

Predictive Geothermal Analytics: AI in Porosity Estimation

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Summary

This study employs artificial intelligence to predict porosity in geothermal reservoirs, aiming to enhance resource extraction and reduce uncertainties in reservoir characterization. Utilizing well log data collected from the southern Saskatchewan area, the research integrates machine learning techniques with geological expertise to develop a robust and scalable predictive framework focused on porosity estimation. Early findings reveal strong correlations between well log features and porosity, underscoring the potential of AI to refine geothermal resource assessments and support sustainable energy development.

Theory / Method / Workflow

The research introduces an AI-driven approach designed specifically for porosity prediction—a key factor in optimizing resource extraction and effective reservoir management. Well log data from southern Saskatchewan forms the foundation of this analysis. The methodology involves:

- 1. Data Preprocessing:**
 - Cleaning and normalizing well log data to ensure high-quality input for model training.
 - Addressing missing data to maximize the utility of the dataset.
- 2. Feature Engineering:**
 - Identifying and selecting relevant well log features such as gamma-ray, resistivity, and density logs.
 - Transforming these features into machine-readable formats for effective analysis.
- 3. Model Development:**
 - Evaluating various machine learning algorithms, including Random Forests, Gradient Boosting, and Neural Networks.
 - Focusing on the algorithm that best predicts porosity from the available data.
- 4. Validation and Testing:**
 - Implementing cross-validation techniques and testing against independent datasets to ensure model accuracy and reliability.
- 5. Scalability Assessment:**
 - Initially applying the framework to the wells included in our study, with plans to expand its use once the tool has been further refined.

Python-based libraries such as Scikit-learn and TensorFlow are leveraged to integrate domain-specific knowledge with advanced analytics, creating a flexible solution for porosity prediction.

Results, Observations, Conclusions

Preliminary analysis of existing well log data demonstrates a strong relationship between key features and porosity. The AI-driven model reliably predicts porosity while offering clear insights into subsurface properties. These encouraging early findings serve as a foundation for ongoing enhancements, further strengthening the model's support for geothermal reservoir evaluations.

Novel/Additive Information

This work aims to create a practical tool that improves the prediction of porosity data in key wells critical for geothermal modeling. The focus is on refining this tool for targeted applications rather than extending it to all geothermal fields immediately.

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