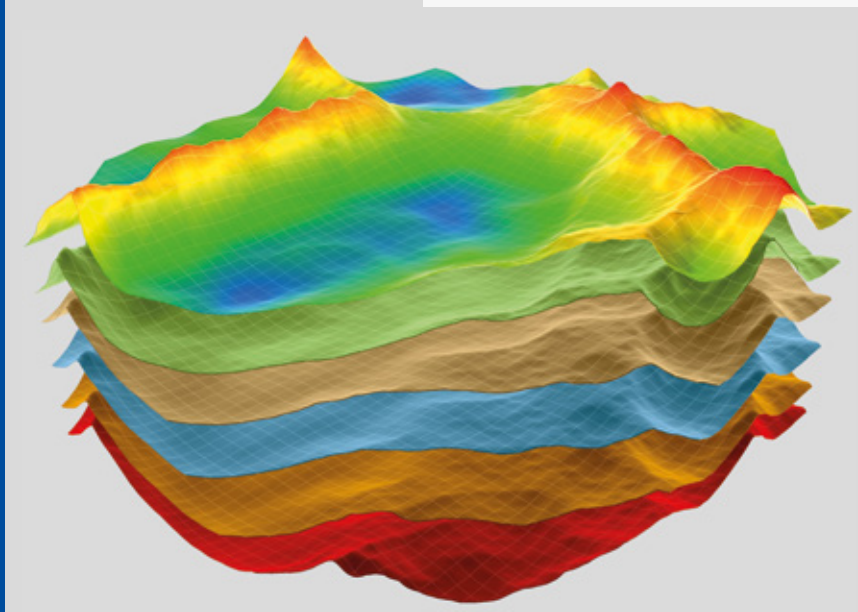
AI-PetroMech

High Quality Geomechanical Data Prediction and Synthetic Petrophysical Logs

GEOLOG



Conventional Approach

Requires the running of Wireline or LWD/MWD Gamma Ray, Sonic and Density to derive the most relevant geomechanical parameters: Young's modulus, UCS, Vp/Vs, density, Poisson's Ratio, shear and bulk modulus. The cost of running these downhole tools can be high and risky in highly deviated and horizontal wells, limiting the direct determination of the geomechanical parameters in development wells. Although obtaining this data can allow improved decision making in near-real time, this comes at a significant cost and risk.

GEOLOG's Approach

The same geomechanical parameters are obtained using machine learning technologies to create and train a Model based on available data from a limited number of wells in the same field (typically five). This model allows us to predict with high accuracy the geomechanical parameters in new wells using only drilling parameters and Gamma Ray, eliminating the need to run Sonic and Density tools and their associated costs and risks: enabling improved decision making in near-real time with low-risk, low cost data when you most need it.

