TEAM 45

# AI-Assisted Well Log Prediction from Seismic Data

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## Introduction

**Problem Statement:**
Subsurface interpretation relies on limited well-log data and wide-coverage seismic data, which are not directly integrated. This leads to gaps in understanding between wells and increases uncertainty in reservoir evaluation.

**Solution:**
This project introduces an AI-assisted workflow that combines seismic data with available well logs to predict missing log curves. By integrating geophysical preprocessing, machine learning modeling, and engineering validation, the system generates consistent and interpretable logs, with strong performance in the sonic (DT) log and reliable trends in gamma ray (GR).

## Project Objective

Develop an AI-assisted workflow that uses seismic data together with available well logs to predict missing well logs, improving subsurface continuity and supporting reservoir interpretation.

## Data & Constraints

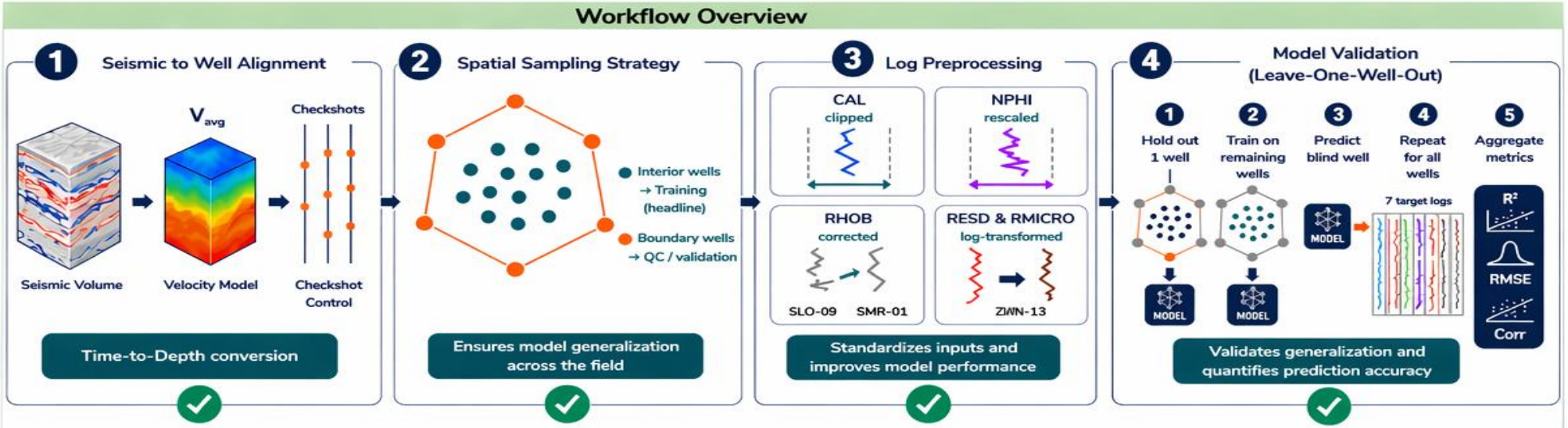
| Constraints | Specifications |
|---|---|
| Separate frontend, API, and model deployment | Process 50+ wells and 10 GR reliably |
| Containerized backend across CPUs and cloud GPUs | Achieve ≥90% correlation vs, experts |
| Seismic resolution limits fine-scale prediction | Cut manual correlation time by ≥50% |
| Training logs need ≥90% completeness | Website uptime ≥97%, downtime ≤1 hour |
| Support SEG-Y, LAS, CSV, GeoTIFF formats | Improve quality ≥10% over baseline interpolation |
| - | Optional: SEG-Y property cube export |

## Model Performance Summary

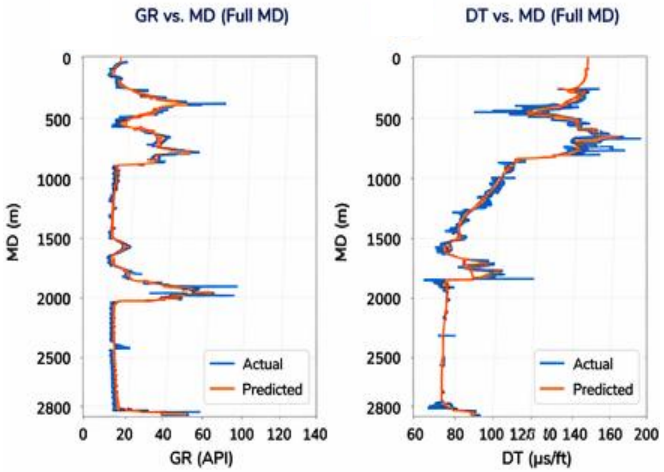
| Log | Metric | Extra Trees (Curve-Aware) | HGBR (Curve-Aware) |
|---|---|---|---|
| DT (Sonic) | $R^2$ | 0.93 | 0.88 |
| | RMSE (µs/ft) | 6.8 | 8.2 |
| | Correlation | 0.96 | 0.93 |
| GR (Gamma Ray) | $R^2$ | 0.79 | 0.73 |
| | RMSE (API) | 11.6 | 13.9 |
| | Correlation | 0.89 | 0.86 |

*Extra Trees with curve-aware features achieved the best overall performance, especially in DT prediction.*

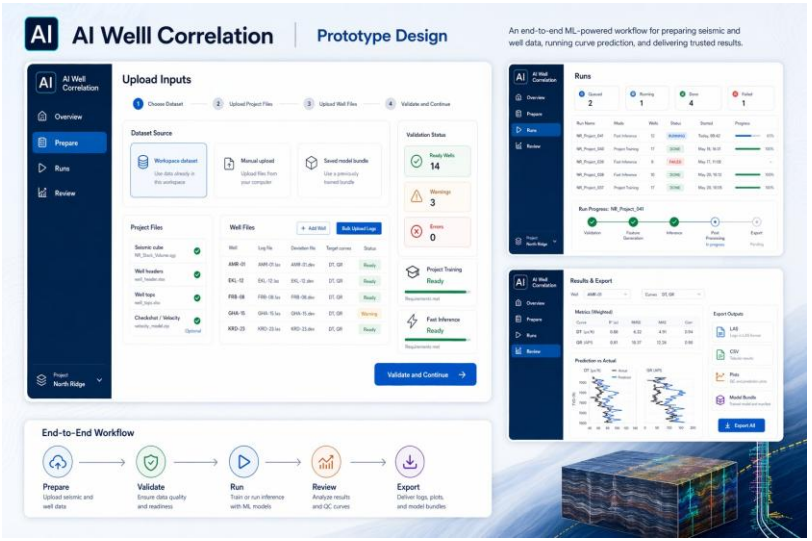
## Workflow Overview




## Results (Example Well: AMR-01)




## Final Prototype Design




## Conclusion

The workflow demonstrated that combining seismic data with available well logs can reliably reproduce formation-scale trends, with the highest accuracy achieved in the sonic (DT) log and consistent behavior observed in gamma ray (GR). The results confirm the system's ability to extend log information beyond existing wells while maintaining geological consistency. However, resolution limitations and data constraints still affect the accuracy of some curves. Overall, the system provides a practical tool to support subsurface interpretation and improve confidence in reservoir analysis.