AI-PetroMech Service

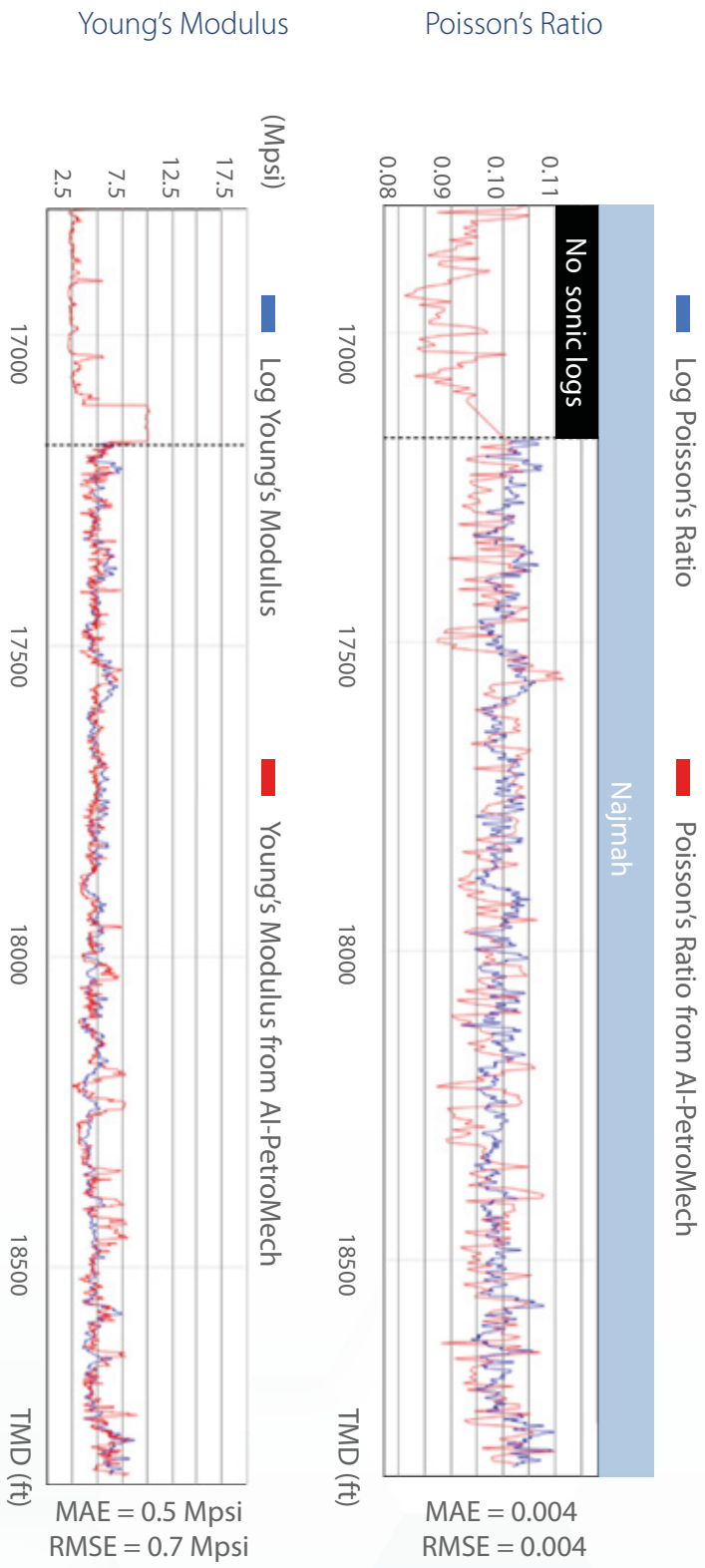
GEOLOG has developed a proprietary workflow, named AI-PetroMech that takes data from different depth-based data sets . The tests performed in different geological contexts have shown that the minimum number of wells for creating and training the Model ranges from 4 to 6 depending on the quality of the data.

Inputs (Model Building & Data Prediction)		**Outputs (Deliverables)**
Data Required for Phase-1: Building and Validating the Model - Drilling parameters - Sonic log - Density log - GR - XRF (Optional)* - Young's Modulus and UCS formulas**	»	- Young's Modulus - UCS - Uniaxial Compressive Strength - Vp wave and Vs wave velocity - Density - Poisson's Ratio - Shear Modulus - Bulk modulus
Data Required for Phase-2: Predicting Geo-Mechanical Parameters - Drilling parameters - GR - XRF (Optional)*		

** XRF can replace GR in case of tool failure or data unavailability.*
*** Young's Modulus and UCS are calculated from logs using empirical formulas.* ***Client can propose preferred formulas.***

Challenges and Solutions

- Perform geomechanical characterization while drilling in different geological contexts (carbonates, unconventional, siliciclastic).
- Sonic and density logs are not required in the new wells to obtain geomechanical parameters.
- *Provide an alternative to downhole tools (sonic and density) when their use is not feasible or risky.*
- *Possibility to obtain the geomechanical data of existing wells in a given field to optimize future drilling.*



Model Building and Validation – Offset Wells

AI-PetroMech was trained with 10 wells in the same basin across carbonate formations. These wells have a full range of petrophysical well logs provided by the client (Density, Sonic and Gamma logs), and the depth-based drilling parameters and the XRF data provided by GEOLOG.

Prediction of GeoMechanical Parameters – New Wells

AI-PetroMech requires depth-based drilling parameters provided by GEOLOG and gamma ray (Wireline or LWD or MWD) provided by the client. XRF can replace GR in case of data unavailability or tool failure.

Results: Poisson's Ratio and Young's Modulus

In the graphs the results of AI-PetroMech Poisson's ratio and Young's Modulus. In blue, the "Conventional approach", in red, the parameter value predicted by GEOLOG. The derived values were closely aligned with the well-log derived data for the same well with errors consistently within 5% of log values derived by conventional logs.

GEOLOG around the World

Technical Paper References

Predict Geomechanical Parameters with Machine Learning Combining Drilling Data and Gamma Ray.
SPE-204688-MS. (SPE Middle East Oil & Gas Show, December 2021